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Preface

This volume of articles were selected among from the articles presented in UIU organized 'International Conference on Sustainable Development' at UIU on 16-18 February 2017 at UIU campus, Dhanmondi, Dhaka, Bangladesh. The articles in this book focus on several themes of development and scrutinizing issues of sustainability. The articles are empirical and academic in nature. The contributors are young scientists, academics, development practitioners, and policy activists from Bangladesh and abroad.

Articles are presented in this book under respective theme. Some themes contain higher number of articles and some are less. The articles will enable us to understand the complexities of sustainable development, debates on development discourses from different optics, science-policy gaps and challenges of science-policy interface, innovations of approaches to sustainable development, and local knowledge and practices of development.

We express our deep gratitude to all academics, scientists, economists, environmentalists, development practitioners, social activists, researchers, academics and policy analysts who contributed in the 1st International Conference on Sustainable Development of United International University (UIU).

We gratefully acknowledge the cooperation of the reviewers, composers, designers and all others who sincerely extended help and cooperation for making it possible to publish this book/ proceedings.



Hamidul Huq, PhD, WUR
Convener
1st UIU-ICSD 2017
30 November 2017

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Dynamics of Survival and Sustainable Livelihoods: A Study of Slums in Siliguri Municipal Corporation Area, India

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Abstract

Rapid industrialization and urbanisation process are strongly interlinked with the experience of vibrant economic growth and development. A serious consequence of this phenomenon is the migration of rural population into urban centers giving rise to rapidly growing cities and towns to accommodate the exodus. India is transforming into a nation of cities. As the globe is urbanizing and globalizing at the most rapid pace, the slum dwellers also continues to grow enormously both within the inner-cities and in the outskirts. Unprecedented growth of slums in cities of the developing countries like Siliguri Municipal Corporation Area (SMCA) of west Bengal in India is the direct consequence of urbanization and migration due to inter-regional disparities and unbalanced growth process. Living in an urban environment is clearly a distinct experience from life in a rural setting. Yet despite the contrasts in terms of context, there is one factor that remains unchanged: people themselves. Wherever people live, they retain essentially the same human needs, and the desire for the same entitlements or rights. They require access to productive resources such as land, knowledge and capital, and from these an income to support their consumption needs. They require food, shelter, clothing, access to medical facilities, the ability to educate children, and the ability to participate socially, politically, intellectually in the society of which they are a part. Thus these requirements amount to the entitlement for each person has to lead a life that is fundamentally secure in respect of basic needs and broader social and psychological needs. Vicious circle of poverty among the slum dwellers brought about by structural adjustment and poor governance make social capital an important means for economic survival for the urban poor. The ethical dimension of the poor in the cities like SMCA stands on equal opportunities, inclusive and harmonious living without discrimination of any kind as to race, colour and religion including rights and entitlements, justice, respect of human dignity and community. So far as ethical dimension is concern, the public sphere of the city is very insensitive to the needs of the urban poor slum people. With respect to justice and democracy, the slum dwellers are still typically treated as intruder and encroachers in the public space. However, the slum dwellers in SMCA within their unfriendly environment are struggling extremely to make a living behind the shadow of the city. it is noteworthy that Indian plans of anti-poverty programmes was in a proper place even after the neo-liberal regime, where the basic idea behind the massive shift of various welfare and service oriented strategy to poverty reduction strategy was to improve accessibility and to benefit of the urban poor with the trickle down effects. But, the overall impact on the incidence of urban poverty remains unaffected to a greater extent and the trickledown effect was unsatisfactory. They point to the need for a dedicated urban Sustainable Development Goals to sharpen the focus on better ways to address urban poverty, access to infrastructure and basic services, housing and security

of tenure, and the institutional arrangements needed to fund, implement, and track progress in meeting these objectives. Policies affecting housing, employment, transportation, access to public services and access to healthy foods have an impact on the standard of living of the urban poor. A detailed examination of these alternative cultural development models disclose a myriad of possible means by which economic, social, and environmental sustainability might be advanced in practice. Against this backdrop, this paper will attempt to analyze, both theoretically and empirically, the poverty scenario, policy initiative, its leakage and fostering different dimensions of sustainable development for the lives of the excluded and marginalized urban poor community in SMCA.

Keywords: *Urbanization, Incidence of Slums, Livelihood Strategies, Outcome and Sustainable Development.*

1. Introduction

Urbanization, migration, incidence of slums and poverty are interlinked. In the advent of post MDGs, the major challenge to the policy makers, academicians, researchers in developmental agenda is to end of vicious circle of poverty and to focus on sustainable development particularly for the urban poor. Unprecedented growth of slums in Siliguri Municipal Corporation Area (SMCA) in India is the direct consequence of urbanization and migration due to inter-regional disparities and unbalanced growth process. India is transforming into a nation of cities. Cities are potentially the places where access to infrastructure, services and employment can allow human beings to satisfy their basic needs and realize their ambitions and aspirations. As the globe is urbanizing and globalizing at the most rapid pace, the slum dwellers also continues to grow enormously both within the inner-cities and in the outskirts. The locus of poverty is moving from rural to urban areas and recently this process is termed as the „urbanization of poverty" i.e., slums and informal settlements are clear manifestation of urban poverty. The nexus of urban poverty and sustainable development is complex phenomenon. Urban poverty equally posed a great challenge to urban sustainability in Indian cities like SMCA because most of the poor in these in informal settlements does not possess high skill or education to enable them to find well paid and secured employment in the formal sector. When, the formal sector is failed to generate adequate employment and income opportunities in the cities like SMCA, the surplus urban labor force is compelled to generate its own means of employment and survival in the informal sector. This is the entry point of the urban poor to integrate themselves with the up market urban economy. The workers in this sector remain deprived from all kinds of job security, such as job contract, paid leave, medical leave, pension, health insurance and even accidental benefit.

Slums and squatter settlements are of the developing countries located in poor and highly vulnerable locations and comprise a neglected segment of the urban populations. The area of such informal settlements is the place where the people suffer mostly from exclusion and struggling extremely to make a living in the city. They also face difficulties in adapting different lifestyle, culture; languages, religion etc., and consequently these groups often live in ghettos where their interactions with the rest of the city dwellers are limited. It is being increasingly realized that the informal sector possesses massive potential in creating large scale employment opportunities for the urban poor migrants. Thus, the informal sector acts as a vehicle of employment provider and

social development and social security, and yet it is marginalized from the development agenda. Living in an urban environment is clearly a distinct experience from life in a rural setting. Yet despite the contrasts in terms of context, there is one factor that remains unchanged: people themselves. Wherever people live, they retain essentially the same human needs, and the desire for the same entitlements or rights. High levels of poverty brought about by structural adjustment and poor governance make social capital an important means for economic survival. Taken together, these are valuable assets that individuals and groups can use to address a wide range of needs and interests. There are two main reasons why social capital is important to urban settings, first; to build on poor people's social capital as an explicit poverty elimination strategy; second, to increase the participation of the most vulnerable groups for making pro-poor programmes effective and enhancing right to participation (DFID, 2002). But the urban poor who are living in slums or informal settlements are vulnerable with respect to the determinants of livelihoods. Hence, the question arises as to how do urban poor cope with the up-market urban centers with their limited livelihood resources? To meet the emerging challenge of inclusive growth and Sustainable Millennium Development Goals (SDGs), what should be the attitudeand approaches that can expose the possible means by which economic, socio-cultural, and environmental sustainability might be advanced in practice particularly for the urban poor.

2. Statement of the Problem

Livelihoods are determined by the range of assets that is available to the households. Natural capital refers to the natural stocks like soil, water, air, etc. from which livelihoods resources are derived. Economic or financial needs are the capital, credit, savings which are essential for the pursuit of any livelihood strategy. Human capital includes the skills, knowledge, ability to labour and good health and physical capability. Social capital are those networks that create social claims, social relations, affiliations and associations which people draw upon when pursuing different livelihood strategies requiring coordinated actions. Physical capitals are those basic infrastructures and produced goods such as buildings, roads, water supply, sanitation, etc., needed to support livelihoods. So far as philosophy of living options and opportunities of the urban poor is concern ethical dimension stands on equal opportunity, rights and entitlements, justice, respect of human dignity, freedom in functioning and autonomy and respect of the individual community.

The poor in these settlements do not possess the skill or education to enable them to find well paid and secured employment in the formal sector and due to lack of opportunities in the formal sector they tend to be absorbed in informal employment. Thus their integration into the market economy is through the informal sector, in most cases. But greater integration into the market economy also implies greater vulnerability to fluctuations in the economy. Integration of such settlements into the urban socio-economic fabric occurs through livelihood opportunities available to them and the survival strategies that have to be adopted by the settlers. The measurement of poverty of such people should not focus only on income alone. Poverty is a deprivation of vital structures that go beyond income. Therefore, besides income, how do other socio-economic factors and governmental policies impact on poverty reduction is also a focus of the study. Against this backdrop, the objective of the study is to analyze, boththeoretically and empirically, the poverty scenario, policy initiative and the importance of accelerating inclusive sustainable urban development and poverty reduction with a particular focus on the marginalized urban poor slum community in SMCA.

3. Objectives of the Study

The general objective of the study is to understand the nature of urbanization, proliferation of squatter settlements, strategies, opportunities and sustainable development **of** the old and new migrants living in the inner and peripheral city of SMCA. The study will focus on the following objectives:

(i) To analyse the pattern of urbanisation and rapid growth of urban informal settlements.

(ii) To analyze the socio-economic profile and existing livelihood base of the poor living in informal settlements.

(iii) To analyse the causes of failures of the developmental plans and programmes for the urban poor.

(iv) To analyse the parameters of inclusive development including the needs to focus on sustainable development of the informal settlers

4. Research Methodology

4.1: The Sample Squatter Settlements and Sampling Technique

Following the objective of the study, the purposive reference technique has been adopted to collect the information regarding older and new settlements from the existing and retired officials of the Urban Poverty Alleviation Cell (U.P.A), Councellors, Community Organizers, Siliguri Municipal Corporation, officials of the Refugee Relief and Rehabilitation Department, Siliguri, Government of West Bengal. The inner city squatter settlements have been identified from the heart of the city where the residents are relatively older migrants and from the outer boundaries the peripheral squatter settlements have been identified where the residents are normally new migrants. From each of the inner and peripheral city squatter settlements a fixed number of 120 households have been taken. As a whole, 240 sample households taking 120 from each of settlements have been surveyed. In case of selection of the sample households from the inner city squatter settlements, initially, an older migrant has been identified as the first sample respondent with the help of Resident Community Volunteers (RCVs). Assistance was sought from the first sample household to identify other older migrants. The new identified older migrant was further asked to identify another migrant possessing similar characteristic. Similar process was adopted to identify new migrants in the peripheral city.

5. Limitation of the Study:

In recent past, both slums and squatter areas are often referred to as informal settlements. Alternatively, informal settlements are also commonly known as slums (UN-Habitat 2003). In Siliguri Municipal Corporation, no distinction has been made regarding informal settlements and slums. All the informal settlements have been termed as slums. Hence the study used the term

informal settlements as synonymous to slums and squatter settlements and the terms have been used interchangeably.

6. Brief Review of Related Literature

Urbanization is a cyclic process through which every nation has experienced a transition from agrarian to industrial, commercial and modernization society and plays a crucial role in alleviating urban poverty. Migration due to urbanization in most cases is inevitable for survival and there is little evidence of gradual migration. According to Classical and Keynesian views, imbalances in income increases economic inequality between regions and the resulting migration is an inter-regional process. Keynes viewed migration as a process of divergence when regional imbalances increase. Contesting this theory, the neo-classical economist believed that migration is subject to push and pull factors due to the rural-urban differentials in employment and wages and the resulting process is regional convergence (Lewis, op.cit, Todaro, 1976). Akrofi (2006) is of a similar view that increased urban population is a cause ofrural-urban migration due to pull and push factors. In contrast, Aziz (op.cit), Tewari and Goel (2002) found that high opportunities in urban unorganized sector are the major reasons for migration. Nawagamuwa and Viking (2003) also highlighted the poor governance and internal income differentials as the main reason of rural-urban migration. Johnstone (1983) found in Malaysia that rural-urban disparities, the social and demographic dislocation, sometimes cause voluntary migration to towns and cities. In the cities of the developing countries like Africa, India, Bangladesh, Malaysia, Philipines and in other countries also the urban growth is spatially linked with the growth of squatter settlements. Thus the urban growths in those countries were haphazard and unplanned (Dwyer 1975). The mechanismbehind the growth of informal settlements is the complex product of many factors, where poverty is the foremost cause (Bergel 1955)

Various studies evidenced that majority of the squatters were very poor and squatting was essentially a result of poverty for them. The squatter settlement means Unemployment, low-income and lack of public amenities, water and sanitation with common health hazards. Low level of education in the slums is primarily due poverty and lack of motivation and aspirations lead to dropouts Mohsin (1979) Mani (1980) Aiken (1981). In many of the slums, overall conditions in housing and health services were worse than those in the rural areas (Choudhury 1978) and the problems of these settlements in Latin America, Africa, and Asia is the major concern for the third world cities(Karpat (1976). In this regard, a number of authorities highlighted the weaknesses of local governments, which are frequently unable to address the needs of the poor and in some cases the urban poor are the victims of exclusion and discrimination.

Migration in the cities can be interpreted more as a household livelihood strategy. “Livelihood compromises the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and manage to enhance its capabilities and assets both now and in the future, while not undermining the natural resource base” Chambers and Conway (1992). In Asia, for example, the urban poor households are not only strongly integrated into the economy, but with different family size they always seek to diversify their income involving with different types of activities (Douglass, 1998). According to sustainable livelihood approach, the situation of the urban poor defined not only by their lack

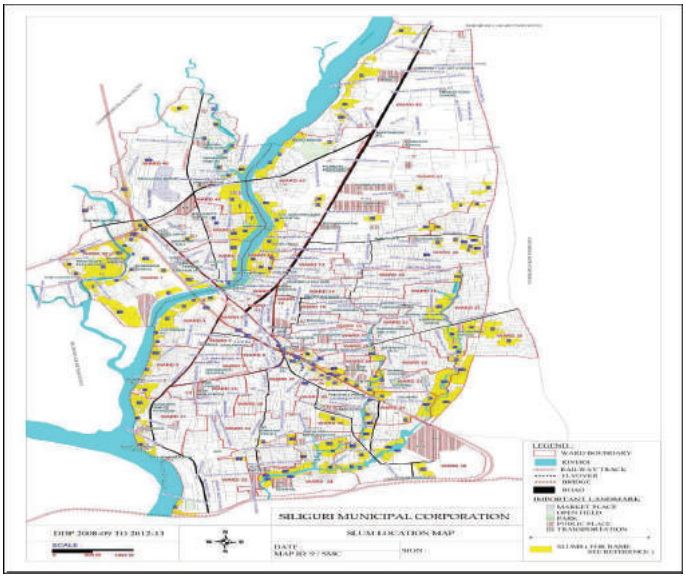
of wealth but also by their insecure and precarious condition in terms of coping with stress and shocks. The high cost of living of the urban poor is one of the factors that result in insecurity or vulnerability, and social exclusion (Moser, 1998). Mitra (op cit) also noted that in India, the excess-supply-limited-demand framework explains the growing urban poverty and the resulting growth of slum populations.

In the light of MSGs, so far as the concept of „sustainable development" of the urban poor is concern, it is a great challenge to the policy makers and planners to the contemporary debate over how cities and regions can be redeveloped and reformed so that urban poverty can be arrested in a sustainable manner (Basiago, 1996). In the context of development of the urban poor who are living in the slums and informal settlements, there are three pillars of sustainability; „economic sustainability", „social sustainability", and „environmental sustainability". Economic sustainability" implies a system of production that satisfies present consumption levels without compromising future needs. The „sustainability" that „economic sustainability" seeks is the „sustainability" of the economic system itself (Hicks, 1946). In a fundamental sense, „Social sustainability" of the urban poor includes ideas of equal opportunity, empowerment, accessibility, participation, cultural identity and institutional stability. It looks to save the environment through economic growth and the alleviation of poverty (Ruttan, 1991).The combined effect of economic, social and environmental sustainability of the urban poor can foster positive image of real development. They should not be pursuing in isolation for sustainable development to flourish.

7. The Region and Demographic Change of the Study Area

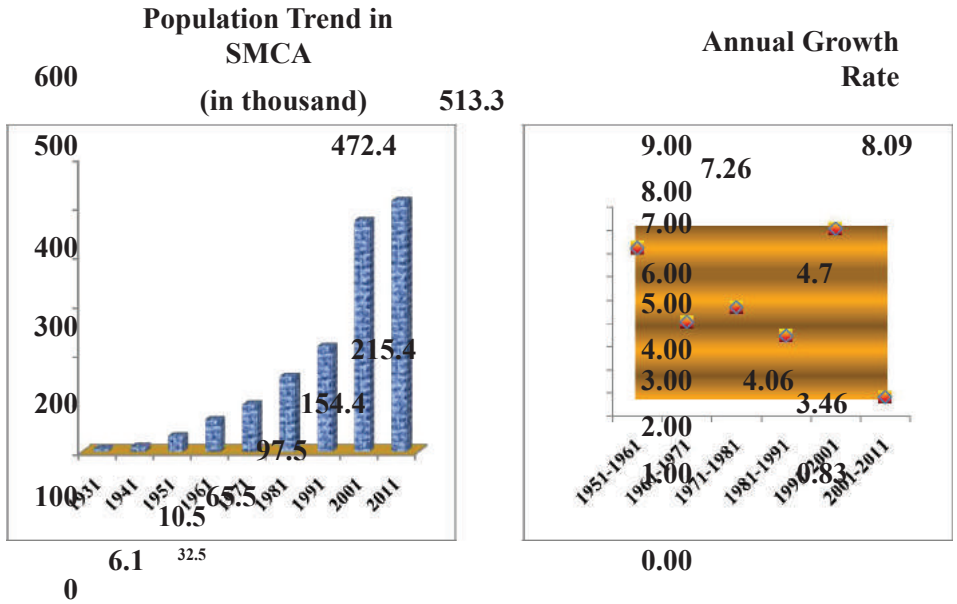
Siliguri is situated in the plains of Himalayas. The city is popularly known as the gateway or the chicken neck of north east India because its corridor is connected with the north-eastern states to the rest of India. Siliguri was a tiny village of less than 800 populations in 1901 and by its typical geographical location, potentiality; process of urban growth and development received its recognition in 1931 and found a place of urban map in west Bengal as non-municipal urban centre. It was declared as a Municipal town in 1950 taking an area of 15.54 sq. km with the population of 32480, which was substantially increased to 40.91 sq. km with the population of 472374, when it was upgraded to Siliguri Municipal Corporation in 1994. The Siliguri Municipal corporation area is covered with 47 Municipal wards, having 154 notified slum and squatter settlements with a population of 175012, spread over 33 Municipal wards (Census 2001). On the other hand, according to census report 2011, it is found that slum population in city of SMCA has reduced sharply from 175012 to 122958 spreading over 23 wards.

7.1: Concentration of Slums/Squatter Settlements in SMCA



The town showed its vital potentiality as it grew as a centre port for the trade between India, Sikkim, Bhutan, Nepal and Tibet. The growth of the town received momentum just after independence of India. In 1947, thousands of refugees poured in from East Pakistan when the country was divided and from Assam who lost their home to anti Bengali riots in 1960. The 1962 war with China, 1965 war with Pakistan and ultimately 1971 with West Pakistan and creation of Bangladesh, each of these events contributed to the major inflow of refugees to the town. There was also major influx of business communities from other parts of the country. After 1981, some important State Government offices have been established in Siliguri. Moreover, as a gateway to the wonderful sights of the Himalayan peaks and ranges in Darjeeling, Siliguri offers important tourist activities stimulating the economy of the town. During the initial period of its growth, Siliguri attracted migrants from its hinterlands like Bihar, Uttar Pradesh and Assam and with the passing of time Siliguri acquired a cosmopolitan character. This is an indicator of the rapid pace of urbanisation in Siliguri Urban Area (SUA). Siliguri was not only the fastest growing towns in the Municipal Corporations of the state and the country till 2001, but the town is also the economic hub for the states of north east India. The high potential of the town to absorb migrant population in the informal labour market is the consequence of large number of squatter slums in the city. The notable point is that the annual growth rates of SMC were overwhelmingly high than that of the growth rate of all other municipal corporations in the state and the country as a whole except 2011(See table-7.1).

Figure (7.1): Demographic Change in Siliguri Municipal Corporation Area (SMCA)



Source: Census 2001, 2011, Govt. of India

According to Census 2001, the concentration of slum population in 6 large cities of West Bengal is evident from the fact that about 52 percent of the total slum population (Cities/Towns reporting slums, Census 2001) in West Bengal lives in these cities. The annual growth rate of SMC during the period 1991-2001 was not only higher than the states of India but it was higher than that of the million plus cities like Greater Mumbai, Kolkata, Delhi and Chennai (NIUA, 2008). Drastic reduction of slumpopulation in the periods of 2001-2011 called for the question regarding removal of slum condition in SMCA.

Rapid pace of urbanization and growth of new towns/ cities like SMCA to an extent has experienced the excessive demand for basic services and lack of these services cause deterioration of the physical environment. The quality of life suffers due to continuous inflow of migrants and as a result the gap between demand and supply of basic services and other infrastructure increases in these areas. The sample family size of the household was significantly higher compared to the average family size of the million plus cities like Delhi, Kolkata, Mumbai and Chennai (NFHS-3, 2005-06). The sex ratio in the peripheral city was higher than that of the sex ratio in the inner city squatter settlements due to higher female in migration. With regard to social caste and religion the slum population was highly heterogeneous. Scheduled Cast/Scheduled Tribe (SC/ST) squatters were significantly higher than that of the proportion of SC/ST in India and the state. Linguistically, the squatters have two different vernaculars, Bengali and Hindi. It is also observed that language instead of religion plays a significant role in the formation slum enclave. A high dependency ratio exerts economic pressure on the household and thereby reduces well being of the squatter.

Paradoxically, the dependency ratio was significantly higher in peripheral city when compared to the inner city in spite of higher proportions of minor and older dependents in the inner city.

8. Migration Characteristics of the Squatter Households SMCA

Migration is one of the most important components in the demographic profile of SMCA. It is evident that the inner city squatter households were about 4 times older than the households in the peripheral city. Most of the migrant households in the inner city squatter settlements were from the poor BIMARU states, followed by international migrants particularly the refugees from Bangladesh and Pakistan. But, majority of migrant households in the peripheral city were from poor neighboring districts. The migration due to economic reasons was overwhelmingly higher in both the settlements. Instead of having wide differences in the push factors of migration in both the cities, majority of the squatter households had migrated due to non-availability of work/ unemployment, followed by income differential and poverty. Economic push and pull factors are often complementary to each other and thus the migration due to greater employment opportunity was supported by non-availability of work at the origin. Differential wage rate was another crucial reason for migration. Among the non-economic push factors, majority of the migration into the inner city was due to Bangladesh war of independence in 1971, followed by migration owing to partition of India 1947, ecological displacement due to floods, soil erosion, droughts, family conflict and ethnic violence due to anti Bengali riots in Assam. Similar findings have been found in the studies of Lewis (1954), ILO (1966), Lee (1966), Todaro (1969, 1976), Papola (1981), Gilbert and Gugler (1982), Sundari (2003). The finding of the sample study is consistent with the study conducted by Mitchell (1959), Safa (1975) that most of the migration other than forced migration moves to cities for better economic opportunities is viewed as an economic phenomenon. Migration a socio-economic process, where everyone has the right to move elsewhere and it can"t be stopped. So, in order to solve those problems especially the quality of environment and maintaining the level of economic development, the local bodies like and urban planners can develop regional planning approach which must integrate the city planning with its surrounding rural and semi-urban areas in a sustainable manner.

9. Human Capital Generation (Level of Education among the Squatter Households under SMCA)

Between 2005 and 2014 was United Nations Decade of Education for Sustainable Development. All types of livelihood assets are important for subsistence of the urban poor. Among them human capital is a broad concept which identifies human characteristics. Among all the livelihood assets, human capital is most important contributing factor for socio-economic development and well being of the squatters. Education allows every person especially children to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future. In the context of development, no one can achieve economic well-being or poverty reduction with low human capital base. Urban poor in all Asian countries are characterized by low levels of education Laquian (2004). High degree of illiteracy among the slum dwellers was also due to the lack of educational facilities and economic backwardness, (Mohsin, 1979; Mani, 1980) in Asian countries. In terms of literacy rate in slums and non-slums population, the picture of SMCA was much below the state and national average. As per information generated from sample survey, the literacy rate among the squatters who are normally the older migrants living in the heart of the city was significantly lower at about 66 percent compared to the new migrants living in the peripheral city at around 73 percent.

Primary level of education is the clear preference among the squatters in the inner city of SMCA. The higher secondary and college level education is simply luxurious to them primarily due to socio-economic backwardness as well as lack of motivation.

On the other hand, it is evident from the present sample study that the percentage of school dropout of the children was much higher at 36 percent in the inner city squatter settlements compared to around 30 percent in the peripheral city. The percentage of dropout children was significantly high at primary level than that of the secondary level in both the settlements. It is true that many of the slum children enter into the school but willingly or unwillingly they are unable to complete the basic education due to socio-economic constraints. Nationally and internationally school level education and more importantly elementary education is considered as an essential human right and a key to poverty alleviation and sustainable human development. With regard to economic characteristics, some of the households in both the inner and peripheral city squatter settlements in SMCA have very low level of income and some of them have relatively high level of income indicating that not all the squatters are economically poor. The average expenditure of the households and the share of expenditure on education to total income and expenditure was less than the minimum level which is seems to be necessary. However, most of the poor households responded that this expenditure poses an extreme burden to send their children to school in both the inner and peripheral city squatter settlements of SMCA.

Education is an important human capital and most effective means to achieve social and sustainable development. A lot of commitment and programmes including community participation programme was made for elementary education in the 1990s. Free and compulsory basic education from 6-14 years of age, as a fundamental right has been legislated in 2009. But, the scenario of educational attainment and dropout rate of the squatters in SMCA indicates that the slogan "Education for All" is an incomplete task till today. The government has failed to pull a greater number of slum children in SMCA under the scheme of free and compulsory basic education. Therefore the study reveals that in terms of educational achievements, the squatters and slum dwellers in SMCA are particularly deprived compared to the state and metropolitan cities and this further raise the question of proper implementation and monitoring of the schemes and programmes, addressed to improve the quality of life of slum dwellers with a view to sustainable human development of the region.

10. Physical Capital (Land, Housing) available to the Sample Squatter Households of SMCA

In livelihood approach, physical capital includes land, housing, infrastructural facilities and own tools and equipment of the human being. Lack of tenure security, insufficient living area, and lack of access to social infrastructure are the acute problems of the urban poor. Housing need of the urban poor is a major element of building socially sustainable inclusive cities. The study shows that the majority of the households in both the inner and peripheral city were compelled to stay in squatter settlement as a residential place due to their poor economic condition, followed by high price of urban land. Findings of the sample study conformed to the work of Ghosh et al (1972), in different cities of India that due to poor economic condition and high price of urban land, squatter settlements occur near railway lines, bus depots and low-lying areas either in the heart of the city or in the periphery of SMCA. Tenurial status is one of the key elements in the poverty

cycle. Lack of security of land tenure hinders most of the attempts to improve housing conditions as well as future planning for the urban poor. It has a direct impact on access to basic services and on investment at settlement level and also reinforces poverty and social exclusion of the urban poor (UNDP, 1991). Living conditions in slums and squatter settlements are extremely difficult along with constant feeling of land insecurity in their settlements. So far as security of tenure of land occupied by the squatters in SMCA is concerned, it is observed that 86-95 percent of the households reported to have the holding number as security of land given by the SMC. Though, holding number itself does not prove any legal status of the land occupied by the squatters. Thus, in this sense, squatter households in both the inner and peripheral city do not have any tenure security. Therefore, the study suggests the need for focusing the policy and strategies for tenure security of the households living in the squatter settlements of SMCA to move out from the poverty cycle. In terms of ownership of houses, about 95 percent of the squatter households in SMCA have their own house and a negligible proportion live in rented (around 5 percent) house in both the inner and peripheral city. The majority of the households in both the cities live in kutcha houses, followed by semi pucca and a small proportion of the households live in pucca houses. In terms of the construction of pucca houses, the households living in both the inner and peripheral city squatter settlements in SMCAwere worse off than that of the state and national average. Therefore, the study reveals that the housing condition in both the inner and peripheral city squatter settlements is far from satisfactory which further requires the applications of appropriate sustainable urban planning policy and collaborative efforts including monitoring and implementation of various housing programmes and schemes under the state and central government projects.

10.2 Infrastructural Facilities

Next to housing characteristics, infrastructural facilities like waste disposal, drainage and electricity facility are important not for healthy living but also for ensuring non-polluted environment. In terms of access to infrastructural facilities available to the households within slums, significant difference has been found between the older inner city and the new peripheral squatter settlements in SMCA. Various studies evidenced that many cities particularly in the slum and squatter areas of the developing countries face serious environment degradation and health risk due to non availability of municipal waste management system. So far as solid waste disposal of squatter settlements are concerned, the picture is quite different in the sample study, while 100 percent of the squatter households have access to the corporation"s dustbin for garbage disposal in the inner city, whereas around 22 percent of the households in the peripheral city do not have such accessibility and as a result resorted to open dumping of garbage in the streets, ditches and open spaces making reasons for environmental degradation which further leads to high health risk like diarrhea, cholera, malaria etc. The sample study also found that asignificant number of the households at around 91 percent in the inner city squatter settlements of SMCA had pucca surface drainage facility compared to 35 percent kutcha drainage facility in the peripheral city. The proportion of the households who do not have any drainage facility was significantly higher in the peripheral city. Around 64 percent of the total households had electricity connection. The picture of squatter settlements and slums in SMCA are still excluded from critical infrastructural facilities that are available to the non-slum population.

10.3 Sanitation, Drinking Water facilities

According to world development indicators 79 percent of the world‟s urban residents have access to proper sanitation. Health and sanitation is the initial criteria for good standard of living. Good hygiene is determined by some of the important physical amenities for example proper sanitation, safe drinking water etc., particularly for the squatters in the city. Any communities can only develop in a sustainable manner if the basic needs like Sanitation, safe Drinking Water facilities particularly the poorest and most vulnerable slum dwellers, are met. So far as the physical amenities of the squatters in the sample study is concerned, it is found that the proportion of older squatter households with personal sanitation facility was significantly lower compared to the state and national average. A larger percentage of the households in the inner city avail the community sanitation. Around 9 percent of the households in the peripheral city did not have any sanitation facility and used open spaces cause serious health risk for themselves and other people). Therefore, special attention should be given on Integrated Low Cost Sanitation programme (ILCS). Various reports and studies documented that in many of the cities, the slum dwellers suffer most from non-availability of safe drinking water. The proportion of slum households having piped water facility was significantly lower compared the proportion of slum population in million plus cities in India. The goals of sustainable development cannot be achieved until and unless health, sanitation and safe drinking facilities are met in a proper direction by the urban local bodies.

11. Utilization of Public Health Services of the Sample Squatter Households in SMCA

Health is one of the most important human assets that are generally reflected through the quality of life. Health is central for sustainable development. Health is important as an end in itself and as an integral part of human well-being, which includes material, psychological, social, cultural, educational, work, environmental, political, and personal security dimensions. With regard to the utilization of public health services, it is observed that a larger number of the squatter households utilize both private and government medical institutions. By and large medical facilities provided by the public sector remains to be the major supporting services for the squatters or slum dwellers. Therefore, the study reveals that due to close proximity to the government hospital and expensive treatment in the private institutions, most of squatter households in the inner city avail the public medical facilities. On the other hand, a substantial portion of the slum households in the peripheral city are compelled to visit the nearest quack doctors due to distant location of the government hospitals and also to cope with the busy work schedule.

So far as child delivery (0-6 years of age) in the squatter settlements of SMCA is concerned, it is found that non-institutional delivery was significantly higher at around 64 percent, as against 36 percent institutional delivery indicating that instead of having available public medical facilities in both the inner and peripheral cities non-institutional delivery with the help of untrained dais was quite common due to customs and traditions of the joint family systems, in addition to monetary problems etc. In this context,Agarwal et al (2007) reported that 66.6 percent of non-institutional deliveries were conducted by untrained persons in Delhi slums.

12. Economic Capital of the Sample Squatter Households in SMCA

\It has already been mentioned that the slum dwellers are very poor in terms of human capital and these poor rural migrants integrate themselves in the urban labour market especially in the informal sector through social capital formation. The fact is that human capital generated through education, knowledge and skills are less important in those types of works where the slum dwellers remain engaged. The WPR in both the inner and peripheral city squatter settlements of SMCA was lower than that of the WPR in the million plus cities like greater Mumbai, Delhi, and Kolkata, but higher than the WPR of the state and the country. Interestingly, the female WPR was significantly high in both the cities of SMCA compared to the female WPR in the metropolitan cities; the state as well as the country. The rapid pace of urbanisation witnessed a steady growth of informal sector activities especially in the cities of the developing countries like SMCA. This sector is closely associated with the poverty of the squatters and slum dwellers, because due to lack of opportunities in the formal sector, a greater number of squatters concentrate in the informal sector. The prevalence of informal employment in many parts of the world not only affects the current living standards of the population but is also a severe constraint that prevents households and economic units from increasing their productivity and finding a route out of poverty.

Table (12.1): Employment in Formal and Informal Sectors of the Squatters Households

Sector & Activity Status	Inner City			Peripheral City		
	Male	Female	Person	Male	Female	Person
Formal Sector Employment	25 (13.44)	6 (12.24)	31 (13.19)	11 (7.69)	2 (4.88)	13 (7.07)
Informal Sector Employment	161 (86.56)	43 (87.76)	204(86.81)	132 (92.31)	39 (95.12)	171 (92.93)
Total Employment	186 (100.0)	49 (100.0)	235(100.0)	143 (100.0)	41 (100.0)	184 (100.0)
Total Informally Employed	181 (97.31)	47 (95.92)	228(97.02)	142 (99.30)	40 (97.56)	182 (98.91)

Source: Field Survey, Figure in parentheses indicates the percentage total Employment by Sectors

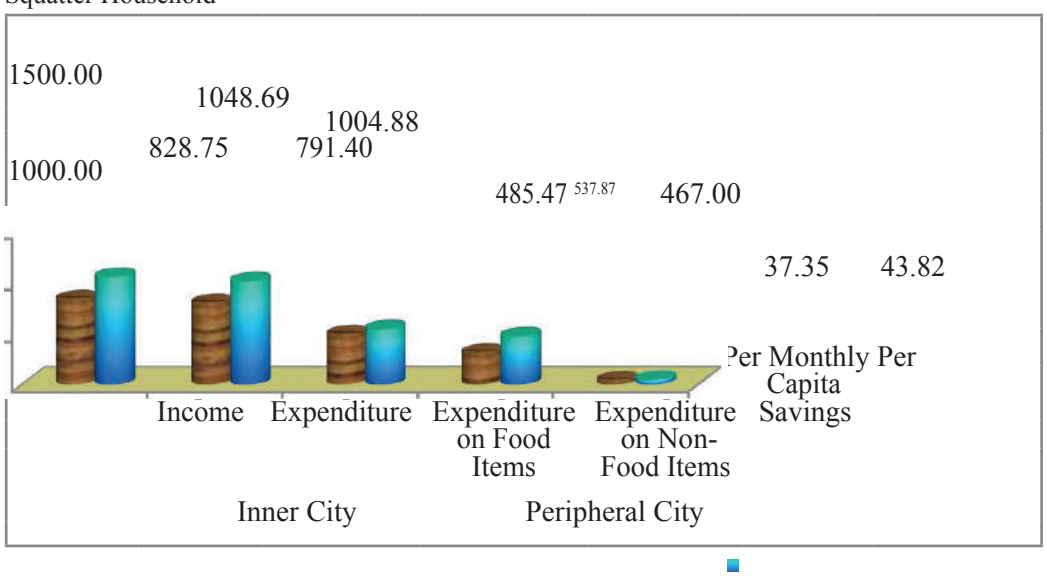
The study reveals that the informal sector is the sole provider of employment and means of economic livelihood among the squatters in the SMCA around 98 percent and the findings corroborate with regard to the feminization of the informal sector. The present study is significantly consistent with the studies of ILO (1977), Aziz, (1984), Bryant (1992), Mitra (1994), Mohanty (2006), Ready (2007), Timalsina (2007) that the urban informal sector emerges to be the sole sector that absorbs the rural migrants and serves as a survival sector for urban poor who are living in the slums and squatter settlement. Expectedly, the proportion of informally casual type employed workers in both the inner and peripheral city squatter settlements in SMCA was significantly higher than that of the urban workers who are informally employed at the national level. It is found that most of the workers in both the inner and peripheral city squatter settlements were not only engaged in informal sector employment, but almost all the workers were informally employed. Therefore,

the government or local bodies should involve directly in the process of formalization of casual employment in the formal sector as well as protective and supportive measures be designed for the informal sector workers and should be strengthened and implemented efficiently to provide the workers who are living in the squatter settlements of SMCA. A successful policy for one group may not work for the other, so policy should adapt to the needs of the workers in the informal economy who contributes substantially to the GDP.

13.1 Monthly per Capita Income, Expenditure and Savings of the squatter households under SMCA

The squatters are the source of cheap labour force in the cities like SMCA. They are largely dependent on cash income to meet the basic needs and it directly comes from the informal sector activities. In these settlements, poverty is characterized by inadequate income for many of the squatters. Due to inadequate earnings they are often unable to meet the basic needs. An extension of their earnings leads to a better nutrition plan, improved health, better education and savings, i.e., well being or standard of living of the slums is ultimately determined by the level of income and the corresponding consumption and savings. From figure (2) it observed that monthly per capita income of the households living in the peripheral city where the older migrants reside was significantly higher as compared to the new migrants living in the inner city squatter settlements (see Figure-13.1).

Figure (13.1): Monthly per Capita Income, Expenditure and Savings (in Rs.) of the Squatter Household



Source: Field Survey,

The lower per capita income was primarily owing to large number of family members in the later. Similarly, corresponding monthly per capita total expenditure, per capita expenditure on food and non-food items and savings were significantly high in the peripheral city than that of

the monthly per capita total expenditure per capita expenditure on food and non-food items and savings of the squatter households in the inner city. The poverty line recommended by the Planning Commission for 2009-10 in terms of per capita consumption expenditure of Rs. 859.50 in urban areas is considered, it is to be found from the present sample study that all the squatters in the inner city squatter settlements were living below poverty line. On the other hand, all the squatters in the peripheral city are living above the poverty line. Further, comparing the MPCI with the international poverty line U$ 1.25/day, it is to be seen that all the households in both the squatter settlements will be fall under absolute poverty.

14. Financial Capital: Indebtedness of the Squatter Households in SMCA

The poor particularly the squatters or slum dwellers are always struggling to provide basic necessities to their families for survival in the cities like SMCA. Due to lack of financial capital they are unable to spend money for unforeseen events and expenses. Therefore, financial capital plays an important role at the time of crisis and other purposes. Both the formal and informal loans/credit has positive impacts toalleviate poverty among the urban poor by generating income, healthcare, education etc. In this regard, Morduch (1998) found that microcredit facility allow the poor households to send their children to school and obtain better healthcare services and building assets. Indebtedness of the people depends on several factors that reflect the socio economic condition of the community or a segment of the population. The income-expenditure pattern of the sample the households found that the per capita expenditure of the households is marginally lower than the per capita income in both the inner and peripheral city squatter settlements of SMCA and it is expected they are free from indebtedness, but the fact is that a considerable number of the squatter household are indebted either with formal sources or informal sources or with both the sources. In terms of access to different sources of loans, Private Financial Intermediaries, social bonding plays a significant role for setting up new business, house construction, wedding, health care and food consumption, expansion of business etc. The poor performance of public financial institutions like banks and co-operatives etc., to provide loans among squatters was mainly due to insecure status of land, lack of collateral assets for mortgage and fear of repayment of loan on time. As a result, in most cases the residents of the informal settlements in SMCA are excluded from the public institutional finance which prevents them from investing their homes, infrastructure, health that again leads to unsustainable development among the community.

16. Community Participation of the Squatter Households

The community participation as a means of sustainable development leads to better quality of life. The residents who are living in the inner and peripheral city squatter settlements are socially, economically, politically and culturally marginalized. For any kind of material or immaterial help the squatters are mostly dependent on the community level leaders who in turn have direct relationship and support with local leaders affiliated by the political parties. These people are relying heavily on political networks for effecting improvements in their quality of life. Consequently, to get by and get ahead a chunk of informal settlers in both the settlements of SMCA remain contact with community leaders through political meetings, rallies etc. Though the squatters of SMCA are no longer just important as political vote banks and it has been reflected by many of the respondent that when the meeting, rally is over, nobody listen or bothered them. In the context of community

participation in developmental agenda, one of our sample respondents reacts as "we the informal settlers or slum dwellers are just used by community leaders to attend local political meetings, rallies, for slogan, protests and procession. Access to public resources, law and o legal structures and, political spaces are important for the development of this power house living in slums. Thus, this scenario further raised the question regarding new attitude and approach of inclusive policies that will focus the needs for sustainable development of the urban poor.

17. Appraisal of urban Poverty Alleviation Programmes/Schemes in SMCA

An evaluation of the urban poverty alleviation programmes/schemes in SMCA reveals that the Schemes and programmes are mostly suffering from the following limitations:

1. Proper accountability of the poor slum dwellers
2. Publicity and awareness against various Schemes and programmes.
3. Land regulation and transparency in land transactions – critical to ensuring secure tenure.
4. Accommodation and basic services for the expanding number of migrants.
5. Beneficiaries of the urban schemes are often influenced by political decisions.
6. Partnership management in the process of planning and implementation.
7. Irregular release of fond both from central and state governments.
8. Lack of funding from national and international agencies.
9. Empowerment of the institution and target groups to participate meaningfully in planning.

18. Conclusion

The study reveals that the overall living condition not only depends on the economic variables but also depends on other demographic, physical and social set of variables. Finally, in terms of livelihood opportunities, the slums and squatter settlements in both the inner and peripheral city of SMCA are still the destination and survival sphere for the present and also the hope for future generation. Whatever progress and achievements have been made regions and countries in the view of Millennium Development Goals (MDGs), still it is not enough to counter the demographic expansion in informal settlements in the cities like SMCA in the developing world because in course of time, the absolute numbers of the informal settlers in the cities are increasing rapidly much to the dissatisfaction of the planners and policy makers. In this regard, efforts to reduce the number and living conditions of the slum dwellers are neither satisfactory nor adequate. Growth with Social Justice has been the basic objective of the development planning in India since independence. Over most of the last 30 years, the nation has maintained an average of more than six percent economic growth even in the recessionary period of 2011-12. Yet, India is the home of largest slum population with vicious circle of poverty in south Asia and this has sidelined all the "feel good" and "shining India" parameters over the years. To meet the emerging challenge of inclusive living along with informal settlers with equal opportunities and harmonious cities, policies have to be geared by generating employment opportunities, health and education, infrastructure etc. Strategies have to be based not just on managerial participation of the lower strata of the urban society particularly the squatters and slum dwellers but they have to be involved actively along with ethical policy in terms of food security, proper health and sanitation, level

of education, and as well as transparent public policy with scaling up organizational financing and proper monitoring for the well being of the poor and sustainable development of the city like SMCA. The participation on the basis of equality in all spares of society is fundamental for sustainable living in the city. To meet the emerging challenge of inclusive living for sustainable development management have to be based not just on managerial participation of the lower strata of the urban society particularly for the squatters and slum dwellers but they have to be involved actively in the policy making decision. The participation on the basis of equality in all spares of society is fundamental to sustainable human settlements. Otherwise, if a large section of people particularly the slum dwellers are not integrated with the mainstream economy and society, a city can never be harmonious for all.

19. Policy Suggestions

On the basis of information collected during the period of field survey and the analysis of the study, the following policy suggestions can be recommended.

(i) Unprecedented growth of slums in SMCA is the direct consequence of urbanization and migration due to inter-regional socio-economic disparities and unbalanced growth process. Therefore, decentralized policies and programmes through the creation of employment opportunities in the rural areas can reduce unemployment, poverty and vulnerability and consequently check the rural-urban migration.

(ii) Among the three basic needs of food, clothing and shelter, regularization of the land tenure and entitlements is the key to secure livelihood of the squatters. Therefore, tenure security measures for the urban poor slum dwellers in SMCA with suitable housing scheme should be given first priority to avoid the psychological tension of eviction and mental stress.

(iii) The slum dwellers in SMCA are mostly from rural and belonged to the socio-economically backward class. The local government should be more sensitive towards educational attainment, job oriented training programmes, skill and knowledge acquisition for the socio-economic uplift of the squatters.

(iv) In terms of infrastructural facilities the squatter settlements in the city needs more investment under slum infrastructural development programmes like road, drainage, water supply, electricity etc.

(v) Medical facility provided by the public sector is not adequate nor the only solution. There should be a provision of subsidized medical centers in the vicinity of the slums especially for the squatters.

(vi) The process of formalization of casual employment in formal sector needs special attention for the security of livelihoods among the slum dwellers. The various social security benefits like provident benefit, accidental benefit, and payment of gratuity etc., for the informal sector workers should be implemented with immediate effect.

(vii) Most of the squatters in SMCA do not have any information regarding welfare schemes beneficiaries and even various slum developmental schemes and programmes sponsored by the state, central and local bodies. In this context, awareness programmes among slum dwellers through community development projects where resident community volunteers can play a significant role in co-ordination.

(viii) There should be easy accessibility to public institutional credit at subsidised rate of interest for the squatters in SMCA for productive purposes in order to protect them from being exploited by money lenders.

(ix) There are large numbers squatter households who are deprived from various welfare schemes like Annapurna Yojana, Antodaya Yojana, Old Age Pension, and Widow Pension etc., not for having ration cards. Hence, provision should be made by the local authorities to provide ration cards within a short period on receiving application.

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Livelihood Sustainability of Street Vendors: A Study in Dhaka City

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Abstract

With an unemployment rate of around 23% and 34 percentages of households living below poverty line, Dhaka, the capital city of Bangladesh incubates profusion of informal sector economy of which street vending takes the biggest portion. Inadequate employment opportunities in both public and private sectors contribute to the rise of these ventures. City dwellers who live on such labor-intensive activities as street vending were surveyed using The British Department for International Development (DFID) defined Framework for ''Sustainable Livelihood'' to cast light on their access to certain types of capital assets. Analysis of collected data shows that street vendors in Dhaka city have the most access to human and social capitals. However, they have very low possessions of two very important sets of assets, such as, natural and physical. Regarding control over another set of capital assets, financial, respondents show a somewhat moderate belongingness. The research findings will expect to facilitate policy makers in devising avenues for developing sustainable livelihood for street vendors in Dhaka city in particular and in other third world cities in general.

Keywords: *Sustainable development, Livelihood assets, DFID SLA Framework, Street vendors, 3rd World cities.*

1. Introduction and Purpose of the study

Dhaka, the most densely populated megacity of the world, is home to 8.5 million people (World Population Review, 2016). Of them, a large number engage themselves in informal income generating activities like scavenging, street vending, working as transport helper, rickshaw pulling etc. Lack of skills and proper education, conflict-driven migration (Timalsina, 2007), shrinking of permanent and protected jobs (UWITIJE, 2016), economic slump (Nkululeko. J Ndiweni, 2014) added with political influence and nepotism give rise to urban informal sector. The activities in the informal sector can be categorized into two sections, the self-employed and casual (non-permanent) labor. A major section of the self-employed individuals works as street vendors. (BHOWMIK, 2005)

According to Dhaka City Corporation records, around 60% of the city dwellers lead an impoverished live who mostly depend on street vending for their living. An unofficial estimate by several hawker associations hints the number of street vendors in Dhaka city to be around 0.25 million in recent years which has increased from 90,000 in 2005 (Shaiara Husain, 2015). Informal sector plays a vital role in the economy of 3rd world countries. Because of the street vendors, other city dwellers can purchase certain commodities even 25-50% lesser than market price. They sometimes provide necessary commodities at doorsteps, thusfurther saving time, money and energy. On the other hand, according to media, vendors pay around BDT 0.5 million per day as illegal toll to local

political leaders and law enforcers to run their businesses on streets and footpaths of Gulistan, Farmgate and New market area (Ansary, 2014).

1.1 Research purpose

The purpose of this research is to explore Dhaka city's street vendors' access to 5 categories of livelihood assets defined by the DFID Guidance and to analyze ways for sustainable development.

1.2 Significance of the study

Street vendors contribute immensely in the shaping of informal economic sector of 3rd world countries like Bangladesh. Therefore, as an integral part of our urban society, they may have quite definitive livelihood approaches and assets to make their survival more sustainable. The findings of this research may be of special significance to policy makers and development sector workers of both government and non-government streams. It is expected to suggest ways for sustainable development in the lives of urban low income community.

2. Background

Livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities or assets while not undermining the natural resource base (Chambers, 1992).

Sustainable livelihood approach is a multi-dimensional approach to poverty reduction where sustainability is considered in terms of capitals or assets available to individuals. It can be applied in both planning new developmental activities and assessing the set of assets' contribution in livelihood sustainability (DFID, 1999).

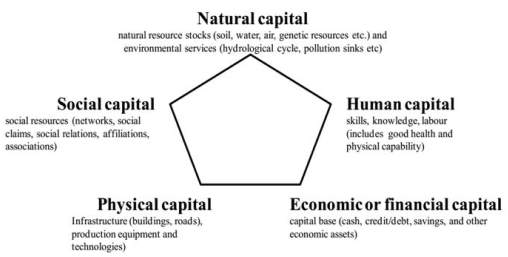


Fig. 1: Livelihood Assets Pentagon (adopted from Stephen Morse, 2009)

Despite the DFID propounded Sustainable livelihood approach began to take place in global poverty reduction research itinerary since the start of the new millennium, its application and implications in Bangladeshi context has remain very rare to date. United Nation's Food and Agriculture Organization commissioned paper on impacts of sustainable livelihood approach (SLA) presented 12 country case studies amongst whichthere was a case on Bangladesh. Here the contributors attempted to relate that Sustainable livelihood approaches had some positive impacts on rural poor having good access to human, social, financial, and physical assets while further

attainment was needed in terms of natural assets (Constance Neely, 2004). Later, Nesar Ahmed (2009) applied SLA to the analysis and development of freshwater prawn industry in Bangladesh- which is very much a part of formal economic sector.

Therefore, application of the SLA framework to analyze livelihood sustainability of lower income community employed in *informal economic sector* in Bangladeshi *urban* setting was a gray area which the researchers of this paper tried to focus on.

3. Methodology

By nature, this research was an exploratory one. For collecting primary data on street vendors' access to livelihood assets, a 38-item structured questionnaire was formulated. Questions in the questionnaire were constructed in light of the DFID propounded Sustainable Livelihood framework. This questionnaire was circulated among 275 respondents of which 237 turned to be valid ones. These respondents were selected on the basis of convenience from around different regions of Dhaka city. Data collection took place during September-December, 2016. Collected survey data was then processed with the help of Microsoft Excel software. Simple statistical tools like frequency and percentage were used to transform the raw data into insightful findings.

4. Results and Discussion

Being part of a patriarchal society, women working on street are still not very frequent in Dhaka. The study found only 46 female street vendors among the total 237 respondents, that is to say, in every five vendors, one is a female, who are mostly engaged in tea stalls and flower sales. 40% of the respondents are aged between 26-35 years while another 28% belong to 36- 45 years of age; these two age groups constitute a majority of around 68% of street vendors. Vendors at the ages of less than 15 years or more than 46 years are really scarce.

4.1 Access to Social assets

Social assets denote individual's relationship with the society s/he belongs to. This relationship is based on trust and reciprocity (Khatiwada, 2013). These assets comprise personal and family networks, as well as close family friends who offer diverse means of potential support when past favors are reclaimed (Ellis, 2000). An individual's success or failure are largely determined by social networks and organizations. It is also important because it lowers the cost of working or doing business together (Khatiwada, 2013).

In the current research, respondents showed a strong possession of social assets. In response to which source they get help from for business, one in every two street vendors mentioned it was their own family while one in every three got help from friends. About 43% respondents identified relatives to be their patrons.Around 55% street vendors have membership of different community organizations. 87% of the respondents got infrequent help from neighbors in times of emergency, while 12% were very lucky to get their neighbors always by their side; only 3 (1.25%) replied they seldom got their neighbors' help. Another question asked was whether they got invitation during neighbors' good times, i.e. festivals and ceremonies. Here, again, 67% said 'sometimes', 30%

'always', and only 3% got 'never' invited. Close knit dependency on family, friends, and relatives, as well as personal involvements with neighbors during good times and bad times clearly point out street vendors' very good access to social assets.

4.2 Access to Human assets

Human assets represent the skills, knowledge, ability to labor and good health that together enable people to pursue different livelihood strategies and achieve their livelihood outcomes (DFID, 1999). In the current study, one in every three respondents did not get any institutional education; however, 50% had only primary level education while 17% extended to secondary level. Nobody was found educated beyond this level. This indicates street vendors in Dhaka city are 5% ahead in access to education where overall country literacy rate is below 62% (UNESCO, 2015).

However, this picture is not very optimistic with regard to their children's education; close to 70% of the street vendor parents could afford to send their kids to school, while net enrollment rate is quite higher at 90.51% (UNESCO-UIS, 2010). It may be accrued to high education costs in urban area like Dhaka.

Street vendors' access to health services projected a positive picture. A hefty 95% of them can afford health care facilities of any sort; 28% were fortunate enough to get it when it is needed and another 67% said they 'sometimes' could manage to get medical facilities. Another relevant question was 'to whom they go for health care services', and 33% replied they visited doctors (both homeopathic and allopathic) while 53% consulted with drug store executives as it is more affordable. However, 14% of the street vendors still relied on traditional healers like quack, kabiraj (herbal and religious treatments) etc.

One particular question that signaled a somewhat weaker possession of human assets was 'to what extent they got current news and information'. Only slightly over 35% street vendors in Dhaka city could get to know what is taking place around in the city; national-level information is a far cry.

Overall, street vendors' access to human assets in Dhaka city projects some wholesome figures considering their education and health care facilities.

4.3 Access to Physical assets

Physical assets comprise the basic infrastructure and goods needed to support livelihoods (DFID, 1999). The different categories of street vendors surveyed in this current research include puffed rice sellers, tea- beetle leaf- cigarette sellers, seasonal fruits sellers, vegetable traders, flower vendors, snacks sellers, junk jewelry sellers, small electronic accessories sellers, indigenous cake sellers etc. A large number of them (62%) have a fixed site or location for doing business, while 9 out of 10 vendors (91%) have their ownvehicles or make-shift shop arrangements (like 3-wheel van, exhibition tray/ basket, hot water flask, oven, hand mike etc.). Close to 80% of the respondents live at 30 minute to 1-hour distance from their business location, while 21% need more than 1 hour to get back home after day's business is over.

However, their access to toilet and necessary water supply is rather dismal; 74% do not get water

nearby, hence need to bring it from home/ distant places. Since street vendors trade on/ by open roadside places, they need to compromise most with toilet facilities; a large portion of them are compelled to squat (55%), or 'manage' market guards (24%) which sometimes result in stealing of their merchandise.

4.4 Access to Financial assets

According to the DFID guideline, financial assets denote financial resources that people use to achieve their livelihood objectives. It can be associated with cash or equivalent that enables people to adopt different alternative livelihood strategies (DFID, 1999).

Respondents in this study represent urban lower income group, hence they quite frequently require financial help for sustenance. Due to complications, street vendors (62%) usually avoid traditional banking system. A big portion identified friends, family and neighbors (68% and 19%) to be their financial patrons, whereas 13% respondents went to informal lenders. However, the help does not come for free; 8 out of every 10 street vendors claimed they were compelled to borrow at high interest rate.

The study at hand attempted to have an overview of financial resources that the street vendors can live on. 42% of the respondents earn tk300 to tk500 daily while 22% earn tk500 to tk800 and a considerable number of street vendors (24%) are earning tk1000 or more. Very few (6%) are earning barely tk300 or less. Since only earnings cannot signify financial conditions, they were asked about 'how much they could save monthly'. The largest portion (32%) said they could save tk1000 to 2000 per month and another 30% could save tk2000 to 3000. People having ability to save hardly tk1000 or beyond tk3000 are very scanty. Therefore, in terms of earning and saving, street vendors in Dhaka city have a somewhat moderate position.

4.5 Access to Natural assets

According to Ellis (2000) Natural livelihood assets comprise the land, water and biological resources that are utilized by people to generate means of survival. As street vendors excessively expose to outside environment, they quite frequently get affected by water-borne and dust-related infections. Almost 76% respondents reported several forms of breathing ailment. Atmospheric factors, especially heavy/ incessant rain affect 6 out of every 10 vendors, whereas 86% reported they need to change type of business to adaptwith weather- this at least partially weakens street vendors' livelihood strategies and outcomes.

5. Conclusion

In light of the above discussion, street vendors in Dhaka city have reasonable access to human and social assets required for livelihood sustainability. This may be because of traditional close-knit family bondage of Bangladeshis. Regarding financial assets, street vendors earn and hold very limited resources which often push them to borrow at high risk. On the other hand, both natural and physical assets seem to be on down side of the scale. Being an over populated region, healthy environment and physical facilities for better livelihood are continuously in severe demand in

Dhaka city. Developmental practitioners and policy makers, therefore, need to address issues like air pollution, water clogging, sanitation, and bottleneck in micro-level banking system with a view to making street vendors' livelihood less vulnerable in Dhaka city.

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Migration & HIV/AIDS Risk

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Abstract

Migration may be a factor in HIV transmission in Bangladesh. The study focused on to identify the number of HIV infected returnee migrants. When the returnee migrants come back to home from abroad due to HIV positive, they become jobless. They cannot do work due their illness. Family members also get affected by him/her. Sometimes wife and children become HIV infected. Sometimes children who lose parents to HIV/AIDS require a great need of emotional and physical assistance to over-come such tragedy. Sometimes society makes them separated and they cannot attend any social program. Sometimes HIV infected people lose their job due their illness. There are also psychologically distressed. HIV infected people are socially, physically, economically and psychologically vulnerable.

Although Bangladesh is a low HIV prevalence country but HIV risk is increasing day by day. Geographically Bangladesh is located border area with India and Myanmar. So there is a risk of HIV/AIDS. This study is important to find out the HIV/AIDS risk of migrant people.

Migrant workers‟ health is always an absent issue. The responsible authorities pay hardly attention to the health concerns of the migrants. There is no national database of migrants returning back with health complications when they encounter abroad. Study shows most of rural people are labor migrant worker. They are less educated. They have no enough knowledge on sexual orientation. They live long away from their family. Most of migrant workers infected by HIV/AIDS for un-protective sexual behavior. They go to sex workers but there no access condoms. Migrants who leave without family are not allowed to buy condom especially in middle- east countries. Migrant workers are less aware about HIV/AIDS. In abroad like of Malaysia and Singapore have no bindings about sex. So migrant people can easily involve with un-proactive sex. They have sexual relation with more than one person. Sometimes employers force them to have sex.

The profiles of Bangladeshi migrants show majority of them leave the country at their prime youth age (18-35) while many women migrate below the age (25 years) limited by the government aims to avoiding vulnerabilities. Most of the migrants both men and women are from the low educational background and engage in low skilled job mainly -construction, service sector, domestic work etc. Migrant worker’s health is always a missing issue. The concerned authorities pay hardly attention to the health concerns of the migrants. There is no national database of migrants returning back with health complications. Migrant workers have hardly access to information and education in order to protect them from HIV infection. They have hardly knowledge about the risky situations they may face in abroad or the punitive laws regards to sodomy.

Keywords: Migration, Migrants, HIV risk, HIV, Bangladesh

1. Introduction

Bangladesh remains as a low HIV prevalence country with less than 0.1% overall prevalence in general population over the years1. The HIV prevalence remains less than 1% both among key and bridge populations2. Till date, the country has registered a total of 3674 cases of HIV infection. However, the estimated number of people living with HIV is around 9500. Although the prevalence remains low, Bangladesh is one of the only four countries in Asia and the Pacific where prevalence has increased more than 25% over a decade till 2012. (Global AIDS Response Progress Report (GARPR)/ Annual Progress Report Bangladesh 2015).[1]

Migration may be a factor in HIV transmission in Bangladesh. Migrants, both international and cross border, have generally not been targeted by HIV prevention efforts in the past and there is little understanding as to how such targeted intervention could be implemented. The limited facilities for voluntary counseling and testing, as well as the social stigma and discrimination attached to HIV, remain a major challenge to reach these migrants. (COUNTRY PROGRESS REPORT 2012, Bangladesh, UNAIDS)[2]

There is no official data on overseas migrants living with HIV. However, the majority of passively reported HIV positive cases have been among returned international migrant workers and their families. A recent analysis of existing data on PLHIV showed that of 645 adult PLHIV who had been employed, 64.3 percent had previously worked abroad30. Among the 219 confirmed HIV cases in 2002, returning emigrant workers comprised 50.7 percent of the total. Condoms are rarely used in family planning, because they are not preferred by men [HIV vulnerabilities faced by women migrants (OKUP, UNDP, 2009)].

The survey data show that 57% of departing and 58% of returned migrants know nothing about sexually transmitted infections (STIs). Among the departing migrants, 30% male and 34% female do not know about HIV/AIDS while 79% of returnee migrants have no knowledge of the modes of HIV transmission. Data show that 11% of returnee male migrants had unprotected sexual relations with girlfriends and 21% had unprotected penetrative sex with commercial sex workers during their stay abroad. On the other hand, 5% returnee female migrants had unprotected sexual relations with co-workers or boyfriends. But 51% returnee migrants both male and female had never used condoms during their sexual intercourse abroad. Only 4% of returnee male migrants used condoms during their last penetrative sex abroad. About 40% of departing migrants both male and female reported that they had unprotected extramarital sexual relations with opposite partners. It was found that 11% of returnee migrants were infected with sexually transmitted diseases, 4% of them women migrants. Survey data also show that only 2 percent of returnee migrants received formal training or orientation on HIV/AIDS before migration. The majority of migrants both departing (71%) and returnees (67%), have gained a general idea on HIV from radio/television. Other major informal sources of HIV/AIDS and STD information are friends/peers, leaflets/booklets etc. Only 4% of departing migrants have learnt about HIV/AIDS and STDs from NGO training. (http://www.iom.org.bd/category/highlights/survey-on-hivaids-and-migrant-workers/)

[1]Global AIDS Response Progress Report (GARPR)/ Annual Progress Report Bangladesh 2015

[2]COUNTRY PROGRESS REPORT 2012, Bangladesh, UNAIDS

Migration is an important livelihood strategy for many people in Bangladesh. This is one of the least-developed countries. In the last decade, 200,000-400,00Bangladeshi men were officially recorded as migrating out for work each year, mostly Middle East Countries and many more men and women are known to leave informally. There are some special issues that are closely related to the HIV epidemic, including issues of migration, gender, and stigma. Although certain most at-risk populations have been the focus in the active surveillance, most cases identified through clinics have, in fact, acquired HIV while working abroad, or from their spouse who worked abroad (40). To date, 371 people attending the ICDDR, B's VCT Unit (Jagori) have been identified as infected with the virus. Of them, 54.2% are returnee-migrants, suggesting that migrants working away from their families may be particularly vulnerable to HIV. (Vulnerability to HIV/AIDS of Migration Affected Families- icddr,b working paper).

A situation assessment by IOM in 2010 found that out of the 125-returnee migrants, 32% had sexual relations with a partner or a sex worker while abroad, and only 2% used protection consistently. Upon returning to their communities, their families are at an increased risk of unknowingly contracting HIV/AIDS. (SCI-Chetona project)

Growing cross-border movement has increased the vulnerability of migrants to HIV/AIDS. Each year, approximately 225,000 Bangladeshis leave the country and take up overseas employment in the Middle East, Southeast Asia and Europe. Mobile population are often exploited, marginalized, and stigmatized throughout the migration process and become susceptible to practicing high-risk sexual behaviors due to unsafe conditions, inaccessibility to services and lack of knowledge. According to the Children Affected by AIDS (CABA)study in 2013 done by NASP, more than half of those surveyed living with HIV, are returnee migrants. (SCI-Chetona project)

The undocumented status of migrants makes this group one of the most under-served, hard to reach and neglected population. As a major exporter of human labor, the involvement of Bangladesh‟s civil society institutions in providing services and protecting the rights of migrant workers is minimal (especially for women). To date, the Bangladeshi government does not have any policy or framework addressing the mobility of HIV/AIDS and those infected with it.

There is no specific data available on overseas migrant people live in HIV/AIDS. My study will focus on to identify the number of HIV infected returnee migrants. When the returnee migrants come back to home from abroad due to HIV positive they become jobless. They cannot do work due their illness. Family members also affected by him/her. Sometimes wife and children become HIV infected. Sometimes children who lose parents to HIV/AIDS require a great need of emotional and physical assistance to over-come such tragedy. These children not only lose the guidance and love of a parent, but also the security that the parent‟s presence in the home would naturally instill. Children who lose parents to HIV/AIDS often suffer from emotional distress, malnutrition, and lack of health care and poor/no access to educations. They are also at a high risk for sex trafficking, homelessness, exploitation and increased exposure to HIV/AIDS. HIV/AIDS infected family members also have discriminated by other family members and neighbor. Sometimes society makes them separated and they can‟t attend any social program. Sometimes HIV infected people lost their job due their illness. There are also psychologically distressed. HIV

infected peoples are socially, physically, economically and psychologically vulnerable. This study will also focus the risk of migrant‟s workers and how they affect their other family members. It‟s also help to find out the number of HIV infected returnee migrants and causes of HIV/AIDS. This study will address the vulnerabilities of HIV infected propels.

Although Bangladesh is a low HIV prevalence country but HIV risk increased day by day. Geographically Bangladesh is located border area with India and Myanmar. So there have a risk of HIV/AIDS. There have also 2-4 million people lives in abroad. Many of them are going to as migrant worker. They are less educated and going to abroad by undocumented way (middle man). For that reason, they didn‟t receive any training and other information. This study is important to find out the HIV/AIDS risk of migrant people.

2. Objectives

The objectives of this study are to:

1. Why the migrants are risk in HIV/AIDS
2. What are the process of safe migration?
3. Activities of Awareness
4. Identify the number of HIV infected returnee migrants
5. Causes of HIV/AIDS
6. How HIV/AIDS affect the family member

3. Methodology

I have collected from primary and secondary sources data-

1) Secondary data- I collected from different types of report, NGOs (who works on HIV/AIDS and migration issues), Bureau of Manpower, Employment and Training (BMET), Government officers (GO), District Employment and Manpower Office (DEMO), Technical Training Center (TTC).

2) Primary data- I collected primary data from 20 people who living with HIV through one to one interview. I collected data also family members whose are affected by HIV/AIDs.

4. Findings and Discussion

Bangladesh's history is a history of migration. People have been mobile in the Bengal delta region for centuries. Patterns of contemporary labor migration go back to colonial times. Every year, around 500,000 Bangladeshis leave the country to work abroad. Bangladesh's economy depends on the emigrants' remittances.

A labor-abundant country, Bangladesh has sent over an estimated 6.7 million migrant workers to more than[3] 140 countries across the globe over a period of more than three decades since the

[3]Workers‟ Migration and Remittances in Bangladesh
Khawaja A. Mamun* and Hiranya K Nath

mid-1970s. Most of these workers temporarily migrate to work in Middle East and Southeast Asia. This mass movement of temporary migrant workers has, to some extent, eased unemployment pressures on the over-burdened labor market in this highly populated country. The natural resource based economic prosperity of the first group of destination countries since the 1970s has created a large demand mainly for unskilled and semi-skilled workers to work in different sectors of those economies. Similarly, the economic boom of the Southeast Asian countries in the late 1980s and the 1990s generated demand for unskilled and semi-skilled workers. Bangladesh with a large population and limited economic opportunities has decidedly taken advantage of economic growth and prosperity in those countries. These flows of migrants leaving the country have not only fulfilled the mandate of the government policy to encourage out-migration as a means of easing unemployment pressure on Bangladesh‟ ever exploding labor market but also the remittances received from the migrant workers have had significant impact on the economy.

There are two major patterns in international migration from Bangladesh: one to the industrialized west that includes the United Kingdom and the United States, and the other to Middle East and Southeast Asia. The migration to the industrialized countries is perceived to be long term or permanent in nature while migration to Middle East and Southeast Asia is usually for short term. The Bangladeshi immigrants living in the industrialized countries of Europe and North America can be divided into two distinct groups: a group of well-educated, high or middle income people of Bangladeshi origin, and the other belonging to the low income or unemployed segments of the population. The origins of migration to these countries can be traced back to the British colonial period. Most of these early migrants were employed as low-skilled workers and there has been hardly any upward economic mobility.

International migration to the countries of Middle East, North Africa, and Southeast Asia took place mainly after the independence of Bangladesh in 1971. The rise in oil prices in the 1970s increased the demand for low-skilled workers to work in the infrastructure development projects in the Middle Eastern countries. Later, there were similar demands from the newly industrialized countries of the Southeast Asia. Migration to these regions has been characterized by short-term employment with specific job contracts and migrants returning home after completion of the contract period.
The Bureau of Manpower, Employment and Training (BMET) maintains a database on the short term labor migrants who officially go overseas for employment. According to the official statistics the total number of Bangladeshis working abroad migrants stands at about 1976 to July 2016 total migrant workers are 10,11,9903. Large numbers of them are following these countries- KSA 27.27%, UAE 23.29%, Oman 11.80% and Kuwait 5.08%.

Temporary labor migration and thus return has proven to be the predominant migration pattern in Asia. Mainly political pressure forces the majority of these so constructed unqualified migrants to return to their countries of origin after their working contracts ends. There was total number of returnee migrants 71,712 in 2009.

Bangladesh is one of the top-1-0 labor sending countries around the world. On average, 400,000 - 500,000 people are deployed annually for overseas job through the official channel. Official data show around 9.6 million people have been deployed in overseas job during 1976 to 2015. Out

of official channel, numbers of fortune seekers headed for foreign Lands every year in search of better livelihoods through various unofficial means. The numbers of such unofficial migration is assumed as same as the official's. Labor migration from Bangladesh is dominated by men (around 95%). The qualitative information explores six specific factors mainly contribute[4] to increase migrant workers' vulnerability to HIV along with some other factors including workplace duress, poor wages and living conditions, loneliness, mental stress, peer pressure etc. Major findings are briefed here as follows:

Sexual orientation and physical need:

Biological desire, mental and psychological yearning etc. determine sexual orientation and attitude of a person either migrant or not. Qualitative data expose that many men migrants who are used to having sex with men (identified MSM) migrate abroad for availing a comparatively conducive scope of having their desired sexual practice although same sex practice is considered as punitive crime and socially and religiously unacceptable both in Bangladesh and in most of the destination countries. Many of them make sexual relations with other men either as passive or active partner voluntary to get biological and mental release while many of them are motivated to get economic or other benefits. Research also shows that physical need of many migrants (not identified MSM) who stay alone years-after-years without families indulge risky sexual attitude and behavior with men in order to get relaxed of their sexual desire either through friendship or in exchange of money or putting force on the naive co-workers.

Available scope of risky sexual behavior:

Focus group discussions with HIV infected migrant workers exposed that sex business was clandestine but common in all major destination countries. Many women migrant workers of different countries either willingly or forcefully are engaged in sex trade. ln absence of family and social binding on one hand and having money in pocket on the other with additional factors - loneliness, mental stress, peer pressure - migrants are motivated to buy sex.

Sexual Abuse and Exploitation:

Sexual abuse and exploitation is another important factor that increases migrant workers „vulnerability to HlV. Recent data of 249 returnee women who received different forms of services over the last two years from OKUP exposed 13.25%women migrants had encountered sexual abuse abroad. Amongst those, 3030% got pregnant. 88% out of those pregnant women returned home for abortion either willingly or with the false promise of remigration given by the abusers while 12% completed abortions in the destination countries. Another study showed 20% of178 Bangladeshi women migrants in three Arab countries reported their experiences of sexual abuse. Many migrants both men and women shared they had encountered sexual violence or gang-rape either by the local nationals or the co-workers from the same country or the others.

4 www.bmet.gov.bd

[4]Migration Scenario: Nature, Patterns and Trends- Dr. Md. Nurul Islam

Lack of knowledge about HIV protection:

Migrant workers have hardly access to information andeducation to have ability to protect them from HIV infection. They have hardly knowledge about the risky situations they may face in the destination countries or the punitive laws regards to sodomy. Basic information related to HIV/ AIDS was incorporated in the pre-departure briefing in 2010 while the briefing became mandatory since 2008. Data recorded by the government run pre-departure briefing centers showed only3,703 out of 107,626 departing migrants attended the briefing in the first three months of 2013, and only 18,000 out of 607,778in2012. Practically, HIV session is usually overlooked in the two-hour-long briefing compare to the discussions about rules and regulations of destination countries that might help the migrants to follow and create good image of the workers. Focus group discussions with the migrants indicate that they hardly care of using condoms not to lose pleasure or they possess wrong perception that fair-skin people can carry no bad diseases. The use of condoms also depends on the willingness of the clients who buy the sex. Lack of negotiation capacity with the client is a factor. ln case of abuse and exploitation there is rarely scope of using condoms.

Lack of access to services &treatment in destination:

Migrant workers are excluded in the national HIV/AIDS programme in most of the major destination countries. By law, detection of HIV is a cause of instant deportation. Focus group discussions with the PLHIV exposed many of them experienced severe harassment and humiliation when they were screened HIV positive abroad. They were not informed the reasons of their deportation or any information about HIV and next course of actions upon their return. Migrants who leave without family are not allowed to buy condom especially in Saudi Arabia. let is even punishable if a migrant is found carrying condom. Buying condom or going to private doctors or clinics is expensive in some countries that refrains them from access to condom and treatment as well especially in case of STl /STD.

Stigma and discrimination:

Lack of information before deportation as well as treatment related referral mechanism between countries of origin and destination refrain the migrants to seek early treatment, which also contributes to get infected to the spouses of the HIV infected migrants. Some of the HIV infected returnee migrants shared they hid their HIV status upon return in a fear of stigma and ostracism from the family or the society.

HIV Prevention Initiatives for Returning Migrants" from 2009 to 2012 and two other little projects on prevention of HIV among migrants (including women migrants) supported by UNAIDS during 2010 to 2012.

Promotion of HIV prevention services to prospective and returnee migrants as well as to the spouses of migrant workers, in partnership with local community based organizations, the government health and family planning department and the Bureau of Manpower Employment and Training

- Capacity building of relevant government officials on migration and HIV issues through

training of trainers (trained 290 officials from 28 TTCs) at the technical training centers under the BMET

- Community-based awareness raising programmes (covered 15,867 returnee migrants-both male and female, 12,191 potential migrants, 54,492 spouses of migrant workers and 43,580 community people) and distribution of pictorial education material (160,000 copies of booklets and leaflets) on HIV and STI prevention in selected migrant prone areas

- Distributed 100,000 leaflets with information on HIV prevention and available service points for counselling, testing and care to the returnee migrant workers at the international airport of Dhaka

IOM Dhaka"s health promotion programmes mainly focus on prevention of HIV and communicable disease through awareness raising, community based social mobilization activities for prospective migrants and their families as well as research and assessments. IOM also provides technical and advisory support to the National HIV and AIDS programme of the Ministry of Health and Family Welfare on developing and implementing strategies on HIV [5]prevention among internal and external migrant populations. IOM Dhaka also facilitates multi-sector collaboration and cooperation on promoting health rights of overseas migrants.

There are some national NGOs working in Bangladesh on HIV/AIDS program. Such as Ashar Alo Society (AAS), Mukta Akash Bangladesh (MAB), Confidential Approach to AIDS Prevention (CAAP), HASAB (HIV/AIDS and STD Alliance Bangladesh). Ashar Alo Society (AAS), Mukta Akash Bangladesh (MAB), Confidential Approach to AIDS Prevention (CAAP) directly work prevention of HIV/AIDS, care & treatment support for HIV infected people and awareness program.

5. Why the migrants are at risk of HIV/AIDS

Study shows most of rural people are labor migrant worker. They are less educated. They have no enough knowledge on sexual orientation. They live long away from their family. Most of migrant workers infected by HIV/AIDS for un-protective sexual behavior. They go to sex workers but there no access condoms. Migrants who leave without family are not allowed to buy condom especially in middle- east countries. Migrant workers are less aware about HIV/AIDS. In abroad like of Malaysia, Singapore has no any bindings about sex. So migrant people can easily involve with un-proactive sex. They have sexual relation with more than one person. Sometime employer force to have sex.

One of migrant worker shared that "***My employer took away my passport and force me to havesex. Sometime female employer didn't get food if I didn't agree to have sex with her***".

Vulnerability Assessment:

Un-protective sexual behaviors, less knowledge of sexual orientation, lack of knowledge about HIV/AIDS are the causes of risk of migrant workers.

6. Process of migration

Study shows most of the migrant workers migrated by their relatives, who leaved abroad. For that reason, they didn‟t receive any training or counseling session before leaving country. Their relatives collect visa and also manages job. Some of them migrated by privet agency. Privet agency manages only job permit and visa. When they are migrated they didn‟t get any information about HIV/AIDS. Some of them migrated India without visa and passport. They lived there illegally for long time.

Vulnerability Assessment:

Most of migrant worker migrated by undocumented way. They didn‟t follow safe migrant process. There are four main components in the labor migration process 1. Pre-departure 2. Departure 3. In service 4. Return. Under each main component there are sub areas as follows: 1. Pre-departure 1. 1 Pre-decision making 1.2. Decision Making 1.3. Selection of Job 1.4. Recruitment 1.5. Pre-departure preparation requirements 1.6. Pre-departure Self preparation/self-assessment and Departure Checklist. Departure 2.1 Travel to Airport 2.2 at the Airport 2.3 In the flight 3. Arrival and in- service 3.1 Arrival in destination country 3.2 At work/In-service 3.3 Repatriation due to various reasons 3.4 End of Contract 4. Return and reintegration 4.1 Returning back to Sri Lanka 4.2 Short term reintegration and re-migrate 4.3 Long term reintegration. Generally, in our country didn‟t follow these rules. Migrant workers mostly from rural area. They didn‟t follow these steps.

7. Activities of Awareness

Study shows migrated people didn‟t aware about HIV/AIDS. They didn‟t receive any counseling or training before leaving country. Only few people know HIV/AIDS from text book. But this is not enough. Some of them know from advertisement. These all are very little information. When people infected by HIV/AIDS then they get service. Some organization works HIV/AIDS awareness program. But they work only few places. Not overall the country.

One of migrant worker shared "***If I get counseling before leaved country then I never infectedthis virus".***

Vulnerability Assessment:

There are only few number of organization like Ashar Alo Society (AAS), Mukto Akash Bangladesh (MAB), Confidential Approach to AIDS Prevention (CAAP), HIV/AIDS and STD Alliance Bangladesh (HASAB) etc. organization works prevention of HIV/AIDS. Bangladesh gov. works HIV/AIDS awareness program. They observe 1st December AIDS day. This day observed district, upazilla level. Some TV program, radio program also broad cast. Basic information related to HIV/

AIDS was incorporated in the pre-departure briefing in 2010 while the briefing became mandatory since 2008. Data recorded by the government run pre-departure briefing centers showed only 3,703 out of 107,626 departing migrants attended the briefing in the first three months of 2013, and only 18,000 out of 607,778 in 2012. Practically, HIV session is usually overlooked in the two-hour-long briefing compare to the discussions about rules and regulations of destination countries that might help the migrants to follow and create good image of the workers. It should be more awareness program through overall the country.

8. Identify the number of HIV infected returnee migrants

Data shows in Bangladesh the first HIV case was detected in 1989 Although HIV prevalence remains very low among general population and has remained below 1% in key population. There are a total of 4143 reported HIV positive cases in Bangladesh (NASP, WAD Report-2015). Estimated number of PLHIV is 8,900 (estimate range: 8,000-9,800, Source: NASP/UNAIDS, 2014). In Bangladesh total number of 4143. Around 30% of migrant population among the reporting cases in 2015 HIV new cases. From the Ashar Alo Society (AAS) member data base in at Dhaka office total members are 1183 till September 2016 where 797 are returnee migrant people, 4 are people with injective drug (PWID), 4 are blood transmission, 44 are Prevention of Mother-to-Child Transmission (PMTCT) Of HIV. Data shows the large numbers of pupation infected with HIV/AIDS in returnee migrant population.

Vulnerability Assessment:

Migration may be a risk factor for HIV transmission in Bangladesh. Lack of information about HIV/AIDS is major fact that migrant people are infected by HIV/AIDS. There are no enough information centers that people get information before migration. All of the country should be door to door information about HIV/AIDS as like of Polio program and other successful program. While migration is the ongoing process in Bangladesh then it should be more work for HIV/AIDS awareness program.

9. Causes of HIV/AIDS

There are four ways of HIV transmission. These are unsafe sexual intercourse, blood exposure, breastfeeding and injective needle share. Study shows most of the migrant workers are infected by HIV/AIDS by unsafe sexual intercourse. They are less aware about HIV/AIDS. They are also little knowledge about sexual orientation. In abroad there have no any restriction about HIV/AIDS. There are some factors have for migrant people. These are- long time far away from home, no bindings for sex, lack of knowledge HIV and sexual orientation, restriction to use condom in destination country especially in middle east countries etc.

Vulnerability Assessment:

Lack of knowledge on HIV/AID is the major factor HIV transmission for migrant people. There have no enough information centers where people get information on HIV/AIDS.

10. How HIV/AIDS affect the family member

Study shows HIV/AIDS affect the family member also. Due to HIV positive their wife and children also have risk to be HIV positive. Others family member don"t take this good way. Stigma and discrimination common phenomena for family members. They are discriminated by neighbors. Family members have death fear always due to illness. Some of them don"t work properly due to illness. Socially their family members are stigmatized. Because some relatives and friends are not contact due to HIV positive. They have wrong information about HIV/AIDS. Due to HIV/AIDs children lost their parents and they are deprived proper education and proper nutrition. Family members always feel insecure socially and economically.

Vulnerability Assessment:

There has a misconception about HIV/AIDs. Most of the people think that HIV is a transmitted disease by casual contact. They think HIV positive cannot live long time.

11. Conclusion

A labor-abundant country, Bangladesh has sent over an estimated 6.7 million migrant workers to more than[i]140 countries across the globe over a period of more than three decades since the mid-1970s. Every year, around 500.000 Bangladeshis leave the country to work abroad. Bangladesh's economy depends on the emigrants' remittances. The profiles of Bangladeshi migrants show majority of them leave the country at their prime youth age (18-35) while many women migrate below the age (25 years) limited by the government aims to avoiding vulnerabilities. Most of the migrants both men and women are from the low educational background and engage in low skilled job mainly -construction, service sector, domestic work etc. Despite low job profiles abroad Bangladeshi migrant workers send the highest money as remittances and contribute to the development of the family, society and the macro economy of the country, Migrant worker's health is always a missing issue. The concerned authorities pay hardly attention to the health concerns of the migrants. There is no national database of migrants returning back with health complications they encounter abroad. Migrant workers have hardly access to information and education to have ability to protect them from HIV infection. They have hardly knowledge about the risky situations they may face in the destination countries or the punitive laws regards to sodomy. Basic information related to HIV/AIDS was incorporated in the pre-departure briefing in 2010 while the briefing became mandatory since 2008. Practically, HIV session is usually overlooked in the two-hour-long briefing compare to the discussions about rules and regulations of destination countries that might help the migrants to follow and create good image of the workers. Most of migrant workers infected by HIV/AIDS for un-protective sexual behavior. They go to sex workers but there no access condoms. Migrants who leave without family are not allowed to buy condom especially in middle- east countries. Migrant workers are less aware about HIV/AIDS. Lacks of sexual orientation, training, counseling is major fact that migrant people have risk of HIV/AIDS. There are large number people live in abroad and they cannot get proper information on HIV/AIDS. There should be HIV orientation before going to destination country. HIV/AIDS related awareness program should be increased all over the country. Government should be more initiative to prevention HIV/AIDS prevention

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Assessing Rural Agricultural Practices with Sustainable Livelihood Approach

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Abstract

Like elsewhere, sustainable livelihood is now the buzzword in the sustainable development parlance of Bangladesh, the concept of sustainable livelihood (SL) is an attempt to go beyond the conventional definitions and approaches of poverty eradication. The study used the SLA as a foundation or main basis of analytical tools. Qualitative and quantitative methodologies were used in the study through a structural questioner. Data was collected from Jessore. The study investigated and synthesized the background of relationship between livelihood outcome and its several independent variables. It reveals that seasonality has the most devastating significant negative impact on livelihood outcome. Only 8.3-months security of work as agricultural activities and rest of the months passing through vulnerability is a bad effect of seasonality. The diverse facilities of job are very limited although they take part in different farm duties. Human capital affects livelihood outcome negatively in a significant level, because among the surveyed respondents, only 21% have institutional training which are 4 days' average in duration and only 43% are illiterate and inefficient in the use of technological and scientific agricultural practice. The existing transforming process revels that the surveyed group have access to government and private office. Besides, they play a vital role in decision making process of those activities which significantly affects livelihood outcome.

Keywords: *Sustainable livelihood approach, agricultural outcome, rural livelihood,livelihood outcome*

1. Introduction

Like elsewhere, sustainable livelihood is now the buzzword in the sustainable development jargon of Bangladesh. The concept of sustainable development emerged in 1980s. It propelled a paradigm shift in developing thinking and continued to dominate the development thinking and to dominate the development discourse at various levels from the local to global as well. The concept of sustainable livelihood is rapidly gaining acceptance as an important means of understanding the factors that influence people's lives and well-being. The sustainable approach improves the understanding of the poor and organizes the factors that constraints or enhances livelihood opportunities and shows how they relate. The study reveals that average family income is 8739 BDT through different assets to achieve their positive livelihood outcomes and vulnerabilities which ensure the livelihood outcome and transforming structures and process the shape of livelihoods.

Theoretical aspects and literature review:

Poverty" and "Poverty Alleviation" are frequently discussed and at the center of concern in development arena. Poverty is a multidimensional phenomenon and depends on the context and perspective, almost every country has experienced of hardship of the poverty. The traditional definition and approaches of poverty eradication had been found too narrow because they focused only on certain aspects or manifestations of poverty, such as low income, or did not consider other vital aspects of poverty such as vulnerability and social exclusion (Krantz, 2001). The sustainable livelihood is an attempt to go beyond the conventional definition and approaches of poverty eradication. Livelihood thinking dates back to the work of Robert Chember's in the mid-1980s realizing that conventional development concepts did not yield the desired effects and mankind face an enormous population pressure, Chambers developed the idea of "Sustainable Livelihoods" with the intention to enhance the efficiency of development cooperation. His concept to constitute the basics for the Sustainable Livelihoods Approach (SLA), as it was developed by the British Department for International Development (DFID). Starting from 1997, DFID integrated the approach in its program for development cooperation. The sustainable livelihood approach is a prominent in recent development programs that aim to reduce poverty and vulnerability of the communities (M. Kollmar and St, Gamper, Juli 2012). Various people try to define sustainable livelihood as their own. According to Chambers and Conway 1992- a livelihood Comprises the abilities, assets, (Stores, resources, claims and access) and activities required for a means of living, livelihood is sustainable which can duplicate with and recover from the stress and shocks, maintain or enhance its capabilities and assets and provide generation and contribute net benefits to other livelihoods at the local and global levels in the long and in the short run. It can help development activities and assess the contribution that existing activities have made sustaining livelihood. The sustainable livelihood approach seeks to improve rural development policy and practice by recognizing the seasonal and cyclonal complexity of livelihood strategy (Carney,2002; Allison, and Ellis, 2001). It is being used by development agencies and NGOs to achieve a better understanding of natural resource management strategy (Allison and Horemans, 2006). It is comprised of capacity, assets, and activities required for means of livelihood, livelihood will be sustainable when it can copy with and recover from stress and shocks and maintain or enhance its capacities of and assets, both now and it future, while not undermining the natural resource base. (Carney, 1998, DFID, 1999).

Vulnerability is characterized as insecurity in the well-being of individuals, households, and communities in the face of changes in their external environment. It refers to shocks, adverse trends and unfavorable seasonal patterns that can affect the livelihood (Devereux, 2001). The vulnerability context forms the external environment in which people exit and gain importance through direct impacts upon people's assets status. People move in and out of poverty and the concept of vulnerability captures the processes of change better than poverty line measurements. Vulnerability has two facets: an external side of shocks, seassonalities, and critical trends; and an internal side of defenselessness caused by lack of ability and means to cope with these. People require a range of assets to achieve their positive livelihood outcomes (Scoones, 1998). Different combinations and components of livelihood assets are required for achieving livelihood outcome. The presence or absence of various components of capital assets can facilitate or hinder in the attainment of livelihood success (M. Kollmair and St. Gamper, Juli 2002). The sustainable

livelihood framework draws attention to five types of capital. Human capital represents the skills, knowledge, ability to work and good health that together enable people to pursuit their livelihood strategies and achieve their livelihood objectives (DFID, 1999). Natural capital in the form of cultivable land, water, wild fry and wider environmental goods are critical for farmers in fish production. Social capital in the form of networks, connectedness, cultural norms and others social attributes have significantly helped in exchanging experiences, sharing of knowledge and cooperation among rural households (Fine, 1999, Stirrat, 2004) Financial capital refers to incomes, savings and credit. Transport, road, market, electricity, water supply, sanitary and health facilities are the physical capital. Transforming structures and processes are the institution, organizations, policies and legislation that shape livelihoods. (Book) The institutions and their policies have a profound influence on access to assets (DFID, 1999). Understanding institutional processes allows the identification of barriers and opportunities to sustainable livelihoods. Transforming structures and processes directly influence livelihood strategies. They are of central importance as they operate at all levels and effectively determine access, terms of exchange between different types of capital, and returns to any given livelihood strategy (Shankland, 2000; Keeley, 2001) structures can be described as the hardware (private and public organisations) "that set and implement policy and legislation, deliver services, purchase, trade and perform all manner of other functions that affect livelihoods" (DFID, 2000) processes constitute the "software" determining the way in which structures and individuals operate and interact. Important processes for livelihoods are for instance policies, legislation and institutions, but also culture and power relations. They may serve as incentives for people to make choices, they may be responsible for access to assets or they may enable stakeholders to transform and substitute one type of asset through another ((M. Kollmair and St. Gamper, Juli 2002).

2. Methodology

A combination of qualitative and quantitative methods was used for primary data collection. Data were collected from Jessore, Bangladesh, using purposive sampling methodology and data was collected from 10 villages 12 from each one, total 120 structural interview were conducted for analyzing of successful 100 clean data for analysis. With 8 participants of each group, two FGD were conducted, all data was collected in between September to October 2016, and the sustainable livelihoods framework was applied to analyze the qualitative and quantitative data for assessing the rural agriculture with Sustainable livelihood approach.

3. Techniques of Data Analyses

Data from questionnaire interviews were coded and entered into a database system using Microsoft Excel software. Statistical software SPSS was used to analyze the data, regression was run for producing descriptive statistics, correlation, coefficient Comparisons between different factors were made by ANOVA (Analysis of variance).

4. Findings of the Study

The SLA framework is intended to be a versatile tool for use in planning and management. It offers a way of thinking about livelihoods that helps order complexity and makes clear the many factors that affect livelihood. (DFID2.2). Amongst the surveyed group of farmer, 33% are landless

farmer, 33% are agricultural labor who work in others land as labour. And 34% are farmer who own minimum amount of land. The after math of calculation of the surveyed responds is that (57%) of cultivated crops are consumed by the farmer which cover only 62.25% of their annual needs.

5. Analysis and interpretations

A factor analysis was conducted with the variables related to livelihood outcome of a household. Livelihood outcome refers to the total income of the household including both farming and non-farming activities e.g. remittance, interest, dividend and so no. The factor analysis was conducted using principal axis factoring with varimax rotation as an extraction method (Nummenmaa et al.1996, Aczel,1999; Hair et al,1998) which formed with 10 factors compressed with three main group vulnerability contexts, livelihood asset and transforming structure and process. The identified components account for 71.76% of variance in the data determine towards livelihood outcome of an agricultural household. That implies about 28.24% variations could not explained with this model which could be explained by other factors. The factor transforming structure explained the maximum variance 20.95%. Transforming Structures shape livelihoods. Structures can be described as the hardware (private and public organizations) "that set and implement policy and legislation, deliver services, purchase, trade and perform all manner of other functions that affect livelihoods" (DFID, 2000). The structure included legal process (.77), role of low enforcement authority (.77), local government (.72), quality of private (.73) and public service (.77) and rules toward business (.69). The table-4 gives the evidence of the output that existing transforming structure have significant negative impact on livelihood outcome. The second most important factor is from vulnerability context, Shocks in the form of vulnerability context which can destroy assets. Socks can explain 10.98% of variance. Including antecedent of the component are Health of Farmer (.82) Health of Livestock/Crops (.69) Economic shocks (Local and International) (.69). The rest of factor and the percent of variance explained as Seasonality (2.93%), Trends (5.11%) Livelihood assets are Human capital (5.98%) financial capital (7.35%), social capital (3.49%), natural capital (6.52%), physical capital (4.42%) and transforming process (4.03%).

Table-1: Factor Analysis of Livelihood outcome of rural agricultural household

Group	Factor Name	Variables	Factor Loading	% of Variance Explained	% of Variance Explained Cumulative
Vulnerability context	Socks	Health of Farmer	0.82	10.98	10.98
		Health of Livestock/ Crops	0.69		
		Economic shocks (Local and International	0.69		
	Seasonality	Of Price	0.64	2.93	13.91
		Of Production	0.83		
		Of Employment	0.80		
	Trends	Demographic	0.74	5.11	19.02
		Economic	0.79		
		Technological	0.77		
Livelihood Assets	Human Capital	Health and Nutrition	0.71	5.98	25.00
		Education	0.75		
		Training	0.73		
		Years of Experience	0.72		
		Capacity of Work/Adopt	0.70		
	Financial Capital	Savings of household	0.45	7.35	32.35
		Access to credit	0.77		
	Social Capital	Network	0.74	3.49	35.84
		Mutual Understanding	0.65		
		Formal and Informal Groups	0.74		
		Common rules	0.63		
	Natural Capital	Land Procedure	0.79	6.52	42.36
		Water Aquatic	0.70		
		Resources	0.59		

		Wildlife	0.69		
		Environment	0.65		
	Physical capital	Water supply and sanitation	0.78	4.42	46.78
		Energy Supply (electricity)	0.76		
		Tools and equipment for production	0.66		
		Availability of Seed	0.76		
Transformation structure and Process	Structure	Legal process	0.77	20.95	67.73
		Police low enforcement	0.69		
		local government	0.72		
		Quality of service Private	0.73		
		Quality of service governmental	0.77		
		Rules toward business	0.69		
	Process	Access to government office	0.82	4.03	71.76
		Access to private office	0.80		
		Decision making process	0.77		

Table-2: Correlation coefficient and reliability measure and descriptive Statistics Analysis

Correlation coefficient and reliability measure

Constructs	1	2	3	4	5	6	7	8	9	10	11
Livelihood outcome	1										
Socks	.032	1									
Seasonality	-.068**	.369**	1								
Trend	.134	.467**	.408**	1							
Human Capital	-.145	.212*	-.064	.200*	1						
Natural Capital	.057	-.168	.018	.148	.037	1					

Financial Capital	.138	-.071	-.110	.072	-.037	.276**	1				
Social Capital	.053	-.175	.021	.140	.048	.573**	.222*	1			
Physical capital	-.001	.213*	.232*	.335**	.099	.315**	.203*	.210*	1		
Structure	-.001	-.022	.101	.126	-.205*	.509**	.329**	.362**	.590**	1	
Process	.267**	-.068	.047	.119	-.157	.328**	.490**	.442**	.427**	.556**	1
Mean	8739	2.47	2.96	2.61	5.47	3.2	72330	3.22	2.99	3.03	2.75
Std. Deviation	3708.16	0.6	0.63	0.74	2.08	0.6	112448.6	0.56	0.69	0.74	0.71

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The table -2 represents the mean of standard deviation and correlations between the control variables in the study. The study represents that average household income (livelihood outcome) BDT 8739 and average 72330 used as financial capital including loans. Two tailed Pearson correlation is computed to examine the nature of association among the measures of livelihood outcome. Among the correlated values are appaired both positive and negative results with good association among control variables with each other. The result of correlation analysis shows that livelihood outcomes have significantly correlated with seasonality (-.068) and transformation process (.267) at the 0.01 level. Socks are significantly correlated with Seasonality (.369) Trend (.467) at the 0.01 level and Human Capital (.212) Physical capital (.213) is significant at the 0.05 level.

Table-3: Regression Analysis result along with livelihood outcome

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	8466.334	3275.752		2.585	.011
	Socks	502.693	737.659	.082	.681	.497
	Seasonality	-1027.939	658.320	-.175	-1.561	.122
	Trend	1050.156	611.398	.208	1.718	.089

	Human Capital	-357.835	194.732	-.201	-1.838	.069
	Natural Capital	772.259	812.605	.126	.950	.345
	Financial Capital	.000	.004	-.010	-.086	.931
	Social Capital	-574.073	840.950	-.087	-.683	.497
	Physical capital	-331.680	715.387	-.062	-.464	.644
	Structure	-1331.797	749.173	-.265	-1.778	.079
	Process	2082.274	709.115	.400	2.936	.004

R Square = .180

Adjusted R Square = .088

F- test = 1.957**

Durbin-Watson = 1.618

a. Dependent Variable: Livelihood Outcome (Income of the Household)

Table- 3 presents the results of linier regression analysis. The significant relationship is found between livelihood outcome and independent variables. The independent variables were expressed in terms of standardized factor scores (beta coefficients). The significant factors that remained in the regression were shown in order of importance based on beta coefficients. The regression equation for livelihood output and with respect to independent variables is presented below,

$$Y=\beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+\beta5X5+\beta6X6+\beta7X7+\beta8X8+\beta9X9$$

Where,

Y = Livelihood outcome

B0, β1, β2, β3, β4, β5, β6, β7, β8, β9 = regression coefficients of independent variables.
X1, X2, X3, X4, X5, X6, X7, X8, X9= independent variables presented in Table- 4

The result of beta coefficients from regression analysis in Table- 4 can be used to explain the relative importance of the nine independent variables in contributing to the variance in livelihood outcome. As far as the relative importance of the nine factors is concerned, the result of the regression analysis revealed that five components among nine are statistically significant Seasonality (-.18) Trend (.21) from the livelihood assets Human Capital (-.20) transforming structure (-.27) and process (.40) are significantly related to the livelihood outcome of rural household of Bangladesh. The results are consistence to the finding of factor analysis. The result of ANOVA shows the value of F (1.957) which is statistically 95% level of significant.

6. Discussion and Conclusion

The study investigated and synthesized the antecedents of relationship between livelihood outcome and its several independent variables. Peoples necessitate a range of assets to achieve

their positive livelihood outcomes. Vulnerability is insecurity in the well-being of individuals, households, and communities in the face of changes in their external environment. The institutions and their policies have a profound influence on access to assets to shape it on desired outcome. The study reveals that among the vulnerability context, seasonality has significant negative impact on livelihood outcome, the most devastating is seasonality. Human capital affects livelihood outcome negatively in a significant level, (Table 3) because among the surveyed respondent, only 21% have institutional training which average 4 days in duration and only 43% are illiterate and inefficient in the use to technology and scientific agricultural practice. Physical capital includes roads transportation secure house water supply and sanitation, tools and technology for production and energy which significantly correlated with vulnerability context shocks which means shocks hampered livelihood physical assets. the available structure play a negative role on livelihood assets due to lack of legal process, role of Police/low enforcement, inefficient local government, worsen quality of Private and governmental service and Rules toward business. But the existing process revels that the surveyed group have access to government and private offices and they play a vital role in decision making process of those activities that significantly affects livelihood outcome.

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Tourism as a Sustainable Livelihood: A Study of Sikkim

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Abstract

A livelihood is the way of making a living by the people and it is considered sustainable when it enables people to cope with and recover, from various natural and socio-economic crises. A sustainable livelihood also contributes to the enhancement of their well-being of the present as well as that of the future generations without neglecting and over-exploiting the natural resources. In the landlocked Himalayan state of Sikkim which is continuously coping with the topographical constraints, limited usable natural resources and restricted industrialization, tourism has immense potential for contributing to the economic and social well-being of the people as well as in the conservation of the natural resources and cultural heritage of the state through the practise of rural tourism, cultural and creative tourism within the ambit of community based ecotourism.

Keywords: sustainable livelihood, eco-tourism, rural tourism, cultural and creative tourism, economic development, well-being

1. Introduction

A livelihood is the way of making a living by the people and "encompasses people‟s capabilities, assets, income and activities required to secure the necessities of life" (IFRC n.d.). A livelihood is considered to be sustainable only when it enables people to cope with and recover from the crises like natural disasters, economic or social turmoil and also it contribute to enhancement of their well-being as well as that of the future generations without neglecting and over-exploiting the natural environment or resource base. The Sustainable Livelihood Framework (SLF) which was developed by Department for International Development, UK, identified various factors that affect a person‟s livelihood. SLF viewed livelihoods as systems and tried to understand how those factors interact with each other. Therefore, to understand how sustainable the livelihood is, it is necessary to understand the assets, or capitals that people draw upon and the strategies they develop to make a living, the context within which a livelihood is developed and what makes a livelihood more or less vulnerable to various natural, social and economic crises.

Tourism is often cited as world‟s fastest growing economic sector, one of the world‟s largest employer and soon to be the largest industry (DFID 1997).It is one such livelihood option which has become the means of sustenance for many people by helping them to cope with topographical constraints, limited resources and economic and social turmoil. The Planning Commission of India had also identified tourism as one of the major vehicles for generating employment and promoting sustainable livelihoods in India. But to what extent tourism can be considered to be a sustainable livelihood option depends on certain key issues in terms of its contribution to the

creation of improved livelihood, maximization and retaining of the benefits in the destination areas alongwith minimization of negative environmental and cultural impacts. Tourism can contribute in form of enhanced well-being, better livelihood practice, community-based conservation and the capacity building of the local communities to manage and be engaged with tourism especially in those socio-economically backward or developing and ecologically sensitive areas. For all these reasons tourism may be considered as a sustainable livelihood option. The Endogenous Tourism Project (ETP) partnered by UNDP and GOI Ministry of Tourism wherein women and rural poor are the target beneficiaries aimed to demonstrate that with community empowerment and management of endogenous resources in rural areas it can become an important source of sustainable livelihood. The focus has been on sustainable livelihoods and addressing issues of poverty, through community mobilization and income generation activities related to tourism. "Endogenous tourism" which combines cultural heritage, craft, and ecological dimensions of rural life holds tremendous potential for both income generation and enhancement of the basic quality of life in the rural areas. Through this innovative approach the host community can learn to take pride in their own identity and their cultural and natural environment. Also both domestic and international tourists will be attracted by the history, culture, artistic skills, the way of living of the indigenous population along with appreciating natural environment in all forms without abusing or destroying it but also sparing for the future generations.

Tourism therefore becomes a means to enable accumulation (e.g. income) for consumption and investment; a means to help spread risk; an adaptive response to longer-term declines in income entitlements, due to serious economic or environmental changes beyond control; and/or a means to take pressure off fragile lands and increase house hold incomes for purchase of additional food or payment of school fees (Tao & Wall n.d). Tourism as a livelihood is a non-farm livelihood using human (i.e. labour) and economic (i.e., employment related to tourism) assets as a means to further improve the financial economic asset base (i.e., income, savings, investment) as well as other dimensions to the existing stock of human assets (i.e., health, education) (Tao &Wall n.d.).

Against this background this paper makes an attempt to examine the status of tourism as a sustainable livelihood option in the state of Sikkim with reference to how existing livelihoods has been and can be strengthened through the introduction of tourism as an economic activity.

The Himalayan state of Sikkim is located in the north-eastern part of India having a latitudinal and longitudinal extension of 27°N to 28°N and 88°E to 89°E.This stateis one such example where tourism is one of the dominant livelihood option. Sikkim is a land-locked mountain state with difficult terrain, limited usable resources and limited industrialization and some household and cottage industries. Though agriculture is the mainstay of the people, here the potential of tourism as a livelihood option is immense. In fact the state has become one of the popular destination among the tourists due to its topographical and climatic variations, varieties of flora and fauna, cultural heritage and friendly host population. Tourism has been accorded as one of the major sector of state economy as it has been found to be one of the major revenue earning and employment generating sector. This sector affects directly as well as indirectly the employment and income generation thus having a high multiplier effect. With the establishment of the linkage with the other economic sectors like agriculture, horticulture, pisciculture, cottage industry, tourism can even check the economic leakage thus strengthening the socio-economic development of the state.

In this context it may be said that because of the significant existence of links between tourism and other activities tourism should be seen as a tool for development and not end in itself (Mc Cool and Moisey 2001). According to sustainable livelihood approach, particularly among poor communities, people gain their livelihoods through multiple activities rather than one formal job and any new initiatives do not occur in isolation. Similarly, tourism is a livelihood option which is integrated into an existing system. For the local communities if tourism becomes one of the sources of their livelihood for acquiring sustainability then it often leads to livelihood diversification. In Sikkim too, tourism plays an important role in economic diversification. As Choudhury says, tourism in Sikkim,

"…diversifies economy by introducing tertiary activities and new infrastructures in areas that are basically rural. It helps developing local expertise in certain professional services, such as guide service, interpreter service, etc. Existing tertiary sectors like trade and transport receive additional impetus and become more organized (2006 p.75).

2. Dominant Livelihood Options in Sikkim

Agriculture is the primary activity of the people of this hilly state of Sikkim located in the Eastern Himalayas. Seventy five per cent of the population is directly or indirectly dependent on agriculture and allied sectors, while the rest depends on the manufacturing and service sectors for a living (Sikkim Human Development Report 2014, p 49).Of the total workers 62 per cent are engaged in agriculture, forestry and fishing. Another 13 per cent of the workers are employed in the secondary sector (mining, manufacturing, electricity, water supply and construction), with more than half of them being employed in construction. The tertiary sector constitutes 26 per cent of the workers (Table 1).

Tab.1: Sectoral Distribution of Workers (%), 2011-12

Sectors	Rural			Urban			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Primary	62	86	73	1	3	1	50	77	62
Secondary	16	5	11	25	10	20	18	6	13
Tertiary	22	9	16	74	88	78	32	18	26

Note: Figures are rounded off.

Source: 68thNSS Round (2011-12)

In spite of agriculture being the mainstay of the majority population, its contribution to the state"s GDP is only 8 per cent for 2011-12 (CMIE &Govt. of Sikkim 2011-12).Majority of the farming communities of the state fall in the category of small and marginal farmers. Here the

agricultural practices are highly variable over space and time due to varying altitudes and agro-climatic conditions.About 15.36 % of the total geographical area is devoted to agriculture though the actual area under agricultural use is declining fast due to diversion of land for other non-agricultural uses like establishment of industries, township expansion, construction of roads and other infrastructure projects causing loss of livelihood. Moreover agricultural development in the state is constrained due to mountainous topography, fragmented landholdings, limited irrigation, lack of farm mechanization and frequent occurrences of natural calamities like landslides, floods and earthquakes which makes scarce fertile plain land scarcer. All these disadvantages are the main causes behind the declining trend of the contribution of agriculture to the state GSDP indicating a stagnation and reduction in incomes due to reduction in productivity and the production of major crops, namely, ginger, large cardamom and orange. The sectoral contribution of agriculture to the GSDP has declined from 52 per cent in 1980-81 to 21per cent in 2004-09 (MART 2011).

Another important economic activity practiced by a considerable section of the population for their living is animal husbandry. The congenial temperate climate and the temperate vegetation has been favourable for the exotic and high producing livestock. In addition the indigenous highland population have been traditionally pursuing livestock rearing especially rearing of yaks, sheep, mountain goats, pigs and poultry. The contribution of the livestock sectors including animal husbandry and fisheries in total GSDP of Sikkim during 2007-08 was 5.21 per cent engaging 9.05 of the total work force (MART 2011). The state government has launched dedicated missions on Poultry and Dairy for livelihood promotion in these sectors. A section of the population is also engaged in the tertiary sector and service based livelihoods for example government jobs, private jobs, hotels and restaurants etc.

In Sikkim, tourism has emerged as one of the dominant source of livelihood since past ten to fifteen years or so. The state has become a popular destination for all types of tourists ranging from those spending leisure holidays, or those seeking solitude for meditation to those participating in adventure tourism. Gradually, the flow of tourists are just not restricted to the two peak seasons between March to early June and October to November. Presently the state is receiving increasing number of tourists even during those months which were previouslyconsidered to be the off-season period. Major steps have been taken to break the seasonality factor of tourism and promote all season tourism by having winter tourism, flower festivals, conferences/conventions/seminars, pilgrimage, adventure activities, Wellness-peace-health rejuvenation month stay, cultural tourism etc. In order to increase the duration of stay, special emphasis are given to open new areas, prime and lesser known destinations, enhance local activities and to promote the country side. This has helped in cutting down seasonal unemployment. On the whole, tourism sector has been found to be one of the major revenue earning and employment generating sector. It has been adjudged as the fastest growing industry, showing tremendous growth in terms of standard and quality of service, infrastructural development and competitive promotional packages.The state has taken up the mission to make tourism the main livelihood of the people in Sikkim and to develop skilled human resources for tourism sector.

3. Tourism as a livelihood option

Sikkim has comparative advantage in tourism with its beautiful landscape, diverse flora and fauna, culture and traditions and warm hospitable people. It attracted a record 7.2 lakh tourists in 2010 - which has been declared the „tourism of the year". Tourism has been identified as a major engine of economic growth, employment generator and poverty alleviators. The Government of Sikkim has endorsed this hospitality sector as a main civil industry of the state. Sikkim"s Tourism Mission 2015 seeks to make tourism the main livelihood of the people of Sikkim, and each and every household and individual, a skilled force for the tourism industry. Related policies have been framed to foster economic integration through developing linkages with other sectors in order to harness the direct and indirect multiplier effects of tourism for employment generation and economic development. The tourism sector is expected to provide employment to 75,000 people with a trained manpower of about 17,000. Presently village tourism is encouraged to preserve culture, heritage and handicrafts and to create better economic and employment opportunity in the rural area. Linking of floriculture and horticulture with tourism industry as a part of agro tourism project further helped tourism to grow as a form of sustainable livelihood. Development and promotion of Community Based Ecotourism (CBET), using the approaches of Participatory Management for sustainable development of the resources, has been introduced in Sikkim. This has led to generation of employment, income and revenue for the state. This involves the local communities in the tourism activity which supports their livelihood needs and consequently create their direct stake in conservation of local culture, ecology and environment. This concept of community based eco-tourism is expected to go a long way in providing better income generation options to the rural people. This will also mean less dependence upon the natural resources in as far as it amounts to removal of produce from these areas. There will be, moreover, greater incentive in conservation of local traditions, culture, heritage and environment, as these will be seen as aiding in local economy rather than an impediment to it (Government of Sikkim 2010).

Village or Rural tourism is also growing fast as a form of responsible and sustainable product with critical social objectives through people"s participation. This form of tourism is found to be very effective as the state"s rural hinterlands are endowed with fabulous natural beauty, serene environment, heritage sites and unique cultural flavor. This is expected to help in dispersing the tourist congestion from popular and conventional sites of tourist attraction to the villages where the tourists can get familiarized with the unique and authentic culture and heritage. As a result the tourist are not only mentally rejuvenated culturally enriched but also the indigenous community can sustainably carry forward their works of art and culture which otherwise would have been lost in the oblivion due to economic unviability and lack of sustenance. This can also help in mitigating the problem of rural poverty and unemployment through employment and income generation. Some of the villages of Sikkim like Kewzing, Hee-Bermoik, Yoksum Lachen, Tumin, Pastanga, Tinchim, Lunchok, Maniram, Rong, Jaubari, Darap, have already been part of rural tourism project and are providing home-stay facilities to the tourists.

Trekking and Mountaineering are by far the most vibrant and visible adventure tourism activities in Sikkim. Many of the local population who are naturally skilled and well adapted to the mountain environment earn their livelihood by pursuing the occupation of Mountaineering and trekking guides and porters.There is a great potential for creating enormous number of new jobs. The

employment potential is the highest in the tourism sector as compared to any other sector and in Sikkim the entire economy will be going through a positive transformation once the tourism sector is fully established. The tourism sector has a very strong linkage to socio-economic progress to the state. It has very high revenue-capital ratio. It is estimated that an investment of about 10 lakh creates 47 direct jobs and 11 indirect jobs which surpasses the employment potential of any other sector (Government of Sikkim 2010).

4. Role of Cultural and Creative Tourism

Culture, creativity and tourism are intrinsically related with each other. Beyond the traditional factors of tourism production like sun, sea, sand, mountain, forest and static mode of consumption, culture has also become an important source of attraction. Many of the tourism destinations in order to distinguish themselves from other competitors have turned to culture not only as a means of distinction but also as a means of generating income and jobs (Richards & Wilson 2006: 1210). Even World Tourism Organization 2005 and European Travel Commission also sees,, cultural tourism" as one of the major trends in global tourism in the past three decades and has been identified as one of the major growth areas. According to the OECD report on the *Impact of Cultureon Tourism* (2009:21*),* cultural tourism accounted for almost 359 million international tourism trips in 2007 or 40 per cent global tourism. Moreover in value terms, the contribution of cultural tourism is even greater, since cultural tourists are estimated to spend a one-third more on average than other tourists (Richard 2009,p. 1).

The state of Sikkim has been since last twenty years one of the popular destination among the tourists mainly because of its natural beauty. In addition to its natural diversity this small Himalayan state is also blessed with very rich cultural heritage both tangible and intangible. This is a land of diverse eco-cultural heritage with a rich base of traditional ecological knowledge. The Sikkimese culture finds expression in various forms of beautiful art and crafts and its rich tradition of performing arts.The handicraft and handloom products like carpets, curtains , bags, belts etc. with traditional design and different colours demonstrate the very distinctive marks of Sikkimese culture representing the artistic sense and creativity of the Sikkimese people. The art of wood carving, wooden and clay mask making, making of cane and bamboo craft objects and hand-made papermaking are some other artistic skills which local population has inherited from their forefathers.These forms of art will be nurtured and continued by the future generations only when they become economically sustainable. One way of making it possible is by associating tourism with the art and culture of the state. Also Sikkim's near about 200 monasteries or Gompas have not only been influencing the cultural heritage and lifestyle of the people, but also demonstrates the ancient rituals and practice. So, the state in addition to its natural beauty is also endowed with a rich cultural heritage. Yet as source of tourist attraction in general natural attractions overshadows the cultural attractions and that too only a few selected cultural sites have been conventionally visited by all the tourists visiting the state and often leading to overcrowding beyond the carrying capacity. In fact the use of cultural resources as source of tourist attraction is still in a very nascent stage. Only recently, efforts are being made to make the tourists aware of and attracted to the rich cultural traditions and experience it by coordinating the tourist itineraries with the local fairs and festivals e.g *Jorethang Maghey Mela, Losar cum Tourist Festival at Anden Woolung GumpaGumpa, Daramdin*. Special tourism festivals e.g.,*Hee Bermiok Kalej Valley Heritage*

Festival, are also beingarranged where the local residents get an opportunity to showcase their art, craft, cultural heritage and traditional cuisines. Homestay facilities arranged for the tourists as a part of village tourism festivals e.g. *Maniram Villagetourism festival*, offers experiences of traditional customs, local cuisines and other local activities often linked tothe daily life of the inhabitants. Some other festivals which have been linked with the tourist itinerary are *Yakten*

- *Bojeytar Village Tourism Festival, Pakyong, Bhadauria Purnima Festival - Tsomgo Lake, Loosong, Pelling Tourism Festival, Sikkim-Winter Carnival, Gangtok,* where cultural programmes performed by *Lamas* from themonasteries or by different ethnic groups portraying their cultural uniqueness, sale of local handlooms and handicrafts , local food festival, exhibition and sale of agricultural and horticultural products are arranged.Traditional cuisines of Sikkim is also becoming increasingly popular and has much potential for the world market. This offers an opportunity to preserve the ancient culinary traditions through further research as well as creating highly skilled workforce of culinary professionals who can help in adding Sikkimese cuisines as another feather to the various other attractions of Sikkim as a popular tourist destination. Also as a part of the village tourism the preparation of local cuisines can be demonstrated to the tourists. All this will help in, generating job opportunities as well as further popularising and preserving the traditional cuisines of Sikkim in this era of cultural globalisation when burgers and pizzas tend to dominate the Indian taste buds.

Shopping which is considered as an integral part of the tourism experience is also a valuable contributor to employment, income and revenue. Especially, when tourists are encouraged to shop traditional handicrafts and other locally produced products the local craftsmen, and entrepreneurs are benefitted. In Sikkim the souvenirs popular among the tourists include canvaspaintings and scrolls with local motifs, the „Tashi Tagey‟ or the eightlucky signs, wooden dragon wall hangings, cloth bags, handmade paper products, jewellery of gold and silver intricately carved and inlayed with precious stones, woven items, Buddhist religious items and a host of other things. Designing shopping centres for traditional crafts, jewellery etc. on the lines of craft village or "*shilpabusty*" where not only sell of the products can be facilitated but also craft workshops can be visited by the tourists. There they will also get a chance of exploring their creative potential through active participation in the hands-on training programmes where the local craftsmen will be their teachers. This is „creative tourism‟ whichis "travel directed towards an engaged and authentic experience with participative learning in the arts, heritage or special character of a place, and it provides a connection with those who reside in this place and create this living culture"(UNESCO 2006). By linking culture, creativity and tourism through networks of interaction and economic exchanges guided by the principles of sustainability and involving all the stakeholders will not only lead to preservation of cultural heritage but also will usher in regional socio-economic development.In Sikkim such efforts has been already introduced but is still at a very infant stage.

5. Conclusion

Sikkim has been coping with problems like unemployment and under-employment which is a major concern and cause of insecurity among the youth of the state. Manufacturing sector will always be limited due to topographical constraints which also makes establishment of connectivity a major challenge. To mitigate the problem of unemployment state has taken initiatives to introduce new

forms of vocational education. To provide appropriate livelihood skills to its youth the state has been the pioneer to introduce capacity building programmes and livelihood schools. In 2010, the State Institute of Capacity Building was established at Karfectaar, South Sikkim, as an umbrella organization for livelihood schools which have trained over 4000 unemployed youths in various courses including foreign languages, computer software and hardware, construction, trade, animal husbandry and tourism. In addition, the state government has identified certain potential sectors for growth and livelihood creation and tourism is one of them.

It has been realised that immense potential for Sikkim lies in promoting various forms of tourism like rural tourism, cultural and creative tourism all under the umbrella of community based eco-tourism. The primary sources of tourist attraction in Sikkim include the panoramic view of snow-capped Himalayan ranges, exquisite varieties of flora and fauna, the turbulent Teesta and Rangit which are the main rivers of Sikkim, the lakes, hot springs and waterfalls and the ancient monasteries and gompas. In addition to this recognition of the state‟s unique heritage and culture and associating those with tourism activity will provide this destination with a different identity. A new form of tourism i.e „Cultural and Creative Tourism‟ can be promoted which depends on the mutually beneficial relationship between culture and tourism. Such linkages will not only add new dimensions to the existing factors of tourist attraction but will also enable the promotion and preservation of local culture both tangible and intangible. This will provide an important means of preserving, promoting and supporting cultural heritage, cultural production and creativity of the local population and at the same time will also lead to income generation. This will add economic viability and act as an incentive for still practicing those traditional occupations which symbolizes the local culture and heritage. Thiswill also provide a unique and authentic experience of the distinctive culture and heritage of the destination to the visitors. Thus the potential of tourism as a form of sustainable livelihood will be fully realised through its successfully integration and properco-ordination with other economic activities like organic farming, floriculture, food and food processing, handicraft and cottage industry.Sikkim is moving ahead in this direction and the state has identified tourism as one of the important form of livelihood which can pave way for the state‟s economic development and well-being of present and future generation.

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Climate Change Adaptation and Livelihoods in Southwest Region of Bangladesh

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Abstract

Climate change increasingly affecting the livelihoods of people living in southwest region of Bangladesh, people are experiencing the negative impacts of climate their lack of capacity to prepare for and cope up with the effects of a changing climate now-a-days.

Climate change has affected the livelihoods of people in many folds including food security, malnutrition. It has also created a state of unemployment among the people of South-west communities in Bangladesh. As a result, the affected people are losing their means of livelihoods and are forced to take different alternative ways of livelihoods to cope with the hostile impact of climate change related disasters.

This study is designed to identify the possible effect, how the people are adaptive and identify the external support required to increase their adaptation capacity due to the climate change.

The climate change is posing challenge to the livelihoods in different ways. Livelihoods are either disrupted by the extreme weather events like cyclone, heavy downpour, floods, erosion, storm surges, dense fogs, sea turbulence or by slow onset disasters like salinization, dryness, ecosystem degradation etc. Peoples are getting adaptive with different alternative livelihoods options i.e. making handicrafts, trying to extreme weather suitable and salinity tolerant crops, crab fattening. Tree plantation, duck rearing etc. To reduce the drinking water problem, PSFs are widely used in this area.

To fight against climate change, external support is much needed for the inhabitants living here. People are interviewed to find out what are the external support is needed from their point of view. Some are suggesting with digging more pond and installation of more PSFs may reduce their fresh drinking water problem. People are expecting direct cash support, which may help them to buy their necessary household items which generally not distributed as relief items. Technology is also pointed out by the respondents, which would really help them to fight against the climate change. They are especially focusing on diversified salt and flood tolerant crop varieties which may remain under the water for the longer period of time compared with other types. Establishment of shelter house with professional management service would help the affected people to have their temporary livings during the disaster periods. A multi-dimensional approach is needed for the adaptation and implementation of livelihoods programs related to climate change. Poverty, environmental degradation and sustainable livelihoods, all interact with complex climate change issues in Bangladesh. Public–private sector cooperation in the management of environment and climate change is to be encouraged and concerted efforts are to be undertaken.

Keywords: Climate Change, Climate change adaptation, Livelihoods, Southwest Bangladesh.

1. Introduction

Bangladesh, a low-lying country is well known globally as one of the most vulnerable countries and will even become more as a result of climate change. Drought, surges, floods and tropical cyclones are likely to become more frequent in upcoming days. According to some sector specialist in climate change, *'signs of future changes have already begun tobecome apparent'*.

Climate change is identified as an average weather condition of an area characterized by its own internal dynamics and by changing in external factors that affect climate (Trewartha et al., 1980). United Nations Framework Convention on Climate Change (UNFCC) defines climate change as the change resulting from long term direct and indirect activities that induces changes in the compared time which are much more than the natural change (Daily Star, 2011). On the other hand, the weather is a set of all the phenomena occurring in a given atmosphere at a given time.

Today, climate change is a global challenge. It is a threat to social and economic development andsustainable existence for any country. Bangladesh is one of the most proactive developing countries of the world, facing the challenges of climate change. Our sustainable future depends, togreat extent on our ability to build a socio-economic environment where people have sustainable livelihoods, foodsecurity, health care services and green environment for them. Climate change andits adverse impact has become a block-wall against all of our efforts,how to overcome from ourpoverty situation to achievethe sustainable developed country. Now-a-days, climate change has become the core of discussion and attention amongst the governments, business leaders, development partners and general people.

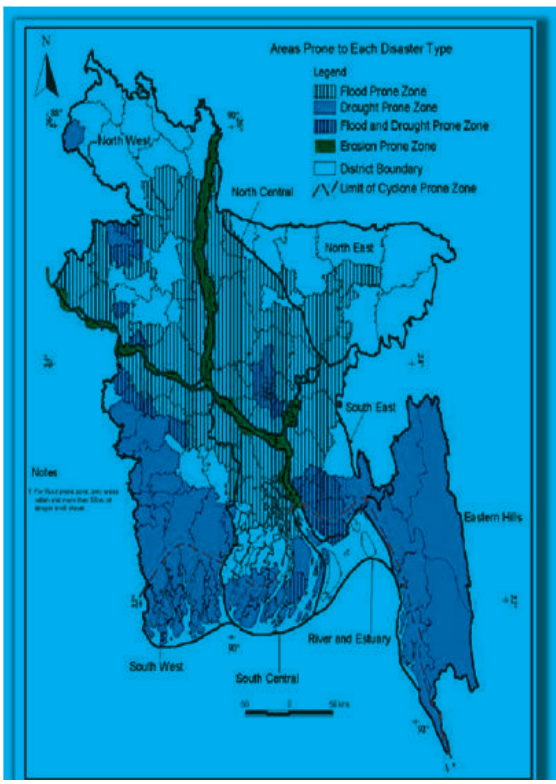
In terms of the impact of climate change few places in the world will experiencethe wide range of effects and the cruelty of changes that will occur in Bangladesh,which will include: Average weather temperatures rising; more extreme hot andcold spells; rainfall being less when it is most needed for agriculture, yet more inthe monsoon when it already causes floods; melting of glaciers, more powerful tornadosand cyclones; and sea level rise displacing communities, turning freshwater into salineand facilitating more powerful storm surges. The impact will be intensified by thefact that Bangladesh is both one of the most populated and one of the poorestnations on earth.

Climate change has affected the livelihoods of people in many foldsincluding scarcity of pure drinking water, malnutrition, extreme poverty, health problems, losses anddamage in crop cultivation, fisheries, poultry, vegetables garden etc. It has also created a state ofunemployment among the people of South-west communities in Bangladesh. As a result, the affected people are losingtheir means of livelihoods and are forced to take different alternative ways of livelihoods to cope with thehostile impact of climate change related disasters.The Livelihoods of the south-west regions of Bangladesh caused by the climate change is hampered a lot. Communities are taking different alternative livelihoods options to cope up with the climate changes.

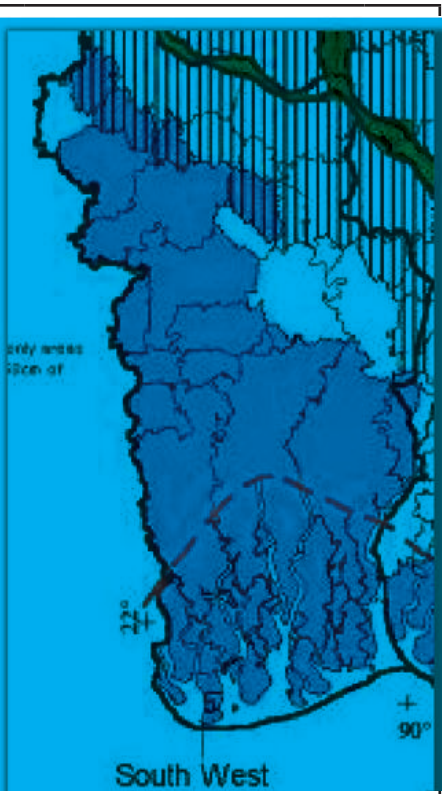
Our study is designed to find out the nature of alternative livelihoods options which can be

minimize individual‟s vulnerability to livelihoods context of climate change in Southwest region of Bangladesh. Therefore, the study is an effort to explore the climate change related damages and alternative livelihoods adaptation strategies of peoples living in southwest parts of Bangladesh. Thus, the present study has given an attention to the damages and alternative livelihoods adaptation strategies of southern regions peopledue to the climate change.

2. Map of Bangladesh & Southwest region



Picture: Showing map of Bangladesh.



Picture: Showing map of Southwest region.

3. Background

Bangladesh is well recognized to be one of the most climate vulnerable countries in the world. It experiences frequent natural calamities, infrastructural damages, assets and adversely impacts on lives and livelihoods, especially to the poor people of Bangladesh. Salinity has been increasing over period of time of southwest coastal region of Bangladesh and 0.223 million ha (26.7%) of total cultivated land is affected by salinity andseriouslytroubled the crop ecology. It is now threatened in livelihoods and food security condition of southwest region of Bangladesh.

Between 2000 and 2010, the southwestern coastal zone of Bangladeshexperienced two mega cyclones which caused enormous economic, infrastructural, agricultural, and human losses. Estimations andprojections shows that 97.1 percent of coastal areas and over 35 million people of coastal Bangladeshare vulnerable and exposed to multiple climate change hazards such as tropical cyclones, storm surges,coastal flooding, salinity intrusion associated with global warming and sea level rises.Generally, livelihoods practices in southwest parts includes fisheries, livestock rearing, shrimp farming, crab farming etc.

Communities of the south-west, have been found creative in adaptation to the climate change, are applying different mechanism and knowledges to be adaptive with the climate changes, such as Salt tolerant rice cultivation, planting high yielding fruit, crab fattening, poly culture, floating garden and cage culture etc. Due to the lack of insufficient capital, small landowner and other poor anddisadvantage groups have small capacity to adopt with the natural calamities. These strategies were mainly reactive and autonomous,mostly short-term strategic and were largely undertaken by individual or household level. South-west region is already identified and declared as extremely vulnerable areas in Bangladesh. If proper adaptation measures are not taken now, it would be a massacre.

4. Objective of the study

This study focuses on the damages (possible impact) due to climate change faced by southwestern region of Bangladesh. The specific objectives of the study are as follows:

i. To identify the possible or expected effects of climate change on livelihoods opportunities.
ii. To identify how people are adaptive to this change.
iii. To identify the external support required to increase their adaptation capacity.

5. Methodology of the study

This study was conducted in Shyamnagar, Dacope & KoyraUpazilas in Khulna and Satkhira Districts during the period of August ‟16 to September,, 16. I have collected primary data from10small fishermen and agricultural laborer, small farmers, non-farm worker i.e. small businessmen, van puller, baoali, maoali through interview and group discussion. The collected data was processed manually and analyzed in order to make the study more analytical, informative and useful to the users. Secondary data was collected from different publishedmaterials like the OXFAM‟s project reports ,The Center for Environmental and Geographic Information Services (CEGIS), Institute of Water Modelling (IWM), Institute of Water and Flood Management (IWFM/ BUET)publication,different relevant writings of some scholars and subject matter expert were also consulted.

6. Findings

1. The Possible Risk of Climate Change in Bangladesh: Impacts on Livelihoods:

Poor people living in the marginalized lands perusing nature dependent livelihoods are facing barriers and constraints earning wellbeing in the changing climate. The climate change isposing

challenge to the livelihoods in different ways. Livelihoods are either disrupted by the extreme weather events like cyclone, heavy downpour, floods, erosion, storm surges, dense fogs, sea turbulence or by slow onset disasters like salinization, dryness, ecosystemdegradation etc. (OXFAM, 2009).

On the other hand, achieving food security and reducing poverty in the Bangladesh has been a major challenge for both governments and development agencies due to vulnerability of Bangladesh agriculture to Climate change. Currently, much more people in the rural Bangladesh are considered food insecure due to recurrent different climatic events like flood, storm, river bank erosion, salinity intrusion, and drought. The poor and marginal farmers are becoming more vulnerable as a result of crop loss due to climate change. Shortage of food and price hike goes beyond the purchasing capacity of the poor people (Nasreen et. al., 2008).

People of southwestern belt in Bangladesh are continuously fighting with impact of climate change. Climate change is forcing people to take diversified occupation to maintain their livelihoods. Researchers pointed out that agriculture in Bangladesh "is already under pressure from increasing demands for food and the parallel problems of depletion of agricultural land and water resources from overuse and contamination. Climate variability and projected global climate change makes the issue particularly urgent (Selvaraju, 2006). It is also mentionable that extreme weather events not only limit livelihoods persuasion during the event but also has the potential to erode household assets, like destruction of house, trees and even it may kill people or injure them. The extreme events also destroy local resource base and thus limits livelihoods and wellbeing. The household assets including human health and motivation, houses, trees, other physical assets, livelihoods tools and equipment are destroyed in the extreme weather events and thus reducing capitals to pursue livelihoods and accordingly reducing resilience to extreme conditions (OXFAM, 2009).

2. How does climate change affect the southwest region?

2. a Flood and water logging

The continuous heavy rainfall during the rainy season causes flooding in the southwest region. This water cannot be drained because of rising sea levels, causes vast areas water logged. Each year more than 144,521 hectares (approx.) of land goes under water for 6-8 months. The problem of stagnant water is gradually approaching down river to the south as it follows the declining slopes of the river



basin, spreading fast and drowning more areas. It is estimated that each year ten-twelve thousand hectares of land is becoming permanently waterlogged and the rate is rapidly increasing.



Heavy monsoon rains have stranded hundreds of thousands. Seven hundred and thirty-eight villages in the region have been affected by the current floods. Over two hundred and forty-five thousands of the poorest and most vulnerable individuals in Bangladesh have been left homelessness and are facing a severe shortage of food. This is the tenth consecutive year that floods have hit in this region and the local communities believe the duration and depth of the floods is increasing cumulatively.

2.b Reduced access to safe drinking water

The floods and water logging often leave tube wells and latrines submerged and the rise in sea level creates more saline intrusion, making safe drinking water scarce and access to it difficult. In addition, there are few ground water aquifers in this region due to a natural shortage of heavy sand particles beneath the ground. Because of the excessive extraction of ground water through deep tube well irrigation, aquifers of this area are often contaminated by arsenic and further affected by a decrease of the water level under the ground. Arsenic has now become a major problem in this region. According to the Groundwater Arsenic Calamity survey conducted by *Uttaran,* a local NGO of Bangladesh, almost 79 percent of aquifers of the southwest region are contaminated by arsenic.

2.c Tropical cyclones and Storm Surges

A severe tropical cyclone hits Bangladesh, on an average, in every three years. These storm generally form in the months just before and after the monsoon and intensify as they move north over the warm waters of the Bay of Bengal. They are accompanied by high winds of over 150/ kph and can result in storm surges up to seven meters high, resulting in extensive damages to the houses and high loss of life to humans and livestock in coastal communities.

2.d Unstable livelihoods

Agriculture and shrimp farming are the major areas of employment and livelihoods in the southwest districts of Bangladesh. Around 85% people of in the region are employed in agriculture and landless farmers make up almost 66% of the population. The height of the sea level is increasing and consequently in many places the saline water from the Bay of Bengal is seeping into the land.

The land and environmental degradation caused by this create serious problems for agriculture. Water logging means that for long periods large areas of land cannot be used for agricultural production, significantly reducing employment opportunities in the region.

2.e Lack of food security

The southwest region of Bangladesh is a food deficit area, where net food production and diversity of food production have declined significantly over recent decades. Environmental degradation caused by irresponsible and flawed government structural development projects and the trend for increasing environmentally unfriendly shrimp production have reduced diversity and quantity of food production pushing vulnerable people further on the verge of extreme suffering and abject poverty.

7. Climate changes today

It is important to note that many of the impacts of climate change are experienced because changes in rainfall,sea level and temperature existing vulnerabilities. For example, upstream deforestation is a majorfactor behind recurrent flooding – but the impact of flooding becomes increasingly severe as rainfall increasesor extreme rainfall events become more frequent. Similar impacts have been felt across different sectors inBangladesh:

- Fisher communities in southwest regions of Bangladesh report that the availability of many local species has declined with the silting up of river beds, changes in temperature, and earlier flooding. Communities are coping by selling labour, migrating and borrowing money from different types of money lenders.

- Water shortages and poor water quality have been attributed to the effects of rapid urbanization and industrialization, aggravated by climate change

- The region has suffered a vast loss of mangroves during the last 50 years, mainly due to human activity, but also due to salt water intrusion in Bangladesh.

- Droughts and lower precipitation have also contributed to the loss of wetlands and the severe degradation of ecosystems

- The incidence of diarrheal diseases and other infectious diseases such as cholera, hepatitis, malaria and dengue fever increases during severe floods, rainfall and droughts in combination with poverty, poor access to safe water and poor sanitation. High temperatures and poor hygiene contribute to bacterial proliferation.

8. Future impacts and vulnerabilities

- The impacts of climate change are not restricted to sea-level rise. The most profound impacts will bein agriculture and food security, water, biodiversity changes, human health and human migration.

- The reductions in yields of staple crops such as rice and wheat are anticipated to be huge: by 2050rice yield could to drop by 8% and wheat yield by 32%.

9. Alternative activities taken by climate change affected people

The arrangements of alternative livelihoods and other activities differ according to nature of disastersinduced by climate change. The affected people are taking several strategies to cope withextreme climatic variability.Like food problem, they also suffer from health, housing problems etc. It is found from different researches that, when they are unable to solve the food crises or other problems, they borrow money from money lenders or from other sources. They also borrow money from neighbors or relatives and from *mohajan* with high interest rate if there are no other options for them. During a particular time, they are taking this mean but the means of borrowing money is not a last long solution. Though, they got relief from the government and NGOs and other organizations during the disaster periods.In disasters prone areas the communities are trying to solve their problems by selling mat and other handicrafts in the local markets. Around 21 per cent families are now making mats and other handicrafts to maintain their livelihoods.

Many NGOs are proving technical support to establish this alternative livelihoods options. They are providing jobs, input support and training to the interested working groups, creating market linkage between buyers and workers with a 100% buy-back guaranty. These buyers also providing the raw materials required for these handicrafts. Livestock rearing is also an important source of income in all over the country. Though, the affected people cannot rear poultry and layer due to lack of dry space, but have taken livestock rearing as a main income earning source. Many households are now rearing livestock to meet their basicneeds. Besides, livestock rearing and sweet water fish cultivation are also found as importantsources of income for households. During flood food crises is found as majorproblem. Women store food and fruits to solve the problem of food crises. Women faceproblems in cooking due to lack of water and fuel wood.

Agricultural lands are gradually losing its fertility. Agricultural crops and vegetablescannot grow due to salinity in water and extreme hot temperature. The southwestern people are now tryingto cultivate extreme weather suitable and salinity tolerant crops.

Crab fattening is increasingly accepted as livelihoods practice for many families in the south-westcoastal districts of Shatkhira, Bagerhat and Khulna. Such adaptation became favorable amongcoastal communities due to natural phenomenon like tidal inundation, water logging, saline water, available feed for crab, very profitable livelihoods option, low investment and high demand inDhaka market and abroad (Alam et al., 2013). A good number of farmer‟s culture and fatten mudcrab (Scylla scrrata) in *gher* of Chittagong region (Abdulla-Bin, 2013).

Manypeople are becoming members of socialsafety network programs supported byyouth club/citizens committee and alsoparticipating in innovative livelihoodsprograms initiated by government orother organizations. Besides thesealternative strategies, the affectedpeople are also trying to increase theirknowledge on climate change, its‟ aftereffects and associated risks. They

thinkthat the knowledge on climate changeand understanding of risks would help to learn more on crop cultivation patterns. Differentclubs and citizen committees have been formed by Government Organizations (GOs) and NGOs to make peopleknowledgeable on the effects of climate change become more resilient.

Water is also another acute problem in the study area. There are some Pond Sand Filters(PSF) installed by government and by NGOs to make water free from salinity. The local people havealso developed a system with the help of NGOs and GOs to store rain water as well as groundwater. Moreover, affected people are also harvesting rain water. During monsoon period theystore drinking water into water filters placing them on house roofs. They are also using surface water and extracting ground water for agricultural cultivation and other household tasks. However, they are becoming more resilient by adopting different types of strategies to strive with the climate change.

Fishermen culture mono-sex tilapia in cage system along the lower Meghna River in Chandpur and Rhamat Khali canal in Lakshimipur (Mustafa, 2013). Landless families also culture tilapia incages along the Aandhamanik River in Patuakhali(www.shibleehatcheryandframsltd.blogspot.co.uk) and this practice is also running well in Shatkhira. Landless Adivasi householders and farmers are using cages for culture of genetically modified tilapia (Oreochromisniloticus) fingerlings in ponds in KaharoleUpzila of Dinajpur, Rajshai, Nilphamari, Panchaghar, Rangpur, Thakurgaon districts (Gupta et al., 2012). Different livelihoodsapproach in agriculture and fish cultivation, tree plantation and duck rearingare practiced considering salinity risks and fresh water scarcity in coastal areas (Alam et al., 2013).

10. External support required to increase their adaptation capacity

To fight against climate change, external support is much needed for the inhabitants living here. People are interviewed to find out what are the external support is needed from their point of view. Some are answering that digging more pond may eradicate their fresh water problem, where as some are with the Pond sand filter (PSF) installation nearby their households may solve the pure drinking water problem they are facing since long.

People also expecting cash support for their instant support to re organize their life. According to them, this may help them to buy their necessary household items which generally not distributed as relief items or what they feel necessary for their family.

Technology is also pointed out by the respondents, according to them, which may help to fight against the climate change. They are especially focusing on diversified salt and flood tolerant crop varietieswhich may remain under the water for the longer period of time compared with other types.

Some shrimp fishermen told that, they are facing a lot of trouble during and after the water lodging

of shrimp diseases which make them capital loss. Most of the shrimps are washed out during the heavy water flows.

Food crisis requires no description. Generally, food is distributed to the affected people after the calamities are over by the GO and NGOs. But peoples are in need of foods during the trouble period. Shelter house can really help, where the affected people can have their temporary livings. But the number is not sufficient to accommodate all the affected people. Shelter houses also need to keep sufficient food storage capacity, medical facility, sanitation facility, accommodation should be sufficient and separated from male and female. There should also be trained professionals to handle the disaster situation more carefully.

11. Comments from climate change victim

"We are all under pressure, but there is really no point to worry. This is our only option, to move from place to place to place. We farm this land for as long as we can, and then the river washes it away. No matter how much we worry, the ending is always the same" Khalilullah is a char dweller (Envoinfo, 2010); "A woman‟s life is hard, and climate change is making it harder," says AregashAyele, an Ethiopian woman …; "Because of changing rainfall patterns, crop yields are suffering and the family does not have enough food for everybody. It has never been like this" (Global health, 2011)

12. Conclusion

Climate change adaptation and livelihoods in Southwest region of Bangladesh encompass all the sectors of the climate change, livelihoods and economy. A multi-dimensional approachis needed for the adaptation and implementation of livelihoods programs related to climatechange. Poverty, environmental degradation and sustainable livelihoods, all interact with complexClimate Change issues in Bangladesh. Public–private sector cooperation in the management ofenvironment and climate change is to be encouraged and concerted efforts are to be undertaken.

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Productivity Improvement of Local Fine Boro Rice Varieties Through Fertilizer Management in The Haor Areas

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Abstract

The experiment was conducted at the farmers' fields of two villages namely Bahadurpur and Noagaon at Sadar upazilla and Daskin Sunamganj, respectively under Dekhar *haor* of Sunamganj district, Bangldesh during the period from November, 2015 to May 2016 to find out the effect of variety and fertilizer on the growth, yield and yield contributing characters of local fine boro rice. Four varieties (Tapi boro, Begun bichi, Rata boro, Atobshail) and three fertilizer treatments (Farmers' practice, BARC recommendation guide based fertilizers and Soil test based fertilizers) were included in the experiment. The experiment was laid out in a two factor Randomized Complete Block Design (RCBD) with three disperse replications at farmers' field. Data were taken on plant height, number of tillers hill^{-1}, panicle length, grains panicle^{-1}, 1000-grain weight, grain and straw yields. Soil status of initial soil analyzed to know the status due to NPKSZn application under soil test value based fertilizer. Result revealed that plant height was significantly affected due to variety except 75 DAT, fertilizer application except at 15 DAT, 30 DAT, at harvest. The plant height was significantly affected due to variety and fertilizer application interactions except at 60 DAT and 75 DAT. Tillers hill^{-1} was significantly affected due to different varieties at 30 DAT, 60 DAT, harvest and was significantly varied due to different fertilizers application only at harvest and also significantly affected due to variety and fertilizer interaction at 30 DAT, 45 DAT and harvest. Effective tillers hill^{-1}, grains panicle^{-1}, sterile spikelets panicle^{-1}, panicle length and 1000 grains weight were significantly varied due to different varieties. The highest grain yield of 2.84 t ha^{-1} was produced by tapi boro. The highest straw yield of 4.90 t ha^{-1} was recorded at begun bichi. Though the grain yield was not statistically significant, the lowest yield was observed in the STB and the highest was in farmers' practice due to lodging in the higher fertilizer application.

Keywords: Productivity, Fine Rice, Fertilizer Management, *Haor*.

1. Introduction

There are many *haors* (basin like structure) where water remains either stagnant or in flash flooding condition during the months of late May to Octoer and mainly Boro rice is grown in the Rabi season. Geographically, most of the *haors* are situated in seven districts of the North-East Bangladesh. The districts are: Sunamganj, Kishoreganj, Netrokona, Sylhet, Habiganj, Maulavibazar and B. Baria. There are as many as 373 small or large *haors* in Bangladesh. The Hakaloki *haor*, Sunir *haor*, Dekhar *haor*, Tanguyar *haor*, Gungiajuri *haor*, Mukhar *haor*, Kaowadighir *haor* etc. are the prominent *haors* in Bangladesh. In terms of ecosystem, crop production practices, economic activities and over all livelihood of the farmers of *haor* areas are quite different from those of the other parts of the country. Early flood, hailstorm and drought are the main constraints to grow modern boro rice. The available statistics indicate that, the total cultivated area in those *haor*

districts is about 1.99 million hectares of which 0.85 million ha is under *haor*. Almost 80% of this area is covered by Boro rice, while only about 10% area is covered by T. Aman production (Huda, 2004). In the *haor* areas, hybrid rice is also grown (Das, 2004). This area is gradually increasing in different locations of *haor* districts (Husain, Hossain and Janaiah, 2001). So, there is a great possibility of growing fine rice as well as other rice and non-rice crops in the *haor* areas. Since the cropped land area is being continuously shrinking over time leading to serious challenge towards increasing productivity and thus to the mission of attaining self-sufficiency in food production for the land scarce economy of Bangladesh, it has indeed become imperative to exploit the crop production potentiality of the large *haor* areas; it is because those areas usually remain under-utilized with quite low cropping intensity (Jabber and Alam,1996).

Objectives

i. To investigate the suitability of local fine rice varieties in the *haor* areas.

ii. To find out the optimum fertilizer dose of local boro fine rice varieties in *haor* areas.

2. Methods and Materials

The experiment was conducted at the farmers' fields of two villages namely Bahadurpur and Noagaon at Sadar upazilla and Daskin Sunamganj, respectively under Dekhar *haor* of Sunamganj district during the period from November, 2015 to May 2016. Four varieties- V_1= Tapi boro, V_2= Begun bichi, V_3= Rata boro, V_4= Atobshail and three fertilizer treatments- $F_{1=}$ Farmers' practice (90-21-21 kg ha^{-1} of urea-TSP-MoP), F_2= BARC recommendation guide'12 based fertilizers (150-56-63.5-37.5-5.5 kg ha^{-1} of urea-TSP-MoP-$CaS0_4$- $ZnS0_4$) and F_3= Soil test based fertilizers (132.5-87.5-67-17.5-2 kg ha^{-1} of urea-TSP-MoP-$CaS0_4$-$ZnS0_4$) were included in the experiment. The initial soil property of the experimental site is presented in Table 1. Soil texture, pH, organic matter, available P and S, Zn and exchangeable K, were determined following standard methods (Black, 1965; Jackson, 1962; Walkley and Black, 1935; Olsen, Cole, Watanable and Dean, 1954 and Page, Miller and Keeney, 1982). Seeds were sown in seedbed on 28 November 2015. Seedlings were transplanted on 4-5 January 2016 at 25 cm × 15 cm spacing. Urea was applied as top dressing in three equal splits at 15, 30 and 45 days after transplanting. Having no measures was taken to control insect and pest. Two hand weeding were done for each plot; first weeding was done at 25 days after transplanting followed by second weeding after first weeding at 45 days. Standing water was maintained 2-3 cm in the field throughout the growing period. Five hills were tagged for counting the tillers and measuring the plant heights. Harvesting was done on 21-22 April 2016. Ten sample hills were collected from each plot to record the agronomic characters. The grain and straw yields were recorded from one square meter area. The data were analyzed following randomized complete block design and mean separation was done by DMRT (Gomez and Gomez, 1984).

3. Results and Discussion

Plant height was significantly varied due to different varieties except at 75 DAT (Table 2). Plant height was significantly varied due to application of different fertilizer doses at 45 DAT, 60 DAT, 75 DAT and 90 DAT. The highest plant height (146.82 cm) was found in tapi boro at harvest. The longest plant (168.40 cm) was produced for application of soil test based fertilizer at 90 DAT (Table 3). Plant height was also significantly varied due to different varieties and different fertilizer doses interaction except at 60 DAT and 75 DAT (Table 4). In table 5, the highest number of tillers hill^{-1} (15.46) was produced by begun bichi at harvest. Number of tillers hill^{-1} was varied due to application of different fertilizer doses at harvest. The highest number of tillers hill^{-1} (15.58) was produced due to soil test based fertilizer (Table 3.5). Number of tillers hill^{-1} was significantly varied due to interaction of different fertilizer doses and different varieties at 30 DAT, 45 DAT and at harvest (Table 7). The effective tillers hill^{-1} was significantly varied due to different varieties, application of different fertilizer doses and their interaction. The highest number of effective tillers hill^{-1} (14.64) was produced by begun bichi (Table 8). The highest number of effective tillers hill^{-1} (14.26) was produced due to soil test based fertilizer (Table 9). Grains panicle^{-1} was significantly varied due to different varieties and their interaction, but not significantly varied due to application of different fertilizer doses. The highest number of grains panicle^{-1} 114.03 was produced by atobshail. Sterile spikelets panicle^{-1} was significantly varied due to different varieties. The highest number of sterile spikelets panicle^{-1} (13.16) was produced by tapi boro. Panicle length was significantly varied due to different varieties and their interaction, but not significantly varied due to application of different fertilizer doses. The highest panicle length (23.69 cm) was produced by tapi boro. 1000 grains weight was significantly varied due to different varieties and their interaction, but not significantly varied due to application of different fertilizer doses. The highest1000 grains weight (20.66 g) was found in rata boro. Grain yield was not was significantly varied due to different varieties, application of different fertilizer doses and their interaction. The highest grain yield 2.84 t ha^{-1} was produced by tapi boro and the highest grain yield 2.85 t ha^{-1} was produced due to application of farmers' practice fertilizer dose. Straw yield was significantly varied due to different varieties, application of different fertilizer doses and their interaction. The highest straw yield 4.90 t ha^{-1} was produced by begun bichi and the highest straw yield 4.85 t ha^{-1} was produced due to application of soil test based fertilizer dose.

Constituents	Characteristics
Soil pH	4.9
Organic matter(%)	1.7
Total Nitrogen (%)	0.11
Exchangeable K (mili mol 100 g^{-1} soil)	0.15
Available P (µg $_g$-1 soil)	1.00
Available S (µg $_g$-1 soil)	27
Available Zn (µg g^{-1} soil)	0.3

Tab. 1: Chemical characteristics of the initial soil of the experimental site

Tab. 2: Effect of variety on the plant height of local boro fine rice at different DAT

Treatment	Plant height (cm)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	Harvest
Variety							
Tapi boro	36.20	49.64	84.42	114.73	141.63	160.13	146.82
Begun bichi	37.86	52.70	88.91	120.10	154.54	171.04	145.69
Rata boro	42.68	56.63	87.23	110.40	147.93	163.96	132.33
Atobshail	40.76	57.40	88.50	120.73	154.40	167.53	146.30
Level of significance	**	**	*	**	NS	**	**

** = Significant at 1 % level of provability;
* = Significant at 5 % level
of provability, NS=Non-
Significant,

Tab. 3: Effect of fertilizers on the plant height of local boro fine rice at different DAT

Treatment	Plant height (cm)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	Harvest
Fertilizer							
FP	39.67	53.70	85.67	114.12	142.17	161.45	141.42
FRG	39.04	54.05	87.60	116.32	149.05	167.15	143.81
STB	39.42	54.53	88.52	119.02	157.65	168.40	143.11
Level of significance	NS	NS	*	*	**	**	NS

** = Significant at 1 % level of provability; * = Significant at 5 % level of provability,
NS=Non- Significant,
FP= Farmers' practice (90-21-21 kg ha^{-1} of urea-TSP-MoP),

FRG= Fertilizer recommendation guide (150-56-63.5-37.5-5.5 kg ha^{-1} of urea-TSP-MoP-$CaS0_4$- $ZnS0_4$), STB= Soil test based (132.5-87.5-67-17.5-2 kg ha^{-1} of urea-TSP-MoP-$CaS0_4$-$ZnS0_4$).

Tab. 4: Effect of variety and fertilizers interaction on the plant height of local boro fine rice at different

DAT

Treatment	Plant height (cm)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	Harvest
Variety x Fertilizer							
V1F1	35.80	48.30	81.50	112.30	131.50	149.90	147.80
V_1F_2	36.60	50.00	87.16	114.40	147.90	168.00	141.26
V_1F_3	36.20	50.63	84.60	117.50	145.50	162.50	151.40
V_2F_1	36.80	51.40	89.80	119.30	144.92	172.00	145.11
V_2F_2	35.20	50.40	84.13	119.20	142.80	166.73	143.80

V_2F_3	41.60	56.31	92.80	121.80	175.90	174.40	148.16
V_3F_1	44.20	56.00	84.10	107.10	141.60	161.50	127.60
V_3F_2	41.66	57.00	86.50	107.80	149.00	164.90	139.60
V_3F_3	42.20	56.90	91.10	116.30	153.20	165.50	129.80
V_4F_1	41.90	59.10	87.30	117.80	150.66	162.40	145.20
V_4F_2	42.70	58.80	92.60	123.90	156.53	169.00	150.60
V_4F_3	37.70	54.30	85.60	120.50	156.00	171.20	143.10
Level of significance	**	*	**	NS	NS	**	*

** = Significant at 1 % level of provability; * = Significant at 5 % level of provability,
NS=Non- Significant,
V_1= Tapi boro,
V_2= Begun bichi,
V_3= Rata boro,
V_4= Atobshail,
F_1= Farmers' practice,
F_2= Fertilizer recommendation guide,
F_3= Soil test based.

Tab. 5: Effect of variety on the tiller production of local boro fine rice at different DAT

Treatment	Tillers hill^{-1} (no.)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	Harvest
Variety							
Tapi boro	4.30	6.61	13.56	15.60	16.90	16.44	15.10
Begun bichi	4.20	7.60	14.43	16.25	18.13	17.80	15.46
Rata boro	4.46	8.46	14.71	16.26	17.65	16.63	15.37
Atobshail	4.34	7.76	13.56	15.12	16.97	21.54	13.56

Level of significance	NS	**	NS	**	NS	NS	**

** = Significant at 1 % level of provability;
* = Significant at 5 % level of provability, NS=Non-Significant, V_1= Tapi boro,

Tab. 6: Effect of fertilizers on the tiller production of local boro fine rice at different DAT

Treatment	Tillers hill^{-1} (no.)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	Harvest
Fertilizer							
FP	4.17	7.35	14.08	16.08	17.66	17.12	14.57
FRG	4.45	7.92	13.60	15.22	16.75	16.32	14.47
STB	4.35	7.55	14.52	16.12	17.83	17.05	15.58
Level of significance	NS	NS	NS	NS	NS	NS	*

** = Significant at 1 % level of provability; * = Significant at 5 % level of provability, NS=Non- Significant, FP= Farmers' practice, FRG= Fertilizer recommendation guide, F_3= Soil test based.

Tab. 7: Effect of variety and fertilizers interaction on the tiller production of local boro fine rice at different DAT

Treatment	Tillers hill^{-1} (no.)						
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	Harvest
Variety x Fertilizer							
V1F1	4.20	6.60	13.80	16.20	17.40	16.90	16.00
V_1F_2	4.40	7.50	11.90	14.60	16.70	16.23	14.60
V_1F_3	4.30	5.73	15.00	16.00	16.60	16.20	14.70

V_2F_1	4.30	7.70	15.70	17.50	19.00	18.20	15.80
V_2F_2	4.00	6.10	14.20	15.66	16.60	17.40	14.80
V_2F_3	4.30	9.00	13.40	15.60	18.80	17.80	15.80
V_3F_1	3.70	7.00	13.73	15.80	16.56	15.43	14.10
V_3F_2	4.80	9.10	14.00	15.40	17.30	16.33	14.80
V_3F_3	4.90	9.30	16.40	17.60	19.10	18.13	17.23
V_4F_1	4.50	8.10	13.10	14.83	17.70	17.10	12.40
V_4F_2	4.60	9.00	14.30	15.23	16.40	15.33	13.70
V_4F_3	3.92	6.20	13.30	15.30	16.83	16.10	14.60
Level of significance	NS	**	**	NS	NS	NS	**

** = Significant at 1 % level of provability; = Significant at 5 % evel of provability, NS=Non- Significant,

* V_1= Tapi boro, V_2= Begun bichi, V_3= Rata boro, V_4= Atobshail, F_1= Farmers' practice F_2= Fertilizer recommendation guide, F_3= Soil test based.

Tab. 8: Effect of variety on the yield and yield contributing characters of local boro fine rice

Treatment	Effective tillers hill^{-1}(no.)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	Panicle length (cm)	1000 Grains Weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Variety							
Tapi boro	13.80	112.50	13.16	23.69	15.18	2.84	4.78
Begun bichi	14.64	101.16	10.25	21.66	19.30	2.70	4.90
Rata boro	13.53	100.43	11.83	21.98	20.66	2.53	4.50
Atobshail	12.67	114.03	10.60	22.18	20.17	2.81	4.49

Level of significance	**	*	*	**	**	NS	*

** = Significant at 1 % level of provability; * = Significant at 5 % level of provability, NS=Non- Significant,

Tab. 9: Effect of fertilizers on the yield and yield contributing characters of local boro fine rice

Treatment	Effective tillers hill^{-1}(no.)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	Panicle length (cm)	1000 Grains Weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Fertilizer							
FP	13.22	102.97	11.25	22.71	18.06	2.85	4.70
FRG	13.50	107.10	11.45	22.32	18.62	2.62	4.45
STB	14.26	111.02	11.69	22.11	19.80	2.70	4.85
Level of significance	*	NS	NS	NS	NS	NS	*

** = Significant at 1 % level of provability; * = Significant at 5 % level of provability, NS=Non- Significant, FP= Farmers' practice FRG= Fertilizer recommendation guide, STB= Soil test based.

Tab. 10: Effect of variety and fertilizers interaction on the yield and yield contributing characters of local boro fine rice

Treatment	Effective tillers hill^{-1}(no.)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	Panicle length (cm)	1000 Grains Weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Variety x Fertilizer							
V_1F_1	15.00	95.20	12.30	24.10	13.93	2.90	4.61
V_1F_2	13.00	117.80	14.40	23.45	13.70	2.72	4.80
V1F3	13.40	124.50	12.80	23.53	17.93	2.91	4.93
V2F1	14.60	100.40	9.60	21.30	17.20	2.43	5.05
V2F2	14.10	101.10	10.60	20.60	19.40	2.79	4.50

V_2F_3	15.23	102.00	10.56	23.10	21.30	2.90	5.16
V_3F_1	12.30	94.40	13.60	22.63	20.70	2.68	4.27
V_3F_2	13.60	98.80	10.70	22.33	20.00	2.48	4.15
V3F3	14.70	108.10	11.20	21.00	21.30	2.43	5.10
V4F1	11.00	121.90	9.5	22.83	20.43	3.39	4.90
V_4F_2	13.30	110.70	10.10	22.90	21.40	2.50	4.35
V4F3	13.73	109.50	12.20	20.83	18.70	2.55	4.23
Level of significance	**	*	NS	*	*	NS	*

** = Significant at 1 % level of provability;

* = Significant at 5 % level of provability, NS=Non- Significant,

* V_1= Tapi boro, V_2= Begun bichi, V_3= Rata boro, V_4= Atobshail, F_1= Farmers' practice, F_2= Fertilizer recommendation guide, F_3= Soil test based.

4. Conclusion

The result of the experiment revealed that the highest grain yield of 2.84 t ha^{-1} was produced by tapi boro. The highest straw yield of 4.90 t ha^{-1} was recorded at begun bichi. Though the grain yield was not statistically significant, the lowest yield was observed in the STB and the highest was in farmers' practice due to lodging in the higher fertilizer application.

5. Acknowledgement

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Land Use Change Due to Urbanization and its Impact on Local Food Security: Case of Madhyapur Thimi Municipality

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Abstract

Urbanization, occupational shift of farmers and massive immigrationare taking place in Kathmandu Valley.Therefore, a study was undertaken to assess the cumulative impacts of these processes led land use change on local food securityin Madhyapur Thimi Municipality. Decadal maps of varied peroids were analyzed using GIS to assess the land use changes within the municipality along with various participatory tools of inquiry.The municipality has undergone rapid change in land during the period of 1980-2014. Much of the agricultural land has been converted into built up areas to cater the increasing population. The total area of agricultural lands is even less than what was analysed from the decadal maps because of land selling to the immigrants who neither cultivates nor allows other to cultivate and no usefulness of land for agricultural purpose due to water logging, leeward side of the buildings, children's interference in crop damaging, land devoid of any cultivations. Local farmers were forced to change their occupation to non-agricultural because of less return from agriculture, changes in lifestyle, haphazard urbanization and non-availability of local manpower for agriculture work. Limited land coupled with occupation shift in the municipality has resulted in the lesser agricultural production. However, the people were found to be less vulnerable to food security due to increased in the income level of farmers and municipal dwellers as a result of shift to more remunerative non-farm activities. In absence of implementation of the land use map developed by the municipality, the haphazard urbanization is prevailing in the study area.

Keywords: *Food security, MadhyaprThimi, Land use, Occupational shift, Urbanization.*

1. Introduction

Urbanization in Kathmandu Valley is not only resulting to rapid conversion of agricultural lands into buildup area, this is also associated to degradation of natural resources, increased pollution of land, air and water sources.Urbanization is undergoing at rapid rates and also haphazardly in the developing countries (Nsian-Gyabaah, 2003)which will contain 4.4 billion people of the world urban population by the year 2025. Agricultural land has increased by 86 % during the period of 1975 to 1985 (MoA, 1998). It is also reported that the forest area declined by 23 % during the period of 1979 to 1994 and is estimated that forest cover in terai and hill areas decreased at an annual rate of 1.3 % and 2.3 % respectively during the period (DFRS, 1999).Similarly, the urban area of the Kathmandu Valley increased from 26 % in 1978 to 46.2 % in 1996 and the built-up area also increased by 13% during the same period (Pradhan, 2000). While on one hand demand for food has increased, the local production of food which traditionally maintained the food supply system in the valley has decreased. The food security in the valley has started becoming a serious concern as the food demand is not being met by local food supply. Reduction of farmlands, loss of

productivity of land and change in the life style of the people are all responsible for decline in local production and supply of food. With Robert Dongol growing urbanization pattern, there are some challenges associated with it such as climate change, food insecurity, competition for water and land, inadequate sanitation, air and water pollution, environmental degradation (Nsian-Gyabaah, 2003).Since most of the land within core urban areas of Kathmandu have been used up in building houses and other infrastructures, and the land prices have escalated beyond the affordability of many, this has set the trend for new settlers moving out of the core areas to look for housing plots in the peripheries. This has increased the pressure on agricultural land in the fringe areas. The large number of land developers and entrepreneurs are involved in converting the agricultural lands into housing plots. Land developers bought large tracts of agricultural land in the peri-urban area, and divided them into different sizes and shapes for building construction. Farmers could not compete with these developers to buy the agricultural land. Therefore, the price of land in the Valley has been rising sharply from 1970 onwards (Pradhan & Parera, 2005).The consequence of increased conversion of agricultural land to non-farm uses has been continually decreasing share of local production and supply of food in the total annual food demand in Kathmandu. The deficit is met from imports from the peripheral rural areas, from other parts of the country and also imports from other countries. The disruption in transportation even for few days results into rise in food price. On the other hand the local food production has declined sharply to meet the current demand. Accompanying the agricultural land use changes has also been shift in the occupation of the people, who have been shifting in large numbers from agricultural to non-farm livelihoods. These changes in Kathmandu have been responsible for undermining sustainability of food system and intensifying vulnerability in food supply system. The food system in the valley now depends on external systems and conditions and disruptions in them even for shorter time has begun stressing the food supply system in the valley.

2. Study Area

MadhyapurThimi is one of the rapidly expanding urban areas in adjacent to Kathmandu Metropolitan City. Since it has good development of urban services like road access, water supply, health and educational infrastructures, this has resulted into rapid growth in population in the recent years. One of the concerns relates to rapid conversion of agricultural land in the study area is to meet the human settlement needs.MadhyapurThimi Municipality, which was once known for its diversified farming and secured food production, is fast converting into an area that depends on imports of food to meet the food demand.

2.1 Population Growth and Ward-wise Distribution of Madhyapur-Thimi Municipality

Table 1 illustrates the urban population growth rate in Madhyapur-Thimi municipality, ranking it 7th most populous urban center in the Kathmandu Valley. The population growth was caused by both the natural population growth and in-migration. The change in the demographic profile of the municipal dwellers in the recent times is indicative that in-migration is the major cause of the population growth in the municipality.

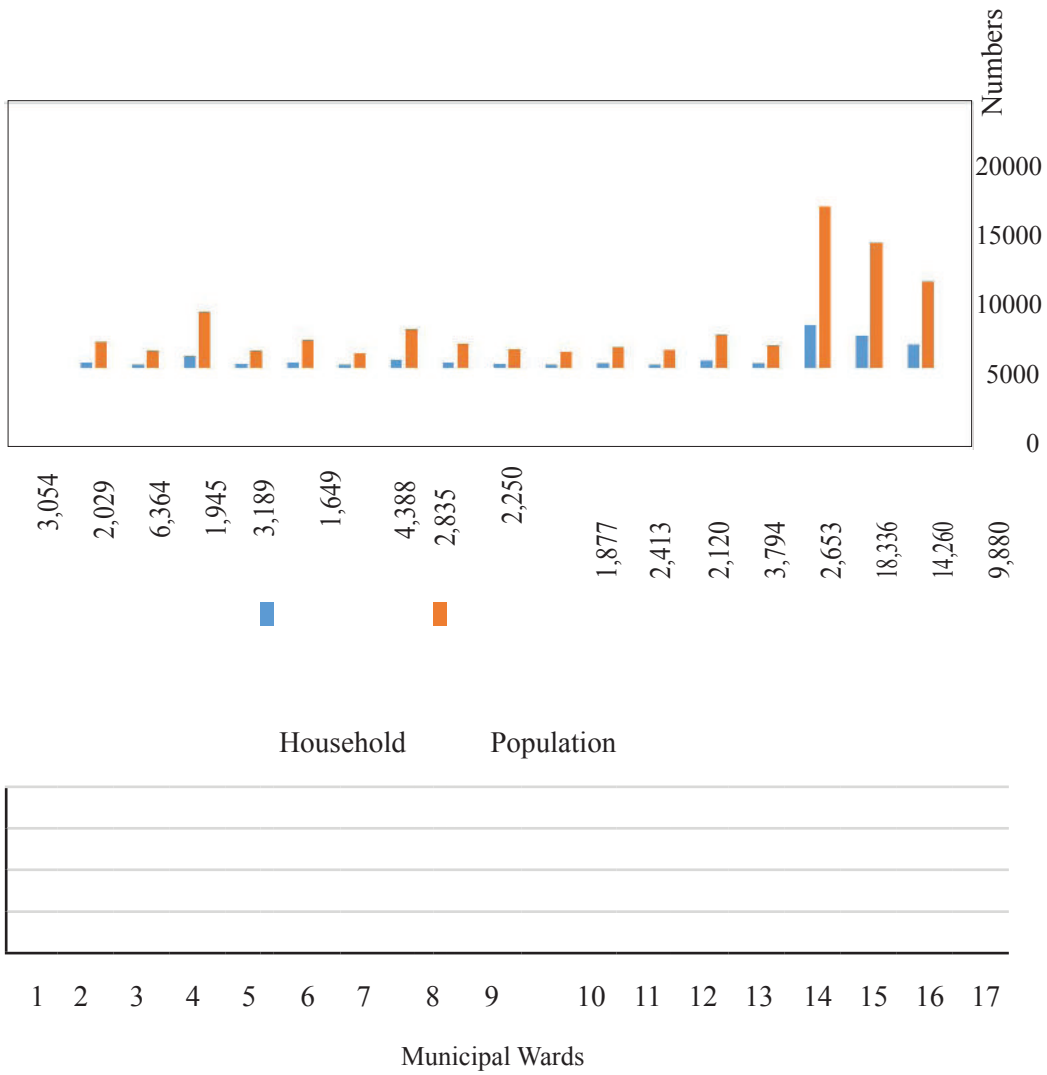
Table 1:Population Growth Rate of municipalities within Kathmandu Valley

SN	Year / Municipality	Population			Pop Growth Rate_	
		1991	2001	2011	2001	2011
1	Karyavinayak	21,273*	25,239*	62,172	1.72%	9.43%
2	Tokha	18,390*	42,308*	99,032	8.69%	8.88%
3	Budhanilkantha	22,862*	46,745*	107,918	7.41%	8.73%
4	Tarkeswar	23,511*	34,143*	76,651	3.80%	8.42%
5	Kageswari Manohara	25,848*	32,077*	60,237	2.18%	6.50%
6	Gokarneswar	24,846*	57,698*	107,351	8.79%	6.41%
7	Madhyapur Thimi	31,917*	47,751	83,036	4.11%	5.69%
8	Kirtipur	30,404*	40,835	65,602	2.99%	4.85%
9	Ananata Lingeswar	19,301*	24,987*	37,989	2.62%	4.28%
10	Chandragiri	37,275*	55,032*	81,419	3.97%	3.99%
11	Kathmandu	421,258	671,846	975,453	4.78%	3.80%
12	Lalitpur	115,865	162,991	220,802	3.47%	3.08%
13	Suryavinayak	19,932*	30,757*	40,501	4.43%	2.79%
14	Nagarjun	20,138*	33,055*	42,995	5.08%	2.66%
15	Changunarayan	22,282*	26,500*	32,522	1.75%	2.07%
16	Bajrabarahi	25,778*	32,051*	39,203	2.20%	2.03%
17	Godavari	17,547*	24,762*	28,793	3.50%	1.52%
18	Bhaktapur	61,405	72,543	81,748	1.68%	1.20%
19	Dakshinkali	20,840*	22,697*	24,297	0.86%	0.68%
20	Mahalaxmi	29,626*	35,802*	38,036	1.91%	0.61%
21	Shankharapur	22,735*	24,260*	25,338	0.65%	0.44%
22	Nagarkot	18,541*	21,965*	22,908	1.71%	0.42%

(CBS, 1991, 2001 and 2011)

*Population summation of respective merged VDCsfor the formation of municipality.

Fig.1 indicates distribution of 83,036 population residing 20,302 households (CBS, 2011) in nine different wards of the municipality. Wards 15, 16 and 17 are the most populous and are witnessing high urban and population growth, which were pockets of intensive agriculture until recently. In less populous wards the number of households is less than 500 and possess predominantly rural characteristics.



(Source: CBS, 2011)

Fig.1: Ward wise population distributions – 2011

3. Methodology

3.1 Research Approach and Design

The research followed a systematic process, involving different stages from preparation and conceptualization of research problem, setting of the research questions to proposal development, undertaking of field inquiries, analysis and writing.Landuse maps of different time scale acquired from aerial and satellite images were analyzed to obtain the pattern of land use changes, both magnitude and direction of land use change at different periods of time. A set of questionnaire was used for the household interview. Also a set of checklist was used for key informant interviews. Qualitative data was collected through field observation and interaction with local people. In addition focus group discussion was carried out to validate and substantiate the information provided by the people on direction and pattern of land use changes. Quantitative data collected through household interviews was processed using the SPSS software to produce the final report.

3.2 Data Collection and Analysis

3.2.1 Map Analysis

Land use maps were prepared based on acquired aerial and satellite images of four time slices-1980s, 1990s, 2000s and 2014s which were geo-referenced in the national coordinate system. The land use maps of 1980s, 1990s, 2000s and 2014s were prepared through interpretation of 1979 and 1992 aerial maps, 2000 and 2014 satellite images, respectively. Thus prepared land use maps were overlaid in ArcGIS 9.1 to analyze the decadal changes of land use.

3.1.3 Field Observation and Interaction

Once the map analysis was done, field observation was carried out to assess the actual scenario to validate thus obtained land use data from map interpretation and analysis. The observation and interaction with the people involved in the Manhohara belt, Hanumante belt, Kamerotar Land pooling area and Sintitar land pooling area; where the huge conversion of agricultual lands to urban land use was taking place at an accelerated rate. Newly created build-up areas in wards 15, 16 and 17 were also visited to validate the information obtained from map interpretation and analysis. The visit was basically to collect the first hand information from the local people and observation of existing land use though physical observation of the area on the ground.

3.1.4 Household Questionnaire Survey

Household questionnaire survey was conducted with a set of semi-structured questionnaire to assess the impacts of urbanization and occupational shift on agricultural system and practices and food production at the local level. A total of 120 households were purposivelyselected. The purpose of the survey was to select those farmers who have been engaged in farming. The respondents who have left the farming profession were also included in the study.

3.1.5 Key Informant Interview

Interview with key informants such aswith local leaders, influential personnel, members of Community Based Organizations (CBOs), elderly citizens, members of the social and religious groups, local farmers, officials from the municipal and the government offices Robert Dongol was carried out with a set of checklist. Snowball sampling method was followed for the selection of 12 key informants to assess the past and existing conditions of the study area along with the impacts of urbanization on the food security.

3.1.6 Focus Group Discussion

Out of the four, two Focus Group Discussion (FGDs) were conducted with the farmers and two with the people who had shifted their occupation to non-farm activities. The discussions was mainly concentrated around the urbanization pattern people had observed in the study area and their impacts on agricultural system and practices and consequently on the local level food production. The information provided by the people were triangulated with the information obtained from the map analysis, key informants' interviews and those obtained from the map analysis.

4. Results and Discussion

4.1 Decadal Land use Change

The following fig.2 (a, b, c and d) shows the decadal changes in land use in the study area. These maps clearly illustrate that the land use has witnessed significant changes over the past last two decades. There was no significant changes in land use pattern till 1990, the major area of the municipality till that decade was dedicated to agriculture. The land use map of 2000s presents significant growth in the human settlement and build-up spaces. If the magnitude of land use change is observed, the major changes occurred during 1990-2000 and much of these changes were relating to conversion of agricultural land into other land uses. The conversion of agriculture lands into residential, industrial and transportation corridors are attributable to urbanization and to create space for growing population.

Fig. 2: Land Use Change Map of 1980-2014 (a: Land Use Map of 1980s, b: Land Use Map of 1990s, c: Land Use Map of 2000s and d: Land Use Map of 2014s)

The analysis revealed that the agricultural land decreased by as much as 30% during this period, and much of the conversion relates to changes of the agricultural land into residential areas (26.7%), industrial (1.8%) and transportation (0.5%) as shown in Table 2.

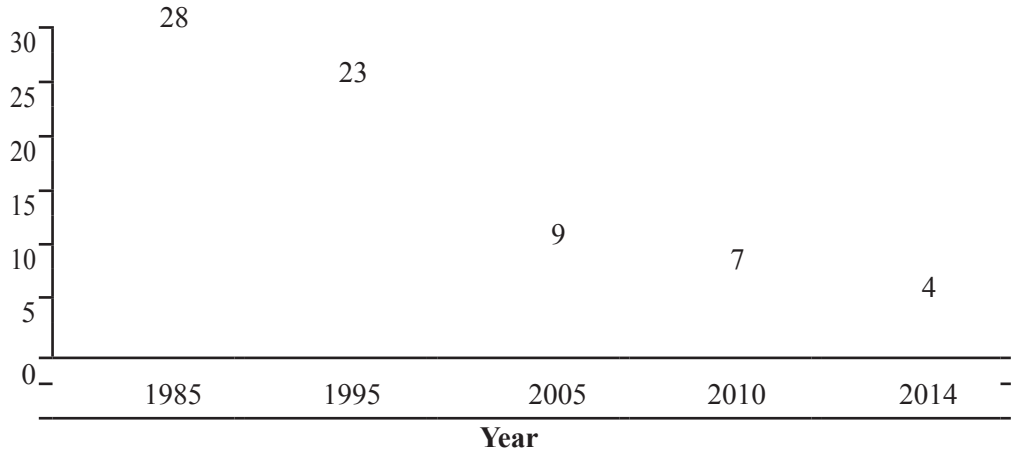
Table 2 Magnitude of Land Use Change (1980-2014)

Land use	Available Land Area (ha)				Change (ha)			Total Change in Ha	Total change in %
	1980	1990	2000	2014	1980-1990	1990-2000	2000-2014	1980-2014	1980-2014
Agricultural	925	925	830	593	0	-94	-237	-332	-30.0%
Residential	49	49	137	344	0	88	207	295	26.7%
Institutional	55	55	58	57	0	3	-1	2	0.2%
Transportation	17	17	21	23	0	5	1	6	0.5%
Industrial	0	0	8	20	0	8	12	20	1.8%
Water body	18	18	7	8	0	-11	1	-10	-0.9%
Forest	33	33	33	32	0	0	-2	-2	-0.2%
Recreational / Open Space	2	2	2	2	0	0	0	0	0.0%
Others	6	6	8	26	0	2	18	20	1.8%

(Source: Map Analysis, 2015)

Table 2 shows that agricultural land decreased by 94 hectares in the period of 1990-2000 and by 237 hectares in the period of 2000-2014. However at the same time the residential area has been increased by 88 hectares and 207 hectares although institutional area, industrial area, forest area, water body and open spaces did not see much change in this period. This clearly indicates that much of the conversion of the agricultural land was essentially to create land for the growth in the residential area. The total agriculture land has been reduced by 237 ha during the period of 2000 to 2014 which has been estimated 17 ha per year over this period. If this unregulated trend continues, there will be no land left for agriculture in MadhyapurThimi municipality in next 35 years.

Questionnaire survey also reveals that agricultural land owned by farmers has decreased significantly over past three decades (fig.3). The average agricultural land owned by family was 1.44 ha in 1985 which reduced to 1.18 ha in 1995 and reduced to merely 0.46 ha in 2005. In 2014 the size of agricultural landholding has reduced down to 0.20 ha (1 ha equals to 20 ropani).



(Source: Field survey, 2014)

Fig.3: Agricultural Land owned by Household Respondents in Last 30 Years

These findings also resonate to the records provided by the municipality and Central Bureau of Statistics (CBS) data. MadhyapurThimi municipality has higher population growth rate, at. 5.69 % per annum against national population growth rate of 1.35 % (CBS, 2011). These creates significant demand of plots to create space for housing for the new settlers. As per the information provided by the municipality, several land pooling projects have been implemented by GoN and private sector within municipality resulting massive land use change, involving conversion of agricultural land to create space for housing plots. The fig.4 shows the spatial distribution of proposed and on-going land pooling projects within the municipality. The total area under land pooling at present is 255 ha.

Municipal records also reveal that on an average 500 new houses are built annually and the size of the land area used in the construction of a house ranges from 95 sq. m. to 191 sq. m. Considering average land area required for the construction a single to be 150 sq. m., total land area required for building these houses would come to 7.5 ha every year and this would accumulate to 75 ha over a decade.

This is the area required only for dwellings. According to land pooling practices in Kathmandu valley, around 30 % land of total land pooling area is required for road and open spaces. This clarifies that the land used for dwellings is only 70 % percentage of total area. This would project the need of land required for the growth in the residential area to be 9.75 ha per annum or 97.5 ha over a decade. Again this estimate is on the lower side because the estimate of 500 houses built per annum in Madhypur-Thimi municipality is based on the records of limited period, which cannot be considered constant over a decade.

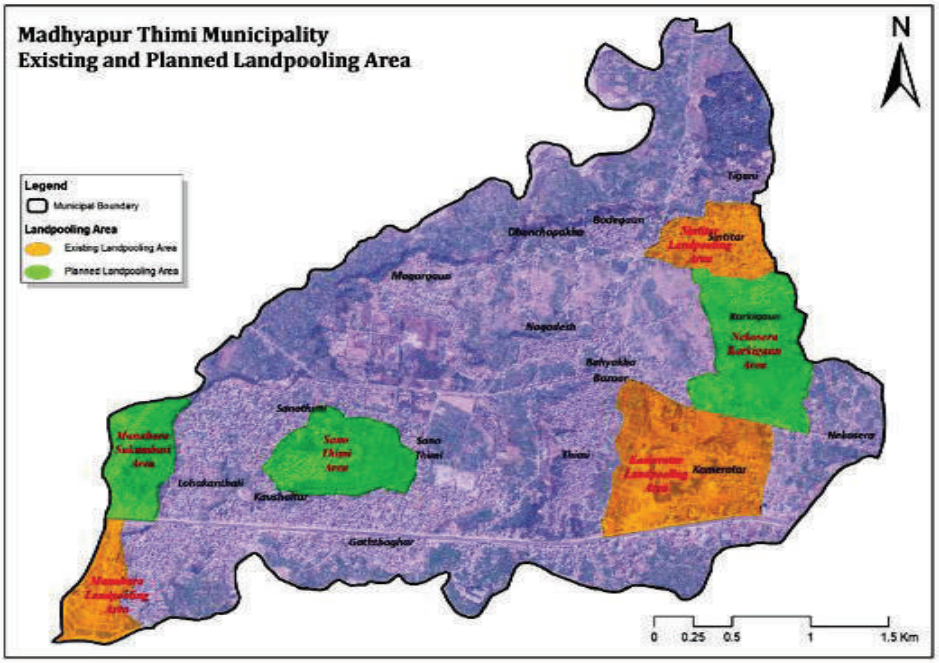


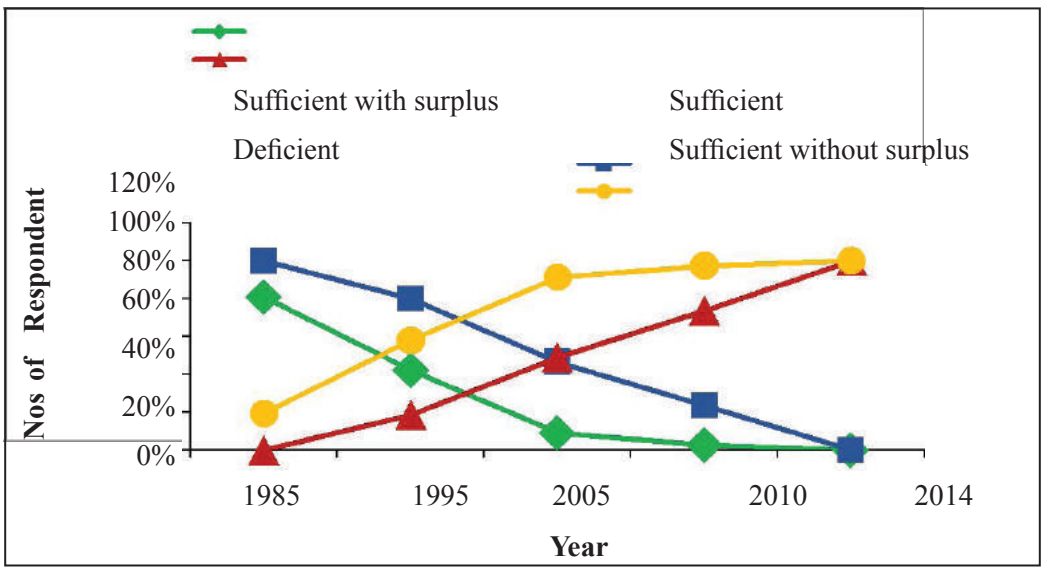
Fig.4: Spatial Distribution of Proposed and on-going Land Pooling Projects of MadhyapurThimi Municipality

4.2 Regulations of Land use

Mandhyapur-Thimi municipality developed a "Development Guidelines and Building Regulations 2001" with the aim of regulating urban development. A principal tenet of the guideline was enforcement of land use to preserve agricultural land within the municipality boundary for secured food production at the local level. Most of non-urban, fertile agricultural land has been placed in this reserve, while existing urban areas had beendesignated as development zones. The regulations mandate the municipality to prevent the development of any kind of urban infrastructure or utilities within the reserve zones. Only the construction of temporary structures is allowed. The intent behind this regulation was to curb the loss of prime farmland to unplanned urban development (Field Visit, 2015). However the implementation of this land use regulation has not taken place effectively resulting uncontrolled construction of residential buildings and plotting of land for housing development has been going on even in the areas designated as protected agricultural zone in the municipality (Field visit, 2015). It was found that most of the areas at the Hanumante River belt, Gatthaghar, Lokanthali, Kaushaltar and Sintitar area have been used up for residential purposes whereas the Manohara belt, Kamerotar area were developed as residential area under land pooling projects implemented jointly by Kathmandu Valley Town Development Committee (KVTDC) and Municipality (Field Visit, 2015). As informed by municipal officer, Hadole area is also under the plan of developing as residential area through land pooling. In addition number of private plotting of land by private companies and land developers were also observed during the field visit. Thus major land use change in the study area is the conversion of agricultural areas into residential areas and the other land use changes in the area is shown in table 2. Thus the land use map prepared by municipality is not being implemented by municipality itself and is almost useless.

4.3 Local Food Security

The responses of the households on sufficiency of local production obtained from households survey is provided in fig.5. Out of the total respondents included in the household survey, all of them were producing enough food and nearly 81 % respondents had surplus food production until 1985. However in due course of time, the gap between food production and requirement increased. By 1995, 80 % of respondents revealed food sufficiency from local production while 42 % respondents were producing surplus and 18% respondents faced deficiency of food. This situation further worsened and by 2000 only 24% had sufficient food from own production while only 3% respondents had surplus food production and 74 % respondents had food deficiency. Currently there are no respondents having sufficient food. Obviously the trend of food deficiency is expanding. In past three decades the state of food sufficiency got completely reversed. The study area where most people had sufficient production to meet the food needs until three decades ago, majority of them have now become food deficit and they are increasingly dependent on purchase of food commodities from the market to meet the food needs.



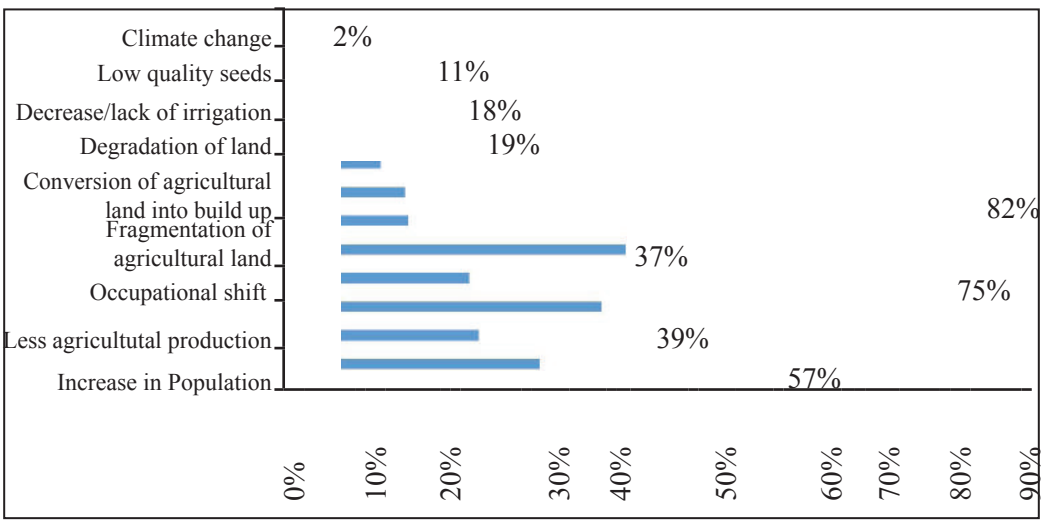
(Source: Field survey, 2014)

Fig.5: Food Sufficiency to meet Annual Food Requirement

No doubt the reduction of agricultural land impacts adversely on local food production. In the FGDs, the participant revealed that most of household had sufficient land for cultivation and there was no need of buying food until 1990. In fact, people were ashamed of buying rice and wheat from the market to meet the household's food needs until this time. The situation has almost completely changed now and almost all the households were left with no option but to buy food to meet the deficiency of food from own production. According to the year book 2011/12 published by Ministry of Agricultural Development (MoAD) and information received from the local farmers,

the average productivity of cereal and cash crops in the study area was 5,936 kg/ha for paddy, 3,511 kg/ha for wheat and 18,689 kg/ha for vegetables (MoAD, 2012). However, the productivity as expressed and analyzed came to be 2000 kg for paddy, 1400 kg/ha for wheat (Field visit, 2015).

The respondents facing deficiency of food were asked to reveal the reasons for decline in the food production. The percentage responses of the food deficit households are presented in fig.6.Respondents were allowed to mark more than one cause of food deficiency. Land use change, and conversion of agricultural land into non-agricultural uses, occupational shift and increase in population have been the key causes of decline in the food production and consequently the local food security in the study area. In addition fragmentation of agricultural land and less agricultural productivity was also mostly expressed as the reason of food deficiency. Thus, the perception summarizes that the land use change impacts food security adversely. In past two decades as much as 334 ha agricultural land has gone out of cultivation due to conversion of agricultural land into other uses. The census data revealed that the population in the municipality has almost doubled that than in 2001 (CBS, 2011). The increasing trend of population growth flags rapid land use change in the municipality in the future.



(Source: Field Survey, 2014)

Fig.6: Causes of Food Deficiency attributed by Respondents

Though there is significant reduction in local food production, availability of food commodities in the local market has improved with the increase in the road access and expansion in the transportation facility. In addition the affordability of people has also increased which has reduced their dependence on own production to meet the household level food needs. However certain groups of people still have difficulties in food access due to their low purchasing capacity and the existing social disparity. At present, almost all of the households in the municipality depend on

imported food from outside and there is poor political and economic governance, uncontrolled and unusual price escalation, as a result those belonging to low income groups are highly vulnerable to declining food security.

4.4Fragmentation of Land

Land fragmentation is another major issue in the study area. As per the existing social, legal and traditional system, the offspring whether male or unmarried female above the age of 35 are entitled to the parental land. The system has become one of the key reasons of land fragmentation in the study area. Besides land plotting is newly introduced trend of land fragmentation. At the present time, land fragmentation is occurring in the study area at a massive scale, much of which is resulting due to rapid conversion of agricultural land into residential uses.Land fragmentation has further affected the productivity as farmers are not able to adopt modern agriculture technologies and equipment. It is because the sizes of lands are getting smaller and scattered, thus, it is not practically possible to promote the use of mechanical equipment for crop cultivation. In addition, irrigating the small piece of land is costlier as compared to large piece of land. During the questionnaire survey, 37% of respondents mentioned that land fragmentation is reason of food deficiency (fig.6). In fact farming efficiency has declined due to the land fragmentation.

During field visit it was found that most of the remaining pieces of land around the residential areas were out of cultivation and were left fallow. In the interaction with land owners and local residents, two major facts were revealed by them as the reasons for keeping the land fallow: i) the land pieces were sold to new buyers who were not using the land for crop cultivation by himself nor allowing the others or the old land owner to continue cultivating the land, and ii) the land becomes no more useful for agricultural purpose because of water logging, shadow of building and the damages caused to the crops by the people. Map analysis also shows these lands as agricultural lands but in reality no agricultural activities were found to be continuing in most of these agricultural lands. This signifies that the percentage of agricultural lands as shown in the fig. 2 and table 1,are not agricultural land. In addition there are substantial amount of land within land pooling area which has been counted as the agricultural land while in fact these are land completely out of crop cultivation and productive agricultural activities.

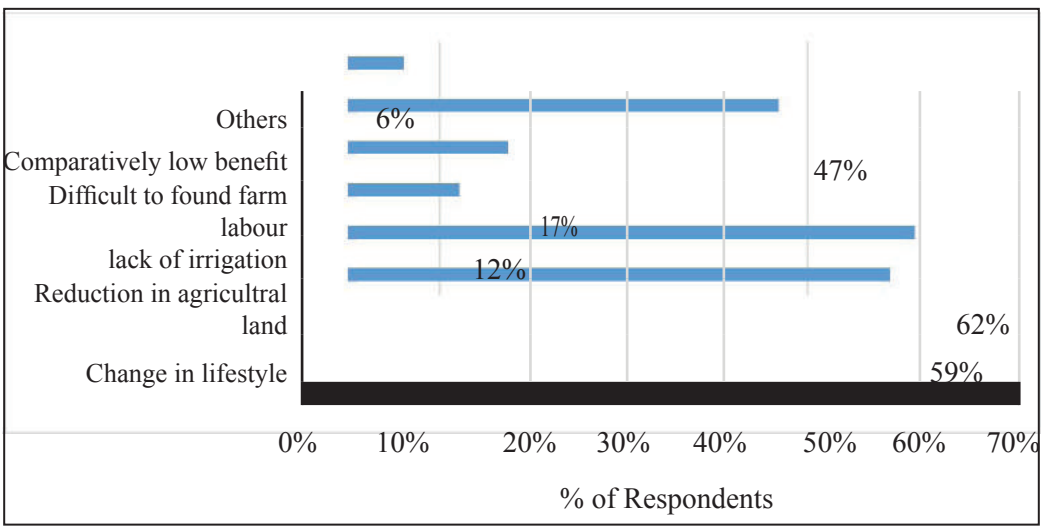
4.5 Occupational Shift and its Causes

MadhyapurThimi municipality (MTM) was known for its agricultural production which was major source of income of the local municipal residents until a decade back. Paddy, wheat and vegetables were the key crops grown in the municipality. Especially the vegetable produced within the municipality contributed significantly to meet the demand of green vegetables in the markets in Kathmandu. However the issue is alarming that the agricultural land owned by farmer is decreasing.It was found that 80% respondents have farming as a major occupation previously which was drastically changed during the period of 1990-2014. Owing to change in lifestyle and lower economic benefit people were forced to change their occupation. The survey reveals that only 31% people are still continuing farming as major occupation whereas 46% and 24% respondents identified business and other activities as their major occupation. The reason behind this situation expressed during the FGD and KII are i) cash crop is the only option for the good

income in the present context, and ii) there are no more agricultural land remaining as well. Crops like paddy, wheat require big plot of land and it also needs large numbers of worker which is difficult to mobilize at present. On the other hand cash cropping provides more financial benefit from small pieces of land than other cropping.

The reason behind the occupation shift in the study area is also interesting part of the study. One of the respondents justified his occupational shift due to index return in the agriculture occupation. In addition life style has been changed and his daughter forced him to change the occupation. In the fig.7, change in lifestyle, reduction in agriculture land, lowering return from farming were identified as the major causes for them to shift from farming to non-farm occupation.

Food security is not only the concern due to decrease in agricultural land but also due the change in life style. Municipal profile reports that on an average 48 % people do not use their land for agriculture purpose and the percentage is even high in wards 15 and 17 where people not using their land for crop cultivation counts to as high as 78 %. The reason behind the not using of their land is they were attracted towards the other new occupation like shop keeping, business, services and running their own cottage industries. Fig.6 show that 75 % respondents claim occupational shift as major cause of food deficiency. 86 % respondent expressed that their income status has increased compared to the income they were making out of agriculture in the past.From the FGD and interaction with local people it was ascertained that occupational shift hampered extensively the local food production though the income status of the people has improved with time.



(Source: Field Survey, 2015)

Fig.7: Causes of occupational shift

5. Conclusions

Land use change in MadhyapurThimi municipality is taking place rapidly undermining the local level food security. The agriculture land is being converted into urban areas to shelter the massive population growth. Though the study area was well known for the agricultural production, the local production was found to have declined considerably during the period 1990-2014 due to reduction of farmland at substantial amount. Currently almost all the households are facing food deficiency. However the affordability of food was found to have increased thus offsetting vulnerability of food deficiency at the household level. Massive scale land fragmentation due to existing social, legal and traditional system and land plotting has adversely affected the local food production. Local food production was found extensively hampered due to occupational shift of farmers, but the people were not found to be vulnerable to food security as the income level of farmers and municipal dwellers has increased, due to shift to more remunerative non-farm activities. If the trend continues, there will be no more land left for crop production within the municipality in next 35 years.There is still good amount of agricultural land remaining which can be preserved through effective execution of existing land use map and effective land use regulation by activating the Development Guidelines and Building Regulations 2001 developed by the municipality.

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Indigenous Knowledge Management in Sustainable Aquaculture-A Study in Southwest Region of Bangladesh

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Abstract

The study assessed on use of local wisdom and indigenous knowledge in sustainable aquaculture. Group & individual interview, focused group discussions and field observations were made in conducting this study with special emphasis on qualitative data. Three unions from three Upazilas from three districts were selected for the study. Indigenous knowledge and farmer‟s wisdom substantially increased aquaculture production and ensures sustainability of the practices over the decades. The peoples in the study area are usually used their local wisdom in three folds starting from preparation of gher, production and management. Few practices are well recognized in aquaculture including means of soil and water P^H balancing system, oxygen circulation, homemade feed & diseases management. They were used tamarind solution to make soil and water P^H neutral. Farmers can easily identify male and female fry using their local wisdom. Water quality is essentially important for aquaculture. They usually conduct water test by using simple practice. The gher laborers were affected by skin diseases in the study areas. The farmers managed it by using their local wisdom. They were used kerosene oil over their body including hands and legs before entering in to the gher. Locally available implements were used in gher. The practices got nearer by indigenous knowledge to magnetize shrimp, and farmers have found viable ways to understand its principles and application in aquaculture. In the world, collective efforts between farmers and scientists have contributed to the quick advancement of aquaculture in many countries.

Key words: sustainable aquaculture; indigenous knowledge; tamarind; wisdom

1. Introduction

Bangladesh is the top ten shrimp-producing countries in the world. Bangladesh is mainly exported shrimp to the European countries, the United States, Japan and some Middle Eastern countries. The exports achieve to be the country‟s second-largest foreign exchange earner after ready-made garments, earning around U.S. $500 million yearly. The growth rate of aquaculture is more than 9% (DOF, 2010) in Bangladesh. Many factors including habitat loss as a result of agricultural intensification, urbanization, environmental degradation, pollution, and overexploitation of resources is responsible for capture fisheries. Indigenous or traditional knowledge" is defined as "the knowledge stored in people‟s memories and activities, and expressed in the form of stories, songs, proverbs, dances, myths, folklore, cultural values, beliefs, rituals, community laws, local language and taxonomy, agricultural practices, equipment materials, plant species and animal breeds" (Grenier, 1998). Indigenous knowledge systems are cumulative, dynamic, continually influenced by internal creativity and experimentation, as well as by contact with external systems (Flavier, De Jesus and Mavfarro, 1995). Many countries have been followed traditional knowledge for generations to generations to come up constraints Gupta, 1990,). Indigenous knowledge contributes

to the increased efficiency, effectiveness and sustainability of the development process (Rao, 2006). Regarding aquaculture, indigenous traditional knowledge and wisdom of farmers all over the world has resulted in the development of sustainable and environmentally friendly aquaculture practices; some of the most relevant ones are presented in the following sections. In India, where traditional aquaculture was mainly practiced along the coastline by fisheries communities, the most ancient traditional fish farming systems include the bheri system in West Bengal, the gheri system in Orissa, the pokkali system in Kerala, and the khar lands or gazani (coastal khar lands) in Karnataka. Regarding fish farmer innovations and their linkage with small-scale aquaculture, we note that Asia has been the center of aquaculture production for decades,and currently, more than 90 percent of the total aquaculture production (in quantity) comes from Asian countries, China being the biggest producer in the world (FAO 2010). The acadja practice of West Africa was first described by Welcomme (1972) based on the practices followed in western African countries to capture fish through trapping by establishing periphyton-based food production systems. The most interesting aspect is that these periphyton-based practices have been developed independently in various geographical locations all over the world, following a very similar strategy. For example, similar methods are also prevalent in Asia and Latin America, such as the katha fishery in Bangladesh, the samarah fishery in Cambodia and shrimp and crayfish production in Mexico. The idea of using periphyton techniques in ponds, based on traditional farmers‟ Practices, has attracted a wide research interest (Azim et al., 2005). Bangladesh, the country is recognized for its accomplishments with regard to efficient and diversified aquaculture production. In southwestern areas of Bangladesh, floods and droughts have been common problems, and farmers have been looking for alternative crops to rice, in order to improve and secure their income. A few years ago, a very innovative and progressive farmer of this region started to integrate rice production with giant river prawn, Macrobrachium rosenbergii , culture in unproductive paddy fields. The major bottleneck nowadays is the availability of freshwater prawn seed, which is mostly collected from the wild; availability of seed spurred the rapid development of prawn farming, and there are several thousand farmers engaged in collecting post larvae from natural waters. Few hatcheries have been established to cater to the seed requirement, and it is reported that wild-collected seed continue to be preferred by farmers (Nandeesha, 2003; Ahmed et al., 2007; Ahmed and Troell, 2010). Post larvae are stocked in the canal and are nursed to the juvenile stage in pockets created in the canal by erecting small dykes. With the onset of monsoon, when the water fills the canal, post larvae are spread to the entire area. In the past, farmers cultivated only one crop of paddy during the dry season, under the assumption that cultivation of paddy during the monsoon would negatively impact the growth of prawn; even in places where there was a potential, farmers did not cultivate a second crop. At present, with the educational programs provided to farmers, more than one crop of paddy is grown by good number of farmers. The stocked prawns are fed largely with snail meat, in view of its ready availability in the area and its easy acceptance by prawns. Prawns are reared for a period of six months, and are harvested based on the average size and sold to processors. Periphytons are the tiny organisms that live on the surfaces of objects under water. Periphyton-based practices have developed independently and are used to catch fish in open waters in various parts of the world. In West Africa the practice is known as *Acadja*, in Bangladesh it is called *Katha*, and in Cambodia *Samarah*. The present research project, which was conducted in Mymensingh, Bangladesh, hasapplied this technique to the farming of fish in ponds.

1.1 *Objective*

The main objective of this study was to elicit farmer‟s local wisdoms (indigenous knowledge) in aquaculture. The other associate objectives were to i) know the practices related to aquaculture;

ii) know the use of indigenous knowledge in aquaculture; and iii) assess the sustainability of the knowledge in practices;

1.3 *Methodology*

The study was conducted in three southern district including Khulna, Bagerhat and Sathkhira. Three Upazilas (One Upazila from each district) were selected for this study. The aim of the study was to explore indigenous knowledge in aquaculture. Various instruments including individual interview, group interview, focus group discussion and observation were administered for the study. Secondary data were collected through literature review from journals, books and other printed materials for this study. Mostly group consents were considered for the validation of information in respect to local or indigenous knowledge.

2. Results: Indigenous Knowledge in Aquaculture

This type of knowledge basically is inherent from senior to junior, family member to family member over generations. The relevant indigenous knowledge related to aquaculture was discussed in following sections.

2.1 *Balancing P^H*

P^H value is indicated the water & soil quality stating the acidic condition, neutral or alkaline. Strong acidic condition is not good for aquaculture or shrimp (Prawn) production. Farmers are able to recognize strong acidic condition of water with following indicators: i) finger nail become blackish color after staying in the gher water for long time; ii) Skin become yellowish;

iii) clothes demonstrated reddish color; iv) starts mortality of shrimp; v) shrimp growth stunted; vi) death of periphyton; and vii) shrimp become blue.
In this case, they used their indigenous knowledge or wisdom to make the water neutral (less acidic) by using tamarind solution (I kg tamarind diluted with water for a *bigha*), then the solution applied to the gher water. In managing this problem, addition of tamarind solution and test it repeatedly for necessary adjustment.

2.2 *Oxygen circulation*

Optimal oxygen supply is essentially important for shrimp farming. This needs to be ensured through regular air circulation in to *gher* water. Shrimp also take breath with the help of oxygen. Farmers can identify the status of oxygen with following indications (especially incase lack of oxygen): i) shrimp move toward edge of the *gher*; and ii) shrimp float towards top strata of water and starts breathe accordingly. In resolving the problem, farmers used small piece of bamboo

and hand for beating on water accordingly. This usually increased access of air with oxygen in to water. Eventually farmers walk across water to make more air flow by making wave.

2.3 *Fish feed management*

Management of feed is very much important in aquaculture. Natural feed is the main sources for aquaculture. The growth of the shrimp depends on availability of the feeds in the gher. Farmers could understand the food crisis with following indicators: if the vein of the shrimp represented blackish colour, meant food is available in the *gher*. On the other hand, the whitish vein indicated scarcity of food. In this case, farmers provide homemade extra fish feed to the *gher* (*suji,* yoke of egg and rice bran etc.)

2.4 *Fry and post larvae*

In shrimp farming quality fry is essentially important for nursing. Poor quality fry in the gher lead to poor yield and less profitability of aqua farming. Indeed, female fry gives low yield as per farmer‟s wisdom. The male fry gives higher yield. As indicated by farmers, the fry from natural sources (river) are belongs to male group. The cost of fry from natural sources is much higher than hatchery fry. The fry from hatchery mostly belongs to female group and cost is low as compared to fry from natural sources.

2.5 *Identification of male/female fry*

It is crucial question to all, how to identify male and female shrimp. As mentioned earlier, there is an impact of male female fry on shrimp production in aquaculture. Mix farming of male and female fry in aquaculture impacted negatively on yield (production). Farmers can identify the male female by observing following criteria: i) male posses teeth but female don‟t posses any teeth; ii) male owned large antenna and female owned small antenna; and iii) male in larger in size and female is small in size. If mix (male and female) fry retains in the *gher*, the farmers sell the female fry at the stage of early harvesting and released male fry to the *gher* immediate after harvesting for further nursing or rearing.

2.6 *Disease management in aquaculture*

Unexpected diseases may cause severe problems in aquaculture. Mostly the diseases are caused by virus. It is quite impossible to control viral disease; though possible to manage under curative measures. It should be managed by adopting preventive measures. The symptoms and indication of diseases is likely i) red and blue spot on the shrimp; ii) showing mouth pox; iii) fall of antenna; and iv) initially crab affected by virus then followed by white fish, *golda* and lastly *bagda.* There is no prescription on such diseases. The ultimate result is failure in aquaculture forthe season.

2.7 *Quality of fry*

Disease free healthy fry is essentially important for aquaculture. Most of the farmers were used healthy and tardy fry for *gher* rearing. The farmer usually releases the fry into the water filled container. If the fry run quickly into water then this one selected for rearing. The slow runner

mostly discarded from *gher* rearing. The tardy one gives high growth performance with maximum yield.

2.8 *Gher water quality*

Before releasing fry in the gher, it is important to test water quality. Saline water is more important for (bagda) shrimp farming. Farmer usually connects their gher with saline water through channeling canal or irrigated water from saline sources. After entering saline water, the farmers go for simple test by making mini pocket within the gher using country net. The usually keeps few fry into the mini pocket *gher* and allow them for 2-3days for their survival test. If they find remarkable mortality of fry then there is urgent need to take measure for water quality. Farmers usually used lime or tamarind to make water more saline. If there is no morality of fry then they released total fry in the *gher*.

2.9 *Management of atur ghor (nursing pond)*

Traditionally called aturghor (Nursing pond) is crucial for aquaculture. It is constructed within the *gher* by making partition with mud dyke and surrounded by net for extra safety. Initially fry was collected from suppliers and rear in the *atur ghor* for 7 to 15 days for their quick growth. Occasionally supplementary feed were supplied to the fry. Based on growth performance of the fry, it was allowed to the main *gher* through connecting channel from *atur ghor* to the main *gher*.

2.10 *Measuring growth performance of shrimp*

Growth of the shrimp has great influence on farm profitability in aquaculture. Stunted growth leads the *gher* vulnerable and caused economic loss. Farmers usually monitored the growth performance of shrimp using their indigenous knowledge. They monitored growth of fry as well as shrimp. The standard size of the fry is one *kor* (one finger node) in the initial stage. After nurturing in the *atur ghor*, the fry become 1.5 *ko*r to 2 *kor* (2 finger node) then they allow it in the main *gher* for shrimp farming.

2.11 *Preparation of periphyton*

Substrate of periphyton is created with Bamboo stems, jute sticks, the remains of sugarcane stalks and tree branches. This practice is increased fish production without increasing the level of nutrient inputs (Wahab et al.,2001; Azim et al., 2001; Keshavanath and Wahab, 2001; Verdegem and Azim, 2001). This traditional practice originated from indigenous knowledge to attract fish, and fish farmers have found easy and feasible ways to understand its principle and apply it in aquaculture. Results clearly demonstrate the scope to increase fish and shrimp production by using the periphyton system and some of the progressive farmers are reaping the benefits through further on farm innovations. The preparation of good peripyton was tested by collecting mud/substrate from the bottom of the *gher*. If the substrate gives bad smell then; the substrate or mud is not well prepared for the system. The farmers usually removed this type mud from the gher. Women usually performed the tasks.

2.12 *Shrimp harvesting*

Usually farmer starts harvest of shrimp after 3 months of releasing fry. *Gon* is important factor in harvesting of shrimp. During Full moon and dark night of the moon is appropriate time of harvesting. During full moon, the 11th to 14 is the best time of shrimp harvesting. On the other hand, during dark night, 25th to 28 th of the moon month is the best time of shrimp harvesting. In this time most of the shrimp enter into the trap (Locally known as *Aton*); and maximum harvest is possible due to gon. In every month 8-9 days are the most suitable days for maximum harvest of shrimp.

2.13 *Harvesting Implements*

Locally available and low cost implements were used in shrimp harvesting. Different types of trap (locally known as *charo* or *aton*) and nets were used in shrimp harvesting. Additionally they used *bamboo baskets, polo, kholoi* in the field of aquaculture. These were made by the community using natural resources and locally available low cost inputs.

2.14 *Salinity in aquaculture*

As per farmer‟s traditional knowledge or wisdom, the natural growth of golda indicated less salinity of water. Even more rainfall was seen in the *golda* growing areas especially in Bagerhat rather than Khulna and Satkhira. On the other hand, *Bagda*(shrimp) growing areas reflected more saline area followed by less rainfall.

2.15 *Pre measures for health issues*

Long terms work in the gher may create skin disease to the farmers. Farmers in this aspect, use kerosene, used Mobil oil and mustard oil both in hand and legs even in a whole body. This measure protects them from skin diseases. After staying long time in the gher water, they just washed their body with slightly boiled (locally known as *kusum kusum gorom pani*) water. Such type of pre caution keep them free from skin diseases and make them comfort with the situation.

3. Discussion

Farmers‟ traditional knowledge has little or no cost; they are readily available, socially acceptable, economically feasible and sustainable; they involve minimum risk to rural farmers and producers, and they are widely believed to conserve resources (Goswami, Mondal and Dana, 2006). The use of farmers‟ innovation, skills and wisdom promotes active community involvement because people depend more on each other; farmers‟ innovations encourage transparency and accountability (Ratnakar and Reddy, 1991). The world where the necessary natural resources for aquaculture progress exist but access to modern technologies is inadequate, thanks to the improve potentials of farmers and through adaptation processes, farmers‟ innovations have been evolved and adapted to increase aquaculture production during the past decade (Edwards, 2009d, Nandeesha, 2007). Periphyton has a positive effect on water quality; the health of the system and the shrimps in it. Research indicates that the presence of micro-organisms on substrates improves the health of the culture stocks, resulting in less mortality or losses, and overall healthier shrimps. The practice

originated from indigenous knowledge regarding devices to attract fish. The farmers therefore find it easy to understand and apply the technology. What the project did was to test whether the traditional technique could be used under pond conditions to increase production. The indigenous may improve the socio-economic status of rural people by generating income and employment. If the practice is applied on a large scale, the need for scientific backstops. Nevertheless, this technology shows great promise since the increase in fish production is so large. Lewis *et al* (1996) endow with possibly the most widespread research to date on the state of aquaculture in Bangladesh. They conclude that not all IK is useful any more than all outsider knowledge could be said to be harmful. There are gaps in all knowledge systems and local sets of practices. Such approaches pose a threat in terms of the potential loss of the local system of fish culture, with practices and technologies that have evolved over many generations. These types of skills, informed by local knowledge, and based upon sets of local beliefs and practices, are somewhat undervalued and often dismissed by outsiders.

4. Conclusion

The practice originated from indigenous knowledge to attract shrimp, and farmers have found easy and feasible ways to understand its principle and apply it in aquaculture. In many countries of Combined efforts between farmers and scientists have contributed to the rapid development of aquaculture in countries where resources were available and market demand for aquaculture products was present.

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Effectiveness of Iron Fortified Cereals for Securing Adequate Iron Intake of Preschool Children

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Abstract

Objective: To determine the effectiveness of iron fortified cereals for preschool children inthe context of socioeconomic condition, cost-effectiveness & biological variation of grains.

Method: reviewing randomized control trials & also meta-analysis using electronic databases,reference list screening & hand searches.

Result: Risk of bias is unclear due to underreporting, but high quality studies lead to similarresults. 23 studies were included as relevant based on inclusion & exclusion criteria.

Conclusion: Efficacious to reduce anemia & maintain adequate hemoglobin level andeffective when biological variability, socioeconomic condition, cost effectiveness are considered.

Keywords: Micronutrient Security, Sustainable Development

1. Introduction

The UN set 17 Sustainable Development Goals to be achieved within 2030. Second Goal relates to end hunger through sustainable agriculture & improved nutritional status. To improve sustainable nutrition status, more emphasize should be given on micronutrients which are essential not only for physical development, but also for their mental & cognitive development. Iron Deficiency Anemia (IDA) can be termed as a public health problem among U-5 children in many low & middle-income countries such as Bangladesh. In order to overcome, the introduction of fortified cereals through sustainable agriculture among communities is evident. Effectiveness has been defined by Last JM (as cited in Davidsson 2004) as the extent to which a specific intervention, procedure, regimen, or service, when deployed in thefield, does what it is intended to do for a defined population. It is different from efficacy in a fact that effectiveness is affected by compliance, which is influenced by behavioral factors that are in turn affected by access tothe intervention, supply, cost, and other factors. Compliance candiffer between population groups and settings. Even if an intervention has beendemonstrated to be efficacious, its effectiveness canbe limited if compliance is low. For example, Supplementation with iron and provision of iron and other micronutrients through home fortification with MNPs can be relatively quickly implemented and are likely to rapidly improve iron stores, which aresuggested as efficacious, but are medical short-term solutions. Medium-term strategies, such as food fortification and bio-fortification, may take some years to plan pilot, and implement. Long-term solutions involve genuine changes in food security and diet and may require fundamental socio-economic and dietary change as well as commercial approaches but of course, an ultimate aim of development, in other words, can be termed effective. Once medium- and long-term interventions are established, short-term solutions could be withdrawn. Iron interventions will only benefit iron-deficient individuals, and thus should be targeted at populations in which iron

deficiency makes a major contribution to anemia (Pasricha et.al. 2013 p-2615). The effectiveness of iron supplementation or food fortificationprograms is considerably more difficult to evaluate than their efficacy. Trial effectiveness, which is efficacy adjusted for compliance in research trial, must be differentiated from programeffectiveness, because compliance in the study population can beinfluenced during the evaluation (Ekstrom et.al. 2002).

According to WHO: Global database on anemia, 2008, over 1.6 billion people worldwide suffer from anemia andapproximately 80 % of the burden of this disorder is borneby individuals living in south Asia and Africa (Shet et. al. 2015). Generally, a lack of iron in the neonatal period and early childhood is considered as a key to thedevelopment of disturbances in cognitive development, behavioral & motor skills. Although iron supplementation improves cognitive functions regardless of the hemoglobin levels (Lobera 2014), The use of supplements must be based on well-established indications, avoiding their use as a routine as It remains controversial about success depending on the timing of the therapy (i.e. critical periods). Therefore, a sustainable way to maintain adequate hemoglobin level through a long term intervention is required. As most of the poor people in sub-Saharan and south Asian region mainly depend on cereal for dietary intake, iron fortificationof rice in school meal has been shown to be an effective strategy to alleviate iron deficiency among school children (Moretti et. al. 2006). This review attempts toexplore the effectiveness of iron fortified cereals for adequate iron status among preschool children by critically examining the findings of observational and clinical study as well as their mechanisms of actions.

2. Objective

To determine the effectiveness of iron fortified cereals for preschool children in the context of socioeconomic condition, cost-effectiveness & biological variation of grains

3. Methods & materials

3.1. Sources of Data:

Several databases, including PubMed, Google scholar, ResearchGate were searched for literatures and extracted data till 15th March 2016. Some of high impact international journals (American Journal of Clinical Nutrition, The Journal of Nutrition, Pediatrics) were included and related articles that have high citation number were selected for the review.

3.2. Search strategy:

For appropriate searching, key words such as fortified cereals, childhood, infancy, iron intake iron deficiency were used. Additional searching was carried out on references includedin the papers, published reviews, and via hand searching. Theliterature search was mainly but not exclusively based on the last 10 years. Some former articles considered as pioneers andor especially relevant were also included.

3.3 Study selection:

Studies meeting the following criteria were included-

1. Control trial, randomized control trial, cohort and comparative studies published providing sufficient information of children aged 6-59 months & their iron status

2. Type of fortified cereals in different regions was considered eligible for review.

3. Some literatures which were published beyond time range of 6-59 months were also studied for exploring the background information and possible mechanism of actions.

The exclusion criteria were-

1. Populations with nonspecific ID-related problems.

2. Participants with special conditions/pathologies other than ID (i.e. malaria, worm infestation)

3. Full text/abstract not available.

Previous studies (reviews and meta-analysis) were considered as another source of articles, provided that they fitted the inclusion criteria. An analysis was carried out about references included in the papers as well as via hand searching.

4. Results

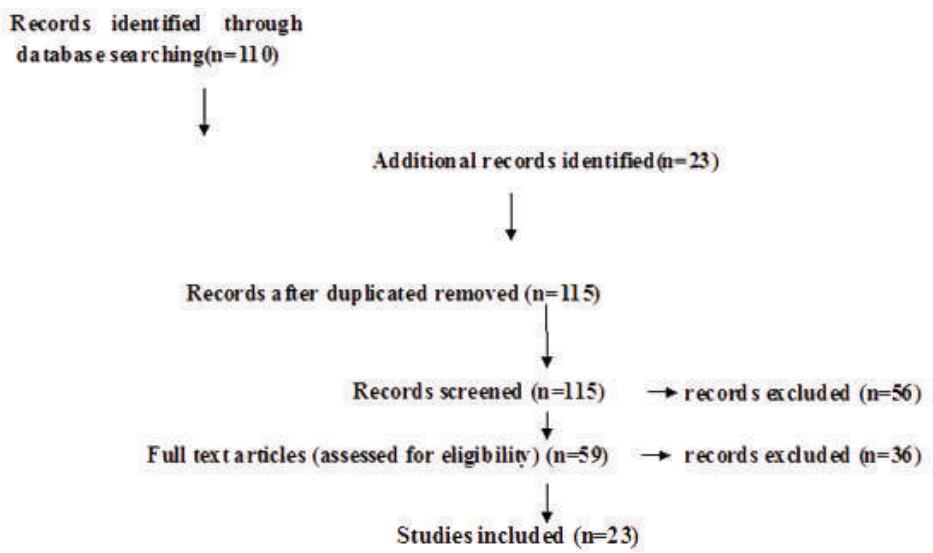


Table 4.1 Comparison of effectiveness among fortified, unfortified cereals & supplementation

Reference	Region of study	Age group (months)	Interven Tion Period (month)	Group 1 (fortified)	Group 2	Results
Rim et al (2008)	Korea DPR	6-12	9	Ferrous Sulfate fortified rice	Unfortified rice	50% less anemia using fortified rice
Beinner et al (2010)	Brazil	6-24	5	Ultra rice (ferric phosphat e fortified)	Unfortified rice + iron drops as supplement ation	Fortification as efficacious as supplementation

Table 4.2 Comparison of effectiveness among different forms of iron fortification in context of cereal types

References	Regions	Age groups (month)	Fortified Forms with Cereals	Results
Davidsson et al (2013)	Bangladesh	6-24	Ferrous sulfate with rice	Similarly positive effectiveness
			Ferrous pyrophosphate with rice	
			Ferrous Fumarate with rice	
Ziegler et al (2010)	US	1-9	Electrolyte Iron with rice	Equally positive effectiveness
			Ferrous Fumarate with rice	
Macharia-mutie et al (2012)	Kenya	12-59	Sodium Iron EDTA with maize	Maize found effective, not the amaranth
			Sodium iron EDTA with amaranth grain	

4. Discussions

Iron fortification interventions in different regions around the world were critically analyzed for effectiveness. In DPR Korea (Rim et. al. 2008), rice granules with ferrous sulfate were given to ensure 10 mg of elemental iron per child per day for 6 months. Infants in the placebo group were fed with the same foodwith added placebo for the same period as the Fe group. Capillary blood samples for biochemical assay at baseline &end of the study were obtained by finger prick. Iron status of infants in the 2 groups was compared at the end of intervention. Mean hemoglobin concentration in the Fe group was significantly higher than inthe control group after 6 months of intervention (Fe group118 g/L, placebo group 110 g/L, $p<0.001$). The prevalence of infants with anemia in the Fe group was significantly lower compared with that in the control group (Fe group 24%, placebo- 48%). Serum ferritinvalues were also significantly different (Fe group 40.7 K/L, placebo group 26.8 K/L). Using the WHO cut off point of 12 mcg/L foriron deficiency, 6.3 % of infants in the Fe group were irondeficient compared with 28.6 % in placebo group. A meta-analysis of data from 11 studies also suggest that fortified cereals reduced the risk of suffering from anemia to 50% (Thompson et. al. 2012), although a stronger effect of the Multi Micronutrient Fortification (i.e. Zinc, vitamins) found by Gibson in Zambia,2011compared to the iron single-fortification strategy, done by Schomann in Guatemala, 2005 cannot be denied. Moreover, Hirve in 2007 found that (as cited in Regil et. Al. 2013) after two months of follow-up there were no statistical differences in anemia **(defined as hemoglobin values < 110 g/L)** (RR 0.89; 95% CI 0.58 to1.39) between the children who received MNP with five nutrients and those supplemented with iron drops.

Iron can be fortified with different compounds. In a double-blind study conducted in Dhaka, Bangladesh by icddr,b, 235 children and infants between 6-24 months were found anemic (cut off point 105 g/l) and randomly assigned to 3 groups to receive an infant cereal fortified with ferrous fumarate (group A), ferric pyrophosphate (group B), or ferrous sulfate (group C) for 9 months' intervention where iron was fortified 4 times higher than commercially complementary foods. All of three source showed similar positive effect on iron status (Davidsson et al. 2013). In another prospective, randomized double-blind trial, exclusively breastfed infants in USA, were enrolled at 1 mo and iron status was determined periodically by administering rice cereal (Cereal L) fortified with electrolytic iron (54.5 mg iron/100 g cereal) to a similar cereal (Cereal M) fortified with ferrous fumarate (52.2 mg Fe/100 g) for efficacy in maintaining iron status and preventing iron deficiency & both found equally efficacious (Ziegler et al 2010). Although, these studies approve beneficial role of iron fortified cereals for preschool children & infants, controversy arises whether they provide same role to schoolchildren when a South African RCT study shows no significant role of neither elemental iron nor NaFeEDTA in brown bread (Stuizvenberg et al 2008). But, in an Indian study, it was demonstrated that Through fortification with NaFeEDTA, whole wheat flour has been demonstrated to be suitable as a highly effective vehicle for Fefortification in markedly reducing anemia (35%), IDA (51%), and ID (67%) in Fe-depleted (Muthaiya et al 2008). Among under-fives, those aged 6–24 months are at most risk of being Fe-deficient (Kikafunda et al 2008).

Different countries are taking initiatives of long term approach with iron-fortified foods based on the availability & accessibility of food vehicles such as, rice in Philippines, flour in Venezuela, fish sauce in Vietnam & soy sauce in China. But, effective vehicle is yet to be determined as they are in developmental stage (Mannar & Gallego 2002). However, in a cost-effective analysis study in different regions, absence of sound evidences on the effectiveness of iron fortification, the present

study assumed fortification to be 50% less effective than supplementation because in the real world, small trail efficacy does not readily translate into large-scale program effectiveness (Baltussen et al. 2004). Yet, in a relatively recent comparative study in Developing country like Brazil where rice is predominant cereal, it is found that prevalence of ID decreased from 69.1 to 25% in the fortified rice given children (6-24 months) and from 76.9 to 52.7% in the supplementary iron drops given children. The prevalence of anemia decreased from 100% at baseline in bothgroups to 61.9% and 85.6% respectively (Beinner et. al 2010) &USA that is commercializing Ultra Rice (fortified with iron) with local producers are estimated to increase the cost of rice by no more than 4%. In populations where young children are routinely fed ~100 g of cooked rice daily, fortifying it with iron may improve iron status at least as well as providing free iron drops. In developed countries such as New Zealand, where mild iron deficiency in toddlers is common, food based strategies given priority to protein food is emphasized (Szymlek et al 2009).

The biological composition should also be considered for effectiveness of cereals that is chosen for fortification. In a controlled trial study among Kenyan preschool children unrefined maize porridge (control 4.1 mg of iron/meal; phytate: iron molar ratio 5:1); unrefined maize (30%) and amaranth grain (70%) porridge (amaranth group; 23 mg of iron/meal; phytate: iron molar ratio 3:1); or unrefined maize porridge with MNP (MNP group; 6.6 mg iron/ meal; phytate: iron molar ratio 2.6:1; 2.5 mg iron as NaFeEDTA). Maize porridge fortified with low-dose, highly bioavailable iron MNP can reduce the prevalence of IDA in preschool children. In contrast, fortification with amaranth grain did not improve iron status despite a large increase in iron intake, likely due to high ratio of phyticacid: iron in the meal (Macharia-Mutie et al 2012). In Vietnam, where the diet provides approximately 4.8 mg of iron, children age 6 to 59.9 months consuming fortified rice with micronized ferrous phosphate& ascorbic acid and sauces with NaFeEDTA, are found to increase iron 2.7 mg to 7.4 mg, and 0.6 mg to 1.2 mg respectively which is not negligible as they are proved by MacPhile to enhance the absorption of both the intrinsic food iron (cited in Laillou et al 2012). A dephytinization technique before administering iron-rich brown bread among children in South Africa has proved the efficacy of fortification previously cancelled out (Troesch et al 2011).

Although researches indicate positive response to fortified cereals, a probable shortcoming could be distribution of fortified food via government programs which does not always work well due to logistical problems or inappropriate priority setting. Thus, commercially distributed fortified foods that fit local nutrition habits may be an additional option to improve nutritional status in developing countries (Hess et al 2016). Also, the fortification processes should be given to the large corporations as they are less vulnerable to fuel cost & keep the product price stable. Slight increase in fuel price are rapidly translated into slight increases the cost of local mills and fortification (Zamora et al 2013).

6. Conclusion

Long-term interventions of iron-fortified cereals are yet to be established. However, most of the studies acknowledged the efficacy to improve hemoglobin level & to reduce prevalence of anemia and probability of effectiveness of these interventions if inhibiting factors of vehicles, enhancing factors of the fortificants, food habits based on socioeconomic & geographical variability and political & commercial aspects are considered.

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Solar PV Mini-grid System: A Lucrative Alternative to Solar Home System in Bangladesh

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Abstract

The rising escalations in the cost of fossil fuels during the last few years have heightened interests in renewable energy technologies. At present, along with some limited applications, solar energy seems to have the greatest potential due to favorable sun shine throughout the year. From last few years, rural electrification through solar PV is becoming more popular day by day in Bangladesh. Specially, the fastest growth has been seen in solar home system (SHS) installation in the rural areas. According to Infrastructure Development Company Limited (IDCOL) data, around 4.1 million SHSs have been already installed in the off-grid rural areas of Bangladesh till October 2016 (Solar Home System Program, IDCOL, n.d). Though a rapid growth of SHS has been noticed in the off-grid areas of Bangladesh, there are some constraints existing in the overall SHS system program. The users are not very much familiar with lots of technical problems like shading on panel, depth of discharge of the battery (DOD), etc. The major complication arises when altercations take place between the users and service providers at the time of repayment of the monthly installment. Therefore, in this study, a comparison is made between centralized mini-grid system and SHS. Central mini grid system may be a lucrative alternative to SHS, as many problems as cited in case of SHS can be minimized by the mini grid system. Moreover, the cost of energy (COE) is also cheaper in case of mini-grid system which is around $0.29-0.31/kWh (Majbaul Alam & SubhesBhattacharyya, 2016) whereas the COE of SHS is around $0.62/kWh (Bernd MÖLLER, Michael GOLBA, Wulf BOIE & Théoneste UHORAKEYE, 2014).

Keywords: *SHS, IDCOL, DOD, mini-grid, COE*

1. Introduction

Bangladesh, a low lying South Asian country, with the geographical coordinates 24° N, 90° E has a total area of 147,570 sq km (Bangladesh Geography, n.d) and a total population of 161.0 million according to world bank data of 2015 (The World Bank, Bangladesh, n.d).The peak demand of power for this huge population till Fiscal Year (FY) 2016 is 11,405MW and it will rise up to 17,304MW by FY2020 according to Bangladesh Power Development Board (BPDB) (Demand Forecast, BPDB, n.d). The year-wise peak power demand forecast of BPDB is shown in figure 1 (Demand Forecast, BPDB, n.d).

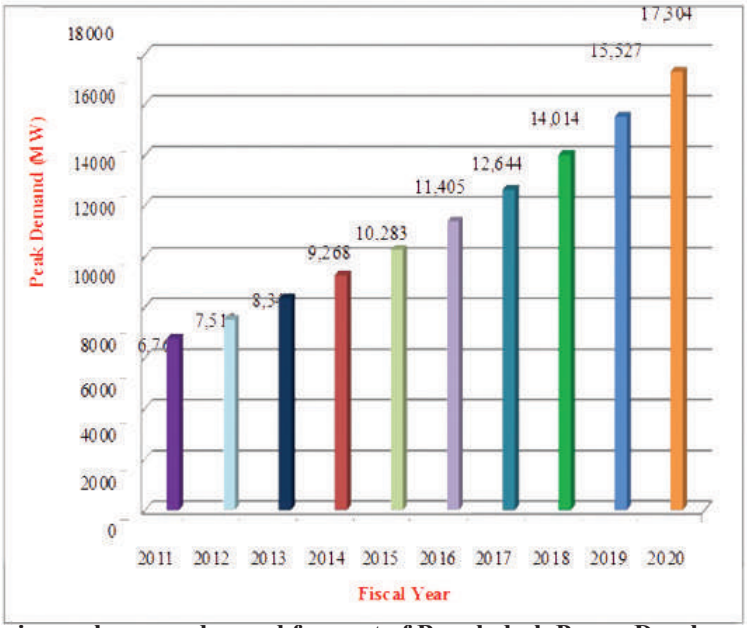


Fig. 1: Year-wise peak power demand forecast of Bangladesh Power Development Board (BPDB)

To meet up this rising demand, more generation of power is required. At present, more than 96.8% of generated power in Bangladesh comes by burning fossil fuels and the share of renewable energy is only around 3.15% (Present Status, SREDA, n.d). Figure 1 shows the percentages of installed capacity of power by different fossil fuel based power plants and renewable energy separately and figure 2 shows the percentage of different RE sources on the total share of renewable energy in the installed capacity (Present Status, SREDA, n.d).

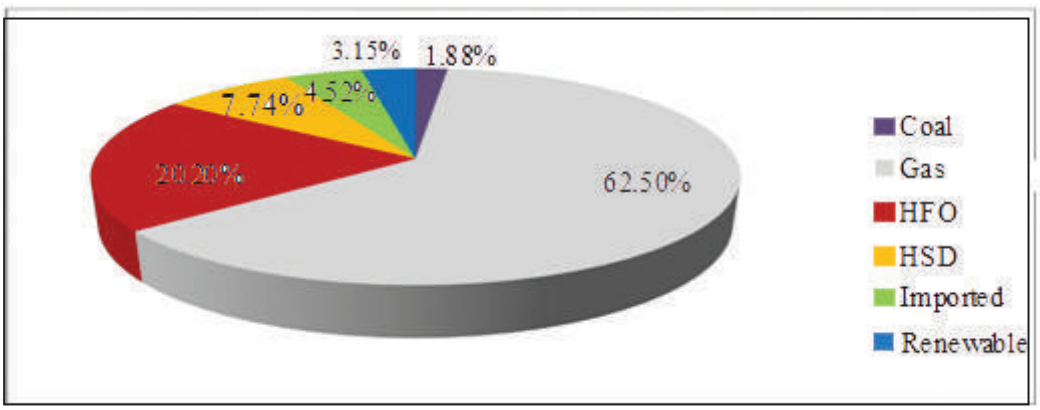


Fig. 2: Pie chart of the installed capacity of fuel based power plants & Renewable sources

Tab. 1: Percentage of different RE sources on the total renewable energy share in the installed capacity

	Renewable Energy Share
Solar	44.1 %
Wind	0.7 %
Hydro	54.9 %
Biogas to electricity	0.2 %
Biomass to electricity	0.1 %

From figure 2, it is seen that, the major amount of power is generated from natural gas. But it is depleting at a very fast rate. And the cost of energy (COE) of other hydro carbon sources is very high and has been rising from last few years. This has heightened the interest on renewable energy technologies. Renewable energy (RE) policy of Bangladeshgovernment envisages of generating 10% of total power from RE sources by 2020 which would be around 2000MW (Future Plan, SREDA, n.d).

Bangladesh receives an average solar radiation in the range of 4-5 kWh/m^2/day (Renewable Energy and Potential, SREDA, n.d) which makes it one of the best places to make the optimum use of solar energy, especially for the rural and off-grid areas of Bangladesh. From table 1 it is seen that a major percentage of renewable energy share comes from solar energy. But still lot of rural people lacks access to electricity. Thus, solar home system (SHS) is becoming very popular from last few years. It presents an attractive alternative to conventional electricity as no fuel cost is involved, requires minimum maintenance cost, very little repair, easy to install anywhere, etc. Under IDCOL's program, around 4.1 million SHSs have already been installed in the remote areas where electrification through grid expansion is challenging and costly and people previously used kerosene lamps for lighting purpose. Thus, almost 18 million beneficiaries, which are around 12% of the total population of Bangladesh, are getting solar electricity (Solar Home System Program, IDCOL, n.d). which was once a dream for them. IDCOL also has a target of financing 6 million SHSs by 2017 with an estimated generation of 220MW of electricity (Solar Home System Program, IDCOL, n.d).

Though solar home system is a very successful and popular project in Bangladesh but it has some major limitations. These limitations exist in both user and service provider sides. Among them insufficient technical knowledge of SHS users, altercation at the time of installment repayment, poor service of the new unregistered service provider and increasing demand of the user are very much common. To minimize these constraints astudy has been done on the centralized mini-grid system and it has been seen that central mini-grid system maybe a lucrative alternative to SHS. Centralized mini-grid system is more successful compared to standalone SHS in case of financial considerations, technical monitoring, user demand and service provider's choice. Moreover, the cost of energy (COE) of mini-grid system is around $0.29-0.31/kWh which is also cheaper than the SHS as the COE of SHS is around $0.62/kWh. According to IDCOL data, till to date, 18 solar mini-grid projects have been approved by IDCOL among which 7 are operational and the rest are under construction (Solar Mini-grid Projects, IDCOL, n.d). This has successfully created access to low-emission electricity for almost 5000 rural households of Bangladesh (Solar Home System

Program, IDCOL, n.d). IDCOL also has a target to install 50 solar mini-grids by 2018 (Solar Mini-grid Projects, IDCOL, n.d). In this paper, the major drawbacks of SHS and the difference between the COE of both SHS and mini-grid system have been highlighted to predict the future trend of mini-grid system in Bangladesh.

2. Present status of solar home system in Bangladesh

Solar home system is mainly a stand-alone system which supplies amenity power for lighting and appliances to remote off-grid households in a cost-effective mode. It is used to meet household's energy demand fulfilling basic electric needs. SHS consists of a solar panel, a charge controller and a battery. The schematic diagram of solar home system is shown in figure 3.

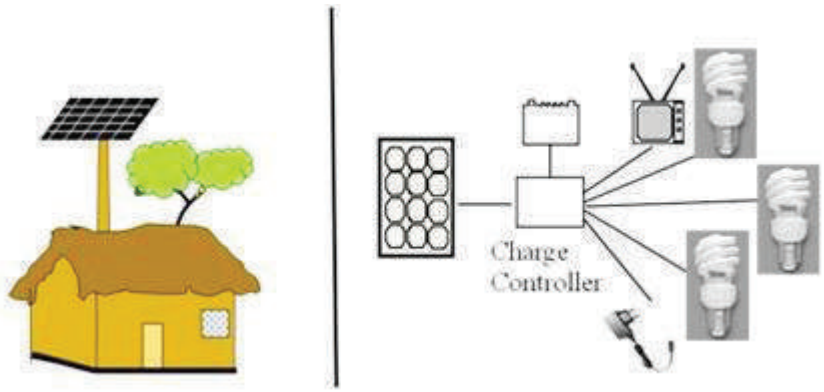


Fig. 3: Schematic diagram of solar home system

SHS can be used to light up homes, shops, fishing boats, charge cellular phones, run televisions, radios and cassette players. The capacity of SHS varies according to its load connection. Table 2 gives an overview of the appliances, time of operation and retail price of various SHS configurations (Peter Marro & Natalie Bertsch, 2015).

Tab. 2: Popular solar home system configurations

Capacity	Appliances	Duration of Operation	Retail price ($)
20Wp	3-watt LED lamp: 2 Mobile charger: 1	4-5 hours	140
50Wp	3-watt LED lamp: 5 LED color TV: 1 Mobile charger: 1	4-5 hours	350
85Wp	3-watt LED lamp: 7 LED color TV: 1 Mobile charger 1 12-watt dc desk fan: 1	4-5 hours	480

The approval of design of SHS and a major financing support is provided by Infrastructure Development Company Limited (IDCOL). IDCOL is a Bangladeshi-government owned financial institution that plays a major role in bridging the financial gap for developing medium to large-scale infrastructure and renewable energy projects in Bangladesh. It isimplementing a large scale SHS program with support from its various partner organizations (POs) comprised of local NGOs, MFIs and private entities on a national partnership basis (Sun-Connec, July 2014). According to IDCOL, the SHS program structure is shown in figure 4 (Nazmul Haque, 2013).

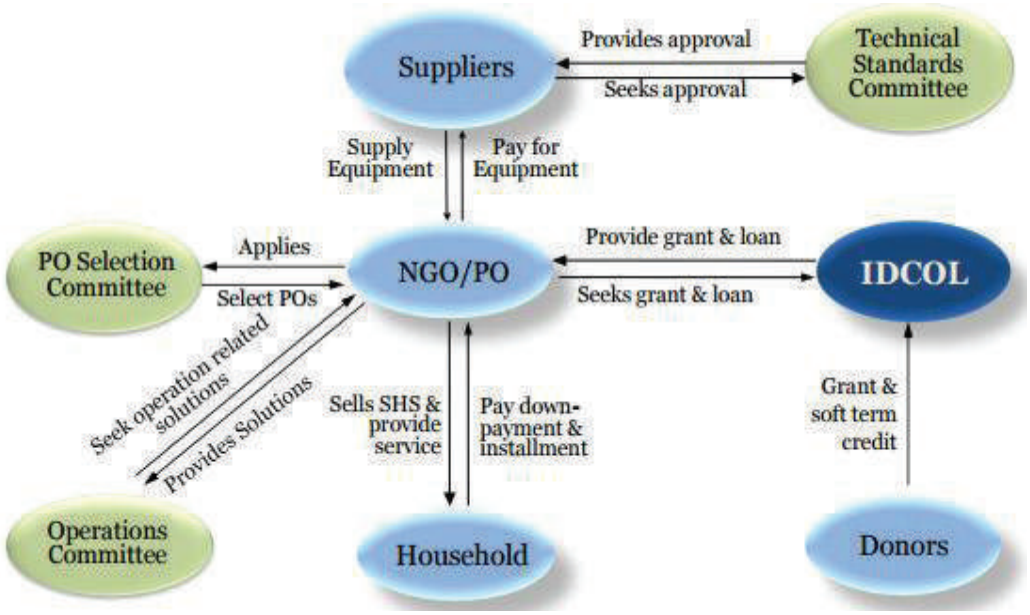


Fig. 4: Solar home system program structure

So far IDCOL has installed 4.1 million SHSs in the off-grid rural areas of Bangladesh which has ensured supply of solar electricity to 18 million people and also has a target of installing 6 million SHSs by 2021. This has saved 1.4 million tons of kerosene consumption till now which is worth USD 411 million approximately (Solar Home System Program, IDCOL, n.d) .Therefore, SHS is an environmentally friendly and economically feasible system. The poor rural inhabitants prefer it because the monthly installments are less for each set up than the equivalent monthly amount spent on kerosene to fulfill their required basic power demands. According to a study, the COE of a SHS is around $0.62/kWh.

3. Limitations of Solar Home System

Though installation of SHS is growing rapidly in the rural areas but some constraints also exist in the overall system. These constraints exist in both user and service provider sides. The users are unfamiliar with many technical problems of the solar panel and the battery such as shading on panel, depth of discharge of the battery, etc. Mainly, they face a big challenge if any problem occurs during the odd times when the service providers are unavailable to provide requisite services. Again, there are lots of drawbacks in case of service providers like poor response in highly remote

areas, several immature and unregistered partner organizations (PO), etc. The major complication arises at the time of repayment of the monthly installment when altercation takes place between the users and service providers. Moreover, there are possibilities of power interruption in case of cloudy days along with no security of power interruption in odd times. Some of the major constraints are discussed in below.

1) Insufficient knowledge about SHS: One of the major problems of solar home system is that many users are not familiar with the technical terms of SHS like tilt angle, shading and hotspot problem, depth of discharge (DOD), panel cleaning, etc. These terms play an important role in solar home system performance.

2) High interest rate: Maximum user of the SHS is middle class people and for them the interest rate is high.

3) Insufficient Counselling: Service Provider Company provides their employee who provides service to solar home system user but they don't provide sufficient training to users about the maintenance of the SHS.

4) No security of power interruption: In case of odd times (at midnight), if power interruption occurs, users have to wait for the service provider employee. Because only they can clear the systems fault. Users normally get poor response from the service provider employee.

5) Less maintenance: As it is already described, for maintenance of the system users have to rely on the employee of the service provider, because of that SHS don't get the proper maintenance.

6) Cost of energy: For solar home system users, cost is same even if they are using less. As for solar home system less amount of equipment is needed the price of the equipment is high which leads to high cost of energy.

7) Waste of power: Solar home system users can't share their extra power with others or unable to get from other users.

8) Unregistered organizations: Everyday different organizations are arising in the market and to sustain and make profit they provide poor quality of equipment's and service.

4. Future scope of energy access: mini-grid system

Solar Home System (SHS) is very much popular and has proved to be a successful business model in Bangladesh. Already such SHS project in Bangladesh has earned name and fame worldwide. However, due to high demand of SHS user and other limitations of SHS, evolution of new technology and innovative solutions are very much needed. To fulfill the demand of large community people in the remote off-grid areas, solar Mini-grid is the most efficient alternative of standalone solar home system. Moreover, the cost of energy of min-grid system is much less compared to SHS. In this model also user will pay a monthly tariff like usual electricity tariff but the tariff is very low. Furthermore, mini-grid system is independent and reliable with low maintenance cost.

4.1. Why Mini-grid System?

There are numerous reasons to choose mini-grid system as an alternative of SHS. In previous users were happy just because they have power to light up the room. But nowadays they need more power as their demands are increasing day by day. SHSs are primarily meant to be used by low and middle income households, as well as micro and small enterprises, in off-grid rural locations to run simple household appliances such as televisions, radios, fans, a few light bulbs, and chargers for mobile phones. They do not allow for more energy- intensive uses such as cooking, water heating, or industrial use, so it should not be thought of a full solution to energy access. Besides, there are many limitations of SHS which already has been discussed in the upper section. So, a system has to be developed which will be the proper solution of the present status.

As of International Energy Agency (IEA), a Mini-Grid is a set of electricity generators and, possibly, energy storage systems interconnected to a distribution network that supplies the entire electricity demand of a localized group of customers. It's like a centralized small power plant where the electricity is generated using solar PV system. In standalone system, User who has extra power can't share with others that mean total waste of power. In case of mini-grid system, users can share exceeded power with the off-grids and earn some revenue.

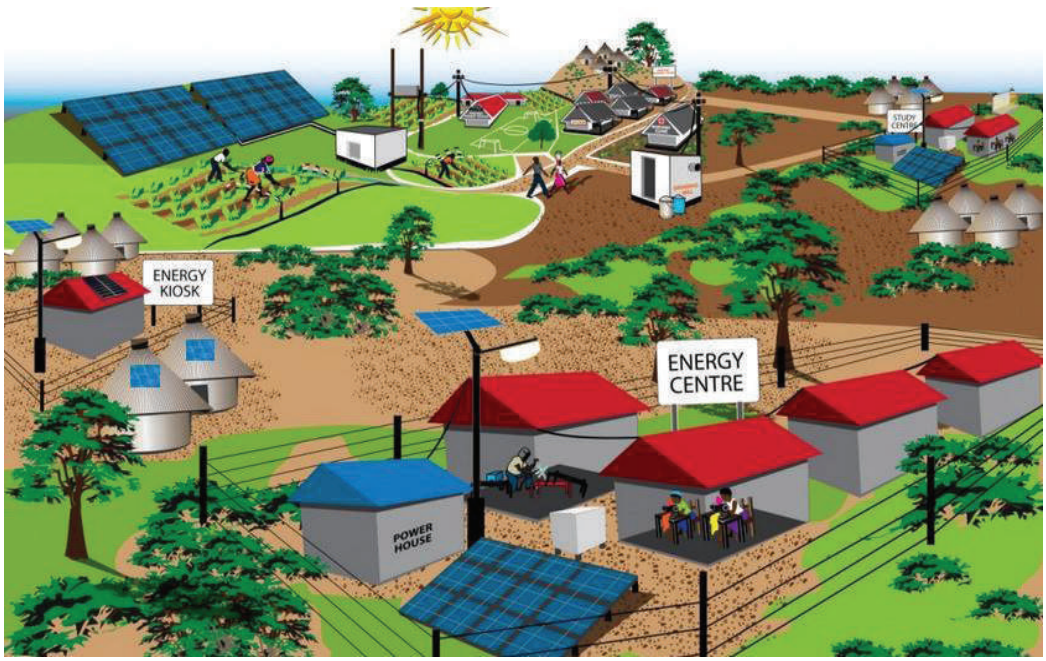


Fig. 5: Solar mini-grid system

Bangladesh is an agriculture country. Around 18.64% of GDP and 64% of employment comes from agriculture. But the major challenge is off-grid irrigation in Bangladesh [15]. Almost 2/3rd of the irrigation pumps in Bangladesh are driven by diesel and their number is close to 1.5 million. Bangladesh imports more than 1 billion worth of diesel for agro-sector alone, lion's share of

which used in irrigation. So, solar PV system based irrigation can be comparative to diesel based irrigation. In accordance with, IDCOL already proposed a model of solar irrigation pump and they have approved 459 solar irrigation pumps of which 324 are already in operation (M. Rezwan Khan, January 2012). The remaining pumps are expected to come into operation shortly. In solar irrigation system battery is not needed as the irrigation takes place when the sunshine is available. So, cost of the solar irrigation system is minimized. Moreover, the solar irrigation system is only use at the time of irrigation that means February to May. So this can be a major advantage for mini-grid system. When the solar irrigation is not taking place, all the irrigation solar PV can be added and produce some power. If a mini-grid system is taken place all this solar irrigation PV can be conneted with the mini-grid. And this will help to reduce the cost of energy of the system.

One of the major compilations occur at the time of monthly repayments of installments in SHS which can be solved in mini-grid system as here user just have to pay the amount of electricity they used. Moreover, due to poor maintaince many times SHS collaps and power interruption occurs. Users have to pass their daily life without power because of poor response of the service provider maintainance engineer. It will not happen in case of solar mini-grid sytem as the system is centralized and all the time a maintaince engineer will be present to check out the system. Again, in solar mini-grid system huge components are bought together so the overall price of the components decrease in comparison with SHS. Overall, the COE of solar mini grid system in Bangladesh stands at $0.29-0.31/kWh where it is $0.62/kWh for SHS.

4.2. Business model of solar mini-grid system

IDCOL structured a program for mini-grid projects, with a vision of implementing 50 solar mini-grid projects of capacity ranges from 100~200 kW by the year 2018 (Solar Based Irrigation Program, IDCOL, 2014). So far IDCOL have approved 18 solar mini-grid projects, among which 7 are operational and created access to electricity for almost 5000 rural households in Bangladesh. The world band, KFW, GPOBA, JICA, USAID, ADB and DFID are financially supporting IDCOL's solar mini-grid projects.

Three projects (GHEL: 100 kWp at Kutubdia, Souro Bangla: 141 kWp at Narsingdi and Hydron: 141 kWp at Bagha, Rajshahi) are up and running and 2 other projects (Solar Electro: 177 kWp at Monpura, Bhola and AVA development: 148.5 kWp at Godagari, Rajshahi) are in the implementation stage (Sohel Ahmed, n.d). After the experience of the pilot project in Sandwip these solar mini-grid projects have been approved by IDCOl.

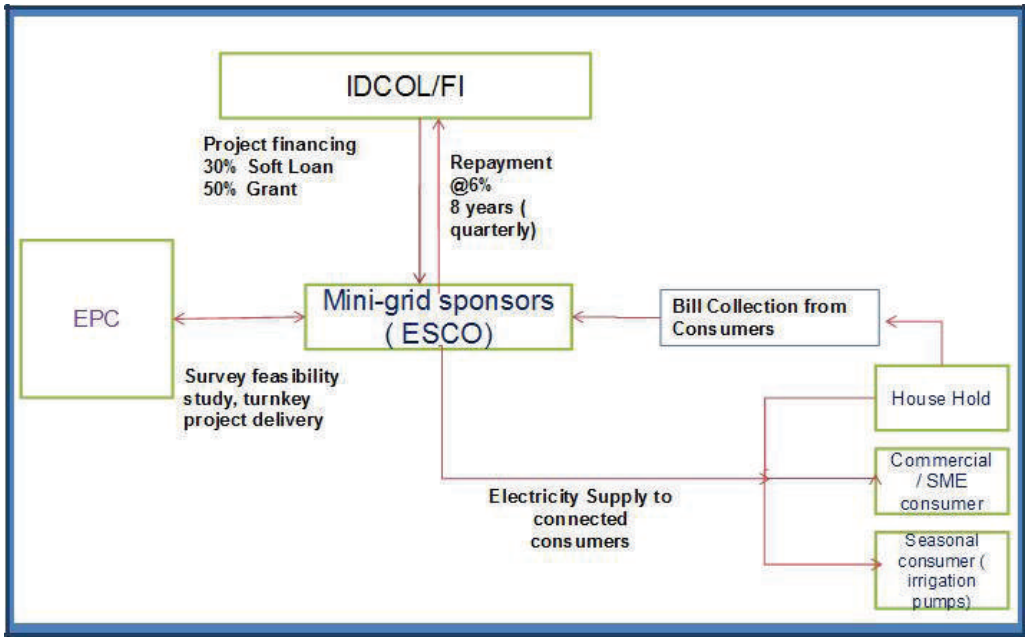


Fig. 6: IDCOL Solar mini-grid business model

The sponsor designs the projects and submits to IDCOL for approval. Once the project gets approved, it assigns the EPC contractor to source the equipment's and install the projects. The technical performance of the projects and warranty of the equipment's are ensured by the EPC controller. Sponsor has the responsibility to manage the ground level operation by ensuring delivery of energy to the consumers and collecting the monthly tariff. The consumers pay the monthly tariff in exchange of electricity generated from the mini-grid plant. Figure 6 depicts the said model. Upon approval of the project, IDCOL provides grant up to 50% and softy finance of up to 30% of the total project cost as a project financer. The sponsor is required to invest equity at 20% of the project cost (Sohel Ahmed, n.d).

4.3. Advantage and contrasts of mini-grid system over SHS

Solar mini-grid is a comprehensive turnkey solution and can be designed for a wide range of power requirements. Beside this it has much superior advantages in comparison with SHS.

1) Security: Security of power all the time even if cloudy days.
2) Price diffidence: Monthly tariff of solar mini grid is independent of national tariff fluctuation.
3) Centralized: As the system is centralized so it is convenient controled and maintained.
4) Fast deployment: Ready to work within hours or days.
5) Long term occupancy: The system is designed to work for at least 20 years.
6) Maintainance cost: Solar mini-grid system has low operational and maintenance costs.
7) Future grid expansion: In case of future national grid connection, solar mini-grid can be utilized.

A comparison between mini-grids and SHS has been shown in table 3 based on policy consideration, regulatory framework, business models and ownership.

Tab. 3: Contrasts between mini-grid and SHS

	Mini-grid	SHS
Policy Consideration	Integrated energy access strategy and planning.	Integrated energy access strategy and planning.
Regulatory Framework	□ Licensing □ Quality and Safety □ Tariff and consumer disputes □ Grants and subsidy scheme	□ Primarily unregulated retail market □ Quality standards
Business models	Locally individual mini-grid business models, scalability has not been proved yet	Standardised business models, rapidly scalable
Ownership	Utility/private/community/ hybrids	Customer financed-based, lease systems and cash

4.4. Transformation of rural electrification

Mini-grids have the potential to fill the gaps in grid infrastructure smarter and faster. For those beyond the reach of the grid, these off-grid systems need to be recognised as the primary means of access to electricity. Mobile technology, availability of microloans and falling solar module prices are already proving to be disruptive drivers of change. In the near to medium-term future, we believe there is the prospect of further technological developments in small scale power generation and large battery storage that could prove to be game changers. A model for rural electrification has been shown in figure 7 (PWCglobar power & utilities,2016).

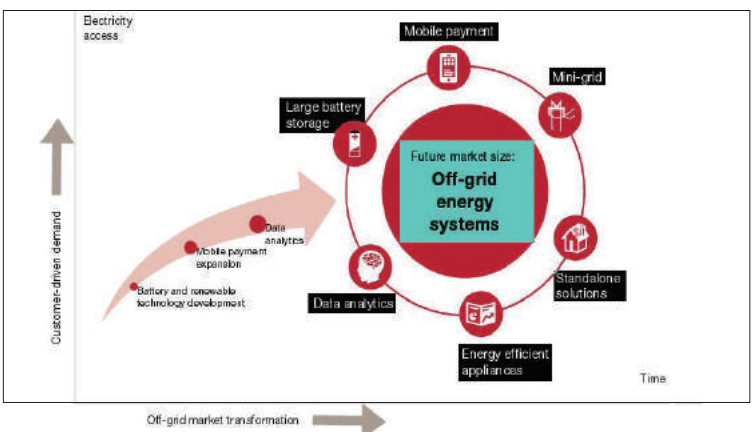


Fig. 7: Proposed model of rural electrification

5. Conclusion

Solar energy is best known for lighting rural houses where grid connection has not reached yet. Still there are a lot of rural areas of Bangladesh where grid is not available and also do not have any possibilities to get grid connection before next 15-20 years. Thus, SHS has gained huge popularity in last few years and progressing in a rapid growth. Though it is an eco-friendly, reliable, clean and sustainable system and has a huge impact on the lives of the rural people, but some of its constraints like reduction of output due to shading on panel, insufficient battery backup support, high generation cost, inefficient service etc., pose serious future threats to the wide scale use of SHS in Bangladesh. Whereas, solar mini-grid system is like a centralized power plant and the power is produced from solar PV. So the increasing demand of the users can be fulfilled by solar mini-grid system. Besides, as the system is maintained by professional engineers, the system will be more reliable with low maintenance cost. Overall our study reveals that, if we go for solar mini-grid system, the limitations of SHS and increasing demand can be overcome. Therefore, solar mini-grid system can provide much better facilities in socio-economic, education and communication in rural off-grid areas. It can be also concluded that, in future mini-gridsystems will gradually replace SHSs in the rural areas of Bangladesh.

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Human Sludge: Untreated Environment Pollutant to Large-scale Green Bio-fuel for Electricity Production in Accordance with Visions and Laws of Government of Bangladesh

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Abstract

This paper represents a conceptual view of sustainable development in electricity generation using sewage as a renewable biofuel. The power demand of Bangladesh is on a sharp rise. In Power System Master Plan of Bangladesh 2010, for achieving future energy security while ensuring a green environment major dependence has been shown on diverse and new renewable energy sources. According to Bangladesh Renewable Energy Policy 2008, Government of Bangladesh aims to produce around 2000MW from renewable sources by 2020, whereas only around 240MW exists today. This paper proposes human sludge as a significant renewable source for Bangladesh, considering both the power issues and the present unsafe disposal of human sludge in Dhaka city. According to the Water Supply & Sewerage Authority Act 1996, it is illegal to connect any wastewater line with the storm sewerage line, whereas wastewater discharges in most cases are directly connected to storm sewerage line which subsequently mixes with main water bodies. This paper seeks a termination of this environmentally hazardous process by proper law enforcement while prospects of electricity generation from this initiative is also illustrated. Experimental values of electricity generation possibilities from wastewater and test results on raw human sludge properties are represented in the paper. Other feasible energy generating possibilities from sewage on the context of Bangladesh are also discussed.

Keywords: Sustainable Development, Biofuel, Energy Security, Green Environment, RenewableEnergy, Government of Bangladesh, Unsafe Disposal, Law enforcement.

1. Introduction

Electricity or Electrical energy is the main lifeblood behind modern human race. Today a scientist in assessing the possibility of finding a new earth in our solar system to an uneducated farmer fulfilling his basic human needs, use tools and means which directly or indirectly depends on energy, mostly in the form of electricity. Although discovery and use of fossil fuel as means of generating electricity gives mankind the extra edge in knowledge and technology, in 21st century the continuously advancing and more electricity dependent mankind is threatened with the limited and decaying fossil fuel reserves and harmful environmental effects of fossil fuel burning, which leads the mankind to an unavoidable question of finding new green sources of energy to ensure sustainable advancement. While this paper concentrates its study on the perspectives of

Bangladesh, the proposed green bio-fuel can be coined as one of the most promising renewable bio-fuel for world's energy security. Human sludge, the odorous bio-matter can provide a solution which satisfies multiple queries of modern world, such as SDG 7.2 where it states to substantially increase the share of renewable energy in global energy mixture.[24] This paper defines human sludge as a multi-question solution for Bangladesh and justifies the definition by explaining the existing energy scenario of Bangladesh and Government's vision of diminishing current and future power crisis. The justification is furthermore extended by quoting related government laws, present sanitation scenario of Dhaka city and environment issues. Test results show the properties of local human excreta and bioelectricity generation possibility from untreated wastewater collected from a local water body of Dhaka city. A survey has been included to portrait the present wastewater disposal scenario of Dhaka city. Furthermore various technological options to evaluate energy potential from wastewater treatment are also illustrated and reference data has been used where necessary.

2. Power Sector of Bangladesh: Past, Present and Future

Bangladesh, a fast developing country, just has set her foot-print among the low middle income countries of the world and aiming to be among the middle income countries within 2021 according to Perspective Plan of Bangladesh 2010-2021 (PPB 2010-2021), has a great appetite for electricity. Rapid economic growth, fast urbanization and expand industrialization and development throughout the country are continuously adding up to the total electricity demand of the country.

Government of Bangladesh (GoB), according to PPB 2010-2021, section 8.2 has a vision of electrifying the whole nation within 2021 and has already made commendable achievements in fulfilling the vision. The electricity generation capacity has risen from around 5000MW in 2009 to 15000MW in 2016, percentage of people having access to electricity increases from 47% in 2009 to 76% in 2016 and per capita electricity generation rises from 220KWH in 2009 to 371KWH in 2016 and so on.[1]

In order to fulfill the vision of providing electricity for all, the Government has taken various short, medium and long-term power generation plans. A Power System Master Plan (PSMP) was introduced in 2005 taking natural gas as the main fuel for electricity generation. After seeing an alarming decrease in natural gas reserve of the country, a revised PSMP was introduced in 2010 (PSMP-2010). According to the studies of PSMP-2010, which is currently in action, the forecasted electricity demand of Bangladesh will be 18838MW in 2021 and 33708mw in 2030. Faced with the challenge of decaying natural gas reserve and currently having 62.75% gas based electricity generation facility[2], the PSMP-2010 undertook various strategies to diminish the gap between electricity requirement and electricity production of the country. Fuel diversification, use of alternative energy sources are regarded among the topmost strategies for continuous power sector growth and energy security. GoB has also shown a great dependency on renewable sources to fortify against the power crisis. For ensuring proper evaluation and establishment of renewable energy sectors, Sustainable and Renewable Energy Development Authority (SREDA) has been created according to The Sustainable and Renewable Energy Development Authority Act, 2012.
The Government has set a target of generating 10 percent of the total electricity supply from renewable resources by 2020 while the present share of electricity generation from renewable sources is only 1%.[1] Development of sustainable energy supplies to substitute indigenous non-renewable energy supplies, Scaling up contributions of renewable energy both to electricity and

heat energy production are among the objectives of the Renewable Energy Policy of Bangladesh.[3] In order to provide strong motivation towards the development of renewable sectors of the country, SREDA is aimed to provide dedicated institutional support to promote renewable energy uses and shall support capacity building, technology development, and market development sufficient to boost the share of electricity generated from renewable energy technologies.[4]

In order to generate 10% electricity, correspondingly meaning around 2000MW in 2020 from renewable sources, which stands at around 240MW in 2016.[1] GoB is in search for new renewable sources for electricity generation. The motivation given by the government in finding new greener renewable sources for electricity production, gives human sludge a strong base point in being a future green bio-fuel solution for fulfilling the electricity requirement of the country. Bangladesh, a home for more than 160 million inhabitants, gives a large production of human sludge on daily basis and the dense population distribution gives easy sludge collection opportunity. Moreover, another achievement of the GoB, where open defecation rate of the country has been reduced to only 1%[5] gives the possibility of almost full scale human sludge collection from any place of the country.

3. Sanitation scenario of Dhaka city

In Bangladesh, where the total population is more than 160million and the population density is 1251.5 people per sq. km of land area [6] management of human sludge has always been a problematic issue. The safe disposal of human excreta is of paramount importance for the health and welfare of people. Not only that, it is also required for the prevention of pollution to the surrounding environment as untreated fecal sludge disposal poses threat to environmental aspects such as water, air, soil quality, bio-diversity etc. Although vastly reduced open defecation in Bangladesh ensures use of sanitation techniques but unsafe practice of sludge disposal is still dominant throughout the country.



Fig. 1: Sewage outlet to drains water bodies



Fig. 2: Sewage outlet to

3.1 Faecal Sludge Management (FSM) scenario of Dhaka city

Dhaka, the capital of Bangladesh and one of the fastest growing cities in the world has a population of more than 17 million with a size of 1,528km^2 (square kilometer). The population density is more than 45,000 people per km^2 in the core area[7] and number of households in Dhaka is 2786133.[8] The dwellers of this highly populated and highly dense city mostly depend on on-site sanitation systems such as pit latrines and septic tanks for sludge storage. These facilities are mostly emptied manually by informal service providers. The collected wastewater is then dumped into isolated open areas or into the storm drain line. Another large proportion is connected directly to surface drain or storm drain lines. Storm drain line, which is mainly constructed for rain water drainage and has direct connection with large water bodies. In many cases storm drain line is also used for dumping the collected sludge from septic tank or pit latrine. The unsafe practice of connecting sewerage line directly with the storm drain line for faecal sludge disposal is widespread throughout the city due to the fact that only 20% of the total households and institutions are connected to the utility provided sewerage network.[9] In order to demonstrate the present sludge disposal scenario of Dhaka city dwellers, a survey has been conducted in two catchments of Dhaka city namely Uttara catchment and Mirpur catchment. A total of eight (8) areas, four (4) under each catchment and a total of 768 households were investigated during the survey. Table 1 displays the quantitative data of the survey. Data are given as percentage of the total household number surveyed in respective area.

Table. 1: Sewer Connection from households in Dhaka City

Sludge Disposal Method	Uttara Catchment				Mirpur Catchment			
	Turag	Uttara Model Town	Uttar khan	Dakshi nkhan	North Mirpur	Pallabi	South Mirpur	Kafrul
Septic tank connected to sewer network	0	0	0	0	0	0	0	0
Septic tank with no outlet	54	96	62	41	98	100	88	78
Unlined pit	0	2	24	18	0	0	0	0
Directly to storm drain/ditch	46	2	14	41	2	0	12	22
Total Household Number	**96**	**92**	**102**	**94**	**92**	**96**	**94**	**102**

The study of this survey reveals the present unsafe practice of sludge disposal in Dhaka city, where most commonly used methods for sludge disposal has been septic tanks with no outlets or connected directly to storm drain or ditch. In both the cases, the untreated sludge finds its way to the large water bodies as no further treatment facility is observed around the city and somewhat similar scenario is present throughout the country. The untreated faecal sludge constituents contaminate

the water and the contaminated water poses health risk to human and aquatic life, moreover the aquatic ecosystem is also largely disrupted due to several constituents of untreated human sludge mixing with water, subsequently posing a severe threat to the environmental ecosystem as well.



Fig. 3: FS management in Dhaka city combined sewer



Fig. 4: Water clogging due to

3.2 Untreated Human sludge: Constituents and environmental effect

For better understanding of the environmental effects of human sludge, test data on raw human sludge are given in Table 2. The aim of the test was to assess the values of constituent in human sludge. Experimental samples were taken from a local septic tank (Single Chamber) and a pit latrine, which were in-use for human wastewater collection. Samples were taken from three portions of the storage facilities. Firstly from the top part, secondly from the middle part and lastly from the bottom part of the storage. Component values of human sludge in table 2 are represented as the average of the three values acquired in both cases.

Table. 2: Pathogenic Characteristics of Human Excreta

Component	Unit	Volume		Analysis Process
		Septic Tank	Pit latrine	
Biochemical Oxygen Demand (BOD_5)	mg/L	831	929	BOD Track
Chemical Oxygen Demand (COD)	mg/L	4729	3090	COD Reactor Digestion Method
NH_3-Nitrogen	mg/L	1064	1267	Spectrophotometer DR 2800 (Nessler Method)
Total Nitrogen (TN)	mg/L	1567	1665	Spectrophotometer DR 2800 (Per sulfate Digestion Method)
Total Phosphorus (TP)	mg/L	529	930	Spectrophotometer DR 2800 (Acid Per sulfate Digestion

				Method)
Total Solids (TS)	mg/L	9456	10050	APHA Standard Method 2540 B
Suspended Solids (SS)	mg/L	6874	7528	APHA Standard Method 2540 D
Total Volatile Solid (TVS)	mg/L	4634	5416	APHA Standard Method 2540 E
Total Volatile Solid (TVS)	% of TS	39.39	53.13	-
Total Coliform (TC)	No./100ml	1.5×10^5	1.48×10^5	Membrane Filtration Method

From table 2 various parameters of the fecal materials which is dumped directly to the water bodies in the case of no treatment facility can be seen. BOD and COD are the amount of oxygen used by microorganisms to consume the organic solids in wastewater[10]. The high rate of these two parameters shows that the direct dumping of the fecal materials in the water decrease the dissolved oxygen level of water which is a threat for aquatic life. Nitrogen and phosphorus although regarded as nutrients in aquatic ecosystem, can be considered as a threat when present in a large quantity. Large quantity of nitrogen and phosphorus can cause abnormal growth of algae and aquatic plants in a waterbody which consequently will cause an abnormal reduction in dissolved oxygen quantity and posing a risk to fishes and other aquatic creatures. Nitrogen and phosphorus levels in excess of acceptable limits are thought to be among the main causes of extinction of various fish species. Total Solids, Suspended Solids, Total Volatile Solids are settle able, floatable and colloidal solids which are hard to remove from water bodies. For this reason methods such as trickling filters or activated sludge plants are used where these dissolved solids first converted to settleable solids then they are removed by sedimentation tanks in the water treatment plants. These further processing of wastewater adds up to the treatment cost. If the untreated dumping can be stopped, it will also be justified from economical point of view. Other constituents such as coliform and bacteria in the fecal waste cause various waterborne diseases namely diarrhea, dysentery, skin and tissue infection and so on.

3.3 A solution and an opportunity

This paper seeks a termination of the current environmentally hazardous practices for faecal sludge disposal in Dhaka city by stating a law from the Water Supply & Sewerage Authority Act 1996 (WASA Act-1996). WASA Act-1996 is the main governing law of Dhaka Water Supply & Sewerage Authority (DWASA) and this act provides for DWASA to manage its facilities and operate with a high degree of autonomy. Moreover this act gives DWASA the sole responsibility of providing water, sewerage and storm water drainage services in Dhaka city. According to the statement of WASA Act-1996, it is an illegal and punishable practice to connect any faecal sludge disposal line with the storm sewerage line.[11] Although the current scenario shows a reverse trend due to unavoidable circumstances, proper application of this act can limit the water contamination of large water bodies. As the act suggests, all illegal connections to the storm sewerage system needs to be disconnected. Without having any connection with drain storm line, the septic tanks, pits or any other sludge storing facilities will fill up very quickly and there will be a requirement for emptying those facilities on regular basis. With fecal wet mass production by human being between 126-250 g/cap/day from high to low income countries[10] and with the large population of Dhaka city, a significant amount of wastewater can be collected from faecal sludge storage facilities

on regular basis. For proper use of high volume collected wastewater, competent wastewater treatment facilities needs to be established. These wastewater treatment facilities can then either be integrated with electricity generation facilities or separate electricity generation units can be constructed which will intake treated wastewater as fuel in accordance with the existing waste to electricity technologies around the world.

4. Technologies for wastewater treatment and electricity generation

Electricity, the most desirable output on the power contexts of Bangladesh, can be generated from proper treatment of the large-scale collected domestic wastewater, which comprises mostly of human excreta. The organic substances of the wastewater decompose or breakdown with time through microbiological activities and this naturally occurring phenomenon gives the basic of electricity generation from wastewater.[12][13]

Electricity generation from wastewater treatment is becoming more and more popular all over the world. Studies show that, in many developed and developing countries around 3-5% of their total electricity generation come merely from wastewater treatment.[14] The technologies of interest for electricity generation by wastewater treatment falls basically under two categories, namely anaerobic and aerobic process.[15] The anaerobic technologies, at present, are the most dominant and established technology around the world, due to their large-scale electricity generation capabilities. Aerobic technologies, although with the label of cleanest technology, still have limited establishments due to their low electricity output capability.

This paper firstly reviews the anaerobic process, where biogas is produced as the main working fluid. Then the use of biogas for electricity generation is discussed and other biogas possibilities in meeting energy crisis of Bangladesh is added for increasing the lucrativeness of this sector. Secondly, this paper demonstrates an experiment conducted on the aerobic process, where Microbial Fuel Cells were constructed for proving the electricity generation phenomena occurring in nature directly from untreated waste without any additional electricity requirement.

4.1 Anaerobic Digester, Waste Treatment and Biogas: A viable energy option for Bangladesh

Production of biogas in a wastewater treatment facility by using anaerobic digester is a vastly established technology around the world. Biogas which is a gaseous mixture mostly of methane (60%-70%)[16] come out from the breaking down of organic matter's molecular structure by microorganism in the absence of oxygen.[17][18] Most of the world's developed or developing countries has started to put importance on biogas opportunities for ensuring energy sustainability with a lower CO_2 footprint. [17][19] For example Germany, in 2014 generated 41,550GWh of energy only from biogas utilization technologies and United Kingdom generated a total of 6,637GWh electricity from biogas in 2013, of which 761GWh was generated solely from sewage sludge biogas. [20]

The energy prospects of biogas are many. On the context of Bangladesh, the most relevant prospects are electricity generation from standalone biogas, direct biogas injection into the existing gas network, biogas co-firing with natural gas in existing natural gas power plants and biogas

upgradation to transportation or cooking fuel.[15][21][22] Although vast establishments are required for full evaluation of this prospects, justification can be added to this investments considering uprising electricity demand and price, present gas shortage, readily available biomass, reduced GHG emission and fertilizer byproduct. [12][17][20]

Bangladesh with more than 70,000 biogas plants[23] across the country is continuously increasing the dependency on biogas for sustainable growth.[3][24] State owned various administrative agencies such as, Bangladesh Accreditation Board (BAB), Bangladesh Biogas Development Foundation (BBDF), Bangladesh Council of Scientific and Industrial Research (BCSIR), Infrastructure Development Company Limited (IDCOL) are already providing necessary incentives to maximize the biogas utilization prospects in Bangladesh.

Bangladesh, with a total biomass availability of more than 106 million tons, which yields to about 5.045 billion m^3 of biogas and 26.65 million tons of bio-fertilizer, is still long short in harnessing large-scale anaerobic treatment opportunities. Annually, the human excreta release of the country has the possibility of producing more than 260 million m^3 of biogas, which is equivalent to more than 1.5million MWh of electricity. This renewable electricity generating bio-fuel is not subject to global price variation or availability crisis either in city, village or remote locations, as in the cases of imported or conventional fuels and comes with the green feature of around 2.05million tons of less annual CO_2 emission in nature.[13]

The anaerobic digester (AD) for wastewater treatment and biogas generation comes in different volumes. Sewage sludge will be the main processing material for biogas generation. Percentage of Total Volatile Solid in the sludge, which is in between 40 – 55% of TS from Table-2 will be main portion for biogas generation. Co-digestion is also possible in AD, when the digester is fed with domestic or industrial organic materials beside sewage sludge. The full process of biogas generation consists of pre-treatment of the acquired sludge, which is needed for improved biogas generation. Then loading of the treated sludge in the digester, where required working environment of microorganism is created for proper organic decomposition. This step produces the biogas, which consists of methane, carbon-di-oxide and other trace gases. Finally the generated biogas needs to go through another treatment process, where unwanted contents of biogas such as hydrogen sulphide, siloxanes, trace gases are removed and the biogas is dried up for efficient performance. The sewage sludge treatment through AD gives versatile benefits as most of the biomass present in the sludge decomposes during the process. Reduction in pathogenic values and absence of odor are also notable among the benefits. Moreover the remaining digested sludge in the AD, through proper treatment can be used as a soil conditioner or fertilizer. The methane percentage in biogas generated from sewage sludge is 63 – 67%, which is higher compared with biogases from other feedstock.

Generated biogas can be efficiently utilized in a Combined Heat and Power generation unit for electricity production whereas upgradation of biogas to bio-methane can also be an interesting prospect on the context of Bangladesh. Upgraded bio-methane can directly be fed into existing gas network for minimizing gas crisis of the country or can be used as an alternative option to CNG for vehicle fueling. On this context, it can be noted that more than a thousand commercial full or partial scale biogas-filling stations are operating in Europe now-a-days. The economic

viability of elecricity generation in a combined cycle gas turbine from natural gas and biogas co-firing is also already been illustrated in various studies.[20][13][25][26]

4.2 Microbial Fuel Cell: An emerging waste-to-electricity technology

Microbial fuel cell (MFC) is a promising technology for direct electricity generation from wastewater by the activities of microorganism. Although not yet being as effective as other technologies, the next generation wastewater to electricity generation infrastructure developers should consider microbial fuel cell technology due to their dominating advantages such as direct electricity generation from organic matters, no production of environment polluting gases, higher efficiency etc.[18]



Fig. 5: Collection point of Waste Water (Buriganga)



Fig. 6: Double Chamber Microbial Fuel Cell

In a MFC, microorganisms in the anode chamber generate electrons by breaking down hydrogen. These generated electrons are used to reduce electron acceptor in cathode after they pass through the external circuit. Protons produced in the anode chamber pass through the salt bridge which completes the electric circuit in the case of double chamber MFCs. The electrons travel to cathode and transmit into oxygen. Eq. (1) & Eq. (2) shows the reaction for water formation by oxygen and positive ion in the anode which spreads by the salt bridge:

$$H_2 \longrightarrow 2H^+ + 2e^- \qquad (1)$$

$$O_2 + 4H^+ + 4e^- \longrightarrow 2H_2O \qquad (2)$$

A steady current is generated by this process which can be measured by connecting a wire between anode and cathode.[27] The cathode chamber is kept in an aerobic condition.

To evaluate the promise of MFC in generating electricity from direct biomatter, experiments were conducted where three (3) single chamber MFCs and one (1) double chamber MFC were

built. Voltage difference was measured in all cases as the indicating parameter. Single chamber MFCs were built using consecutively from dry soil from the riverbed of Buriganga river (400g), sandy soil from the riverbed of Buriganga river (400g) and regular variety garden soil (450g). The double chamber MFC was built from Buriganga river outlet wastewater (250ml). Carbon wire net mixed with graphite powder and copper wire was used as anode. In the case of double chamber MFC the salt bridge was made by soaking a rope in a mixture of water, salt and agar agar powder (5 gm). Bacteria variety for the experiment is mainly Escherichia coli. Cathode is filled with a water and salt solution. In each cases glucose was added right after the MFC was built and after each data processings. The voltage difference was taken after several time intervals and without connecting any resistance. Figure 3 shows acquired data from the experiment.

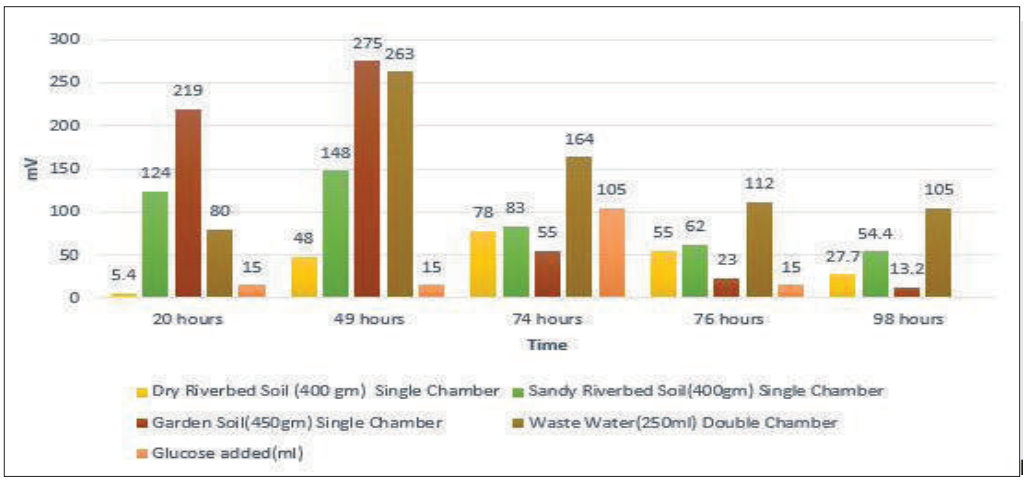


Fig 7: Changes in voltage difference of Different MFC without resistance

Maximum voltage of 275 mV was found for the single chamber MFC build with garden soil after 49 hours and for the double chamber MFC maximum 263 mV was found, while all other MFCs shows electricity generation potential from untreated biomatter. After a period of time, reduction in generated voltage can be seen from the figure which is due to reduced microorganism concentration and is the benchmark feature of wastewater treatment. The experiment was furthermore stretched by constructing two more double chamber MFCs with the previously collected wastewater after 72 hours with volumes 2litre and 300ml respectively. The results show a reduction in generated voltage difference. 93.3mV and 27.7mV respectively were the maximum voltage difference found. The maximum power density, which was 0.079170mW/m^2 in the case of the double chamber built with wastewater right after collection, was reduced to 0.000133 mW/m^2 and 0.000170 mW/m^2 respectively in the cases of two latterly constructed MFCs.

The reduction in results shows the role of toxicity level in wastewater for electricity production. Bacteria concentration is always a big factor as reduced bacterial activity after 72hours yields to lower voltage difference and power density outputs. The experiment was conducted undertaking various obstacles such as impurity of materials used, biomatter percentage of wastewater, oxygen percentage of anode chamber, low chamber capacity etc which may hinder the output parameters. Despite low output values, the conduucted experiment can be used to highlight the electricity generating prospect of MFC technology.

MFC technology although still not upgradable to commercial power production, can be seen as a viable option for future energy generation. This technology is gaining more and more interest from researchers around the world and already significant improvement has been achieved in this sector. At laboratory scale, MFCs has reached current densities of 10A per m^2 of anode surface area. Expexted current density of a MFC is 1000A per m^3 reactor volume when minimum 1cm cell thickness is considered for wastewater pumping. This process represents wastewater treatment capacity of 7.1 kg COD per m^3 reactor volume per day. This range is somewhat similar to a conventional activated sludge or a high-rate anaerobic system wastewater treatment facility.[28]

In order to find alternative energy sources to ensure energy sustainability of Bangladesh, consideration of MFC technology as a future option may open new horizon of clean sustainable energy and this technology which occurs in aerobic medium i.e. at open environment, is more easily integrable with wastewater treatment facilities.

5. Conclusion

The main objective of this paper was to identify human sludge as a solution towards the power crisis of Bangladesh. The present sanitation scenario of Dhaka city was illustrated for providing a justification towards considering human sludge as a possible energy generating biofuel while ensuring appropriate wastewater management. Various concepts of electricity generation simultaneously with wastewater treatment were explained during the study with other possible and profitable outcomes. Law enforcement is the vital issue for getting the benefit from human wastes. Although further studies are required before implementation of above mention possibilities, the finding of this paper can be viewed as the starting point towards a milestone of various achievements where sustainable electricity generation is coupled with proper wastewater treatment, less environmental hazardousness, harm-free aquatic life and fulfillment of Sustainable Development Goals.

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Imminent Sustainable Economic Development of Bangladesh with Coal Based Power Plants

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Abstract

Power generation is the most important concern of Bangladesh for sustainable development. In electricity generation Coal will play an important role for the Sustainable Future in Bangladesh. Like others Bangladesh also wants to find a way to Energy solvency by taking several Coal fired Power Plants projects. In this paper the amounts of daily carbon emission in 2030 by future coal based power plants are calculated. New technology named Scrubber by Carbon Nano Tube is only able to reduce the impact of that large amount of carbon on environment. The paper outlines the generation of power in Bangladesh with greater environmental treat which is being managed within the framework of sustainable development: economic, social and environmental.

Index Terms *- Sustainability, Development, Coal, Environment, Socio-Economic*

1. Introduction

In developing countries energy contributes to the improvement of human, economic, social and environment which is essential to sustainable development. So in that case energy supplied in clean way is the basis for the nurturing the standard of living, quality of living and quantity of human capital and enlightening the government policies. In recent future energy generation with coal based power plant in a more cleaner and environment friendly way will reach the real sustainable economic development.

2. A Developing Country Perspective

Actual sustainable economic development and environment sustainability energy poverty remains a large problem in many portion of the world. Almost 1.3 billion people mostly in rural area in Bangladesh are total rely on traditional biomass energy. That's why in developing countries, demand for energy is growing exponentially due to rapid population growth and rapid economic expansion. This is projected to lead to a near doubling in primary energy use, much of it unsustainable, in the next two decades by developing countries. As a result of this growth, developing countries will account for 50% of primary energy use and 50% of energy related CO2 emissions by the year 2030. In developing countries huge investments are needed for producing, converting, transporting and distributing energy to meet future needs. Most of this investment is needed in the power sector, particularly in Bangladesh, China, India and other Asian countries. Other regions need financing also for oil and gas development and use. It is a dual challenge at these high levels investments. To attract the enough private investment and assistance for development,

governments have to set some policies. With the accompany of governments, investors and donors, need to find more effective and less affluent ways of delivering energy services so that the financial savings might be devoted in other sustainable development desires. They should also guarantee for sustainable designs of production and consumption of energy supplies and services. Insufficiency in accessible electricity and maximum dependent on less efficient as well as unsustainable long-established fuels such as charcoal, animal dung and agricultural waste are both explanations and motives behind scarcity. Electricity and other current energy sources bring upon economic and social development to a country. At present day, the life of the poor has been upgraded through energy services in countless ways. Light turns night into day in other terms lengthen the day by electricity which provides extra hours to work. Latest cooking stoves such as i.e. heater, microwave save women and children from daily disclosure to toxic cooking fumes. Besides foods kept in the electric refrigerators expand its freshness and avert wastage. The below diagram shows the importance of energy in a sustainable way for developing country is given below:

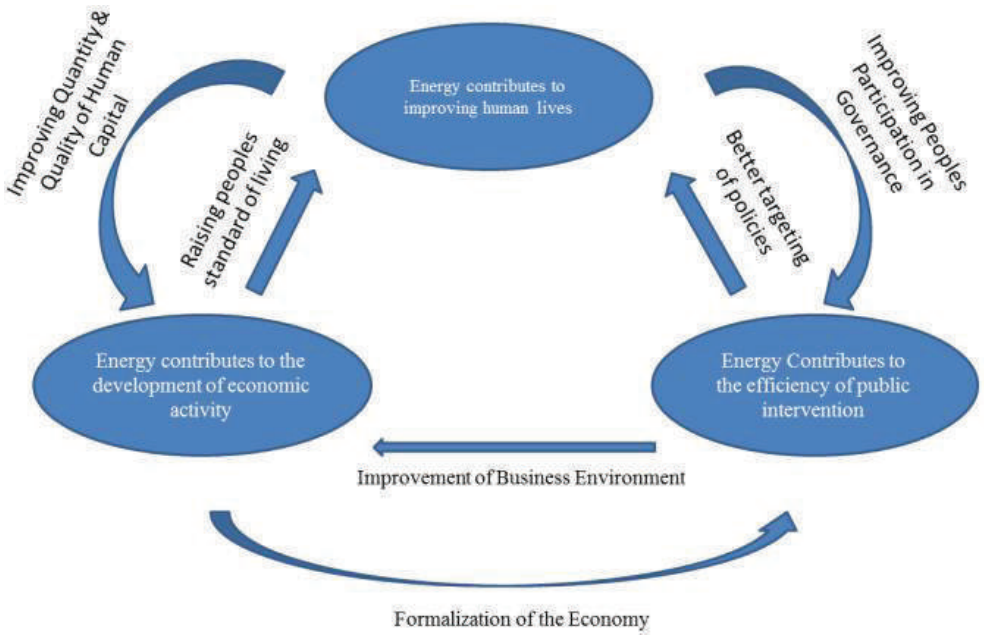


Fig 1: Energy Needed for Developing Countries

For accomplishing Millennium Development Goals (MDGs), the number of people lacking electricity would essential to reduction to below 1 billion and those depend on on biomass would need to fall to 0.7 billion by 2030.

3. Power Demand Forecast (Up to 2030)

Bangladesh continuously developed her economy. So energy is the fuel of increasing economy. Energy used of different sector like garments, mining, re rolling and agriculture are growing day by day. Specially in the next fifteen years the energy consumption growth in a greater extent. If the

government will able to fulfil the demand of energy, Bangladesh economically will be stronger in the world. The adoptions of scenarios of the power demand forecast in the next fifteen years are as shown in the figure 2.

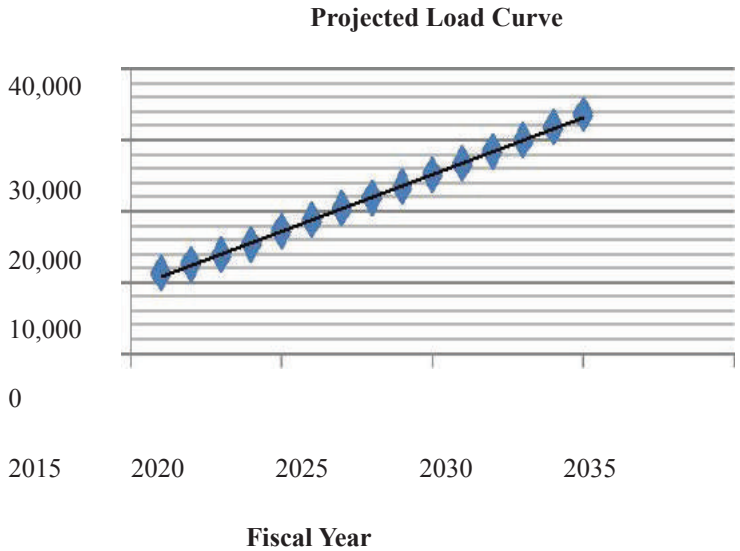


Fig 2: Project Load in Bangladesh Up to 2030

4. Scenario of Power Development Plan

Four cases such as fuel differentiated, domestic coal preferment, imported coal preferment and gas preferment are discussed. Form four cases, the best case for future power development plan are selected. The following cases are examined in consideration of uncertain events in regards to the power development plan.

Tab. 1: Scenario of Power Development Plan

Cases	Concept
Case 1: Fuel Differentiated Case (Base Case)	Development plan by using optimum power sources. Based on the coal development such as developing new domestic mining, increasing the amount of imported coal and growing existing mining capacity securing fuel supply. Also using various sources of energy like natural gases, fossil fuels and renewable energy.
Case 2: Domestic Coal Preferment	For the Base Case, fuel supply mainly depends on a large-scale increase in production at domestic coal mining.
Case 3: Imported Coal	For the Base Case, fuel supply mainly depends on imported coal

Preferment	due to a long dated to develop domestic coal mining.
Case 4: Gas Preferment	For the Base Case, fuel supply mainly depends on new own gas development and gas procurement protected from a long term perspective.

Prime energy supply is the basis of the power development plan. So renewable energy, cross border and the nuclear power generation is the light of any power development plan. The gas supply case will decrease gradually from its peak in 2017 due to the lack of gas production according to PSMP study of Bangladesh government. Power development with oil is also deemed due to the smaller source. So that power development plan is determined by the combination of coal and oil, is accepted as the best case in our study.

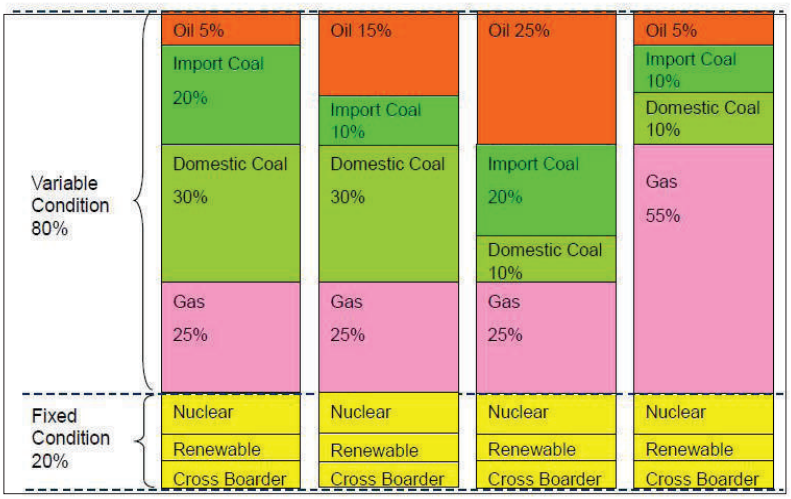


Fig 3: Fuel Wise Composition of Each Case

The below table shows the projected production capacity of power by 2030 depends on primary sources which are plan by Bangladesh.

Tab. 2: Projected Production Capacity of Bangladesh By 2030

Description	Capacity(MW)
Domestic Coal	11250
Imported Coal	8400
Domestic Gas/LNG	8850
Nuclear	4000
Regional Grid	3500
Others (Oil, Hydro and Renewable)	2700
Total	**38700**

For future power development plan of Bangladesh, coal is taken the most primary energy source. This plan is more likely similar to Case 1.

That means the fuel differentiated case has been selected as the most optimum scenario, is able to secure Economy and Energy Security but Environment will be in great threat. Finding the best way able to ensure 3E (Economy, Energy Security and Environment) is our destination.

5. Projected Coal Based Power Plant

Advancing development on a sustainable path and securing the investments needed to meet rapidly growing energy demand. Governments must set out striking framework for fulfilling the demand and maintaining the development and make it sustainable.

That's why Bangladesh government took twenty seven (27) coal based mega power plant to meet the energy demand in 2030 as well as sustainable development. The below table V shows the coal based power plant in 2030 with capacity. So it is clear that in 2030, almost 20000MW electricity will generate from coal.

6. Carbon Emission by the Proposed Coal Based Power Plants

Basically no power plant operates at their full capacity. Carbon emission is rest on the amount of generation. To simplify the calculation an arbitrary generation profile is taken for a typical day. The class of the coal is also the main reason for carbon discharge. There are many varieties of carbon is available in the international market. Categories of coal and their properties is shown in the below table. Bituminous is taken in this calculation which releases least carbon.

Tab. 3: Scenarios of Power Development Concepts

Fuel	CO2 Emissions Factor (Lbs. of Co2 per Million Btu)	Heat Rate (Btu per KWh)	Lbs. CO2 per KWh (CO2 Emissions Factor X Heat Rate/1000000
Bituminous	205.3	10,107	2.08
Sub-Bituminous	212.7	10,107	2.16
Lignite	215.4	10,107	2.18

An arbitrary generation profile for a typical day is given below in the table: (Here Rampal Coal based power plant takes as base)

Tab. 4: Arbitrary Generation Profile for A Typical Day

Time	Hour of Operation	% of Load over Full Capacity	Generation in MW	Output in MWh	Output in KWh	CO_2 Produced in LBS	CO2 in Million Kg
6:00AM to 10:00AM	4	20%	264	1056	1056000	1056000	1.0
10:00AM to 02:00PM	4	80%	1056	4224	4224000	4224000	4.0
02:00PM to 03:00PM	1	30%	396	396	396000	396000	0.4
03:00PM to 06:00PM	3	80%	1056	3168	3168000	3168000	3.0
06:00PM to 10:00PM	4	40%	528	2112	2112000	2112000	2.0
10:00PM to 12:00AM	2	20%	264	528	528000	528000	0.5
12:00AM to 06:00AM	6	10%	132	792	792000	792000	0.7
Total	24			12276	12276000		11.6

Now the amount of carbon di oxide and carbon emission by 2030 in Bangladesh per day is calculated in the below table:

Tab. 5: Proposed Coal Based Power Plants & Their Capacity And Carbon Emission

Name of Power Plant	Capacity	CO2 Produced in Million Kg/Day
Barapukuria Coal Power Plant	1570	13.8
Bhola power station (S Alam)	217	1.9
Boalkhali power station (Beximco)	540	4.7
BPDB/TNB Joint Venture coal plant Unit 1 & 2	1320	11.6
Chittagong power station (Orion & S Alam 1 & 2)	1603	14.1
Gazaria power station (Orion & RPCL)	985	8.6
Kalapara power station Phase I Unit 1&2, Phase II Unit 1&2	2640	23.2
Khulna power station (Orion)	660	5.8
Maheshkhali power station (Huadian) Unit 1 &2, KEPCO	2640	23.2
Matarbari power station Unit 1 & 2	1200	10.5
Mawa power station	660	5.8
Mirsarai power station Unit 1 & 2	300	2.6
Patuakhali power station Unit 1 & 2	1320	11.6
Phulbari Coal Project	1000	8.8
Rampal power station Unit 1 & 2	1320	11.6
Total	**17975**	**157.7**

As our approximate generation profile all the coal based power plant in Bangladesh by 2030 will produce 157.7 million Kg of carbon for every 24 hours of operation.

7. Responding to Climate Change

Everyone is now aware about the climate change and Environment. For industrialised revolution world's top scientists agree that CO2 emission will do a great hamper in the environment. It is also clear that for that reason the main culprit is CO2. Due to the burning coal carbon is produced. Increasing levels of CO2 in the atmosphere have produced greenhouse effect which is warming the earth.

At the end of 21st century the earth's temperature could increase 1.1 to 5.8 degree centigrade for the emission of CO2. If it will happen it would be devastating for the world and mankind and all other species.

So that it is really tough to predict exactly what will be the true impact.

- Extreme weather patterns, storms, droughts and flooding.

- Rising sea levels causing coastal flooding
- The extinction of many species due to their inability to adapt to the changes in the ecosystem

The evidence of happening already been seen. The ice are melting, flooding is regular news in Bangladesh now a days. The weather showing symbols of becoming erotic.

8. Pollution Control & Proposed Technology

Different researcher already developed some membrane based Scrubber which are able to filter the CO2. But the feasibility of this model is very low. So that we want to ideate a Scrubber by Carbon Nano Tube (CNT), using a very important property of CNT is highly absorbent. It will be helpful for getting 3E (Economy, Energy Security and Environment) in Bangladesh. It will be very feasible for coal based power plant for this criterion.

The main mechanism of this scrubber is that, the CNTs were grown to be vertically aligned on silicon wafers, and then embedded in polymer. After specialized processing, the CNT composite material was removed from the wafer. To enable CO2 selectivity, the surface of the membrane was either functionalized or coated with small molecules or polymers.

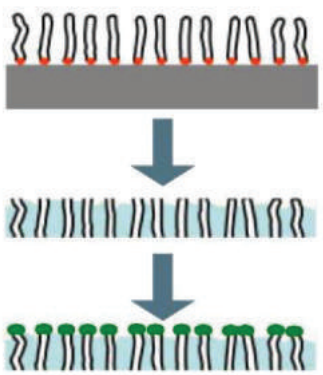


Fig 4: Schematic Diagram of Scrubber Technique by Carbon Nano Tube

9. Pollution Control & Proposed Technology

With the development of Bangladesh, fulfilling the demand of energy by 2030 coal based power plant is only solution because of securing energy and Economy. But coal based power plant is a great threat for environment. For ensuring 3E (Energy security, Economy and Environment), a new technology is introduced which is able to reduce the carbon discharge of coal based power plant and make the plant environment friendly. Through our study it is able to establish a sustainable economic development by coal based power plant with carbon nanotube scrubber.

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Paradigm Shift in Disaster Management: Bangladesh Experience

Dr. Mahfuzul Haque[1]

Abstract

There has been a paradigm shift in disaster management from traditional relief and rehabilitation to disaster risk reduction. This paradigm shift has been aptly reflected in the Standing Orders on Disaster 2010 and several other plans, policies and guidelines adopted by the government from time to time. They have put emphasis on the importance of disaster risk reduction as well as strengthening coping strategies and emergency response system.The paper argues that due to this paradigm shift from responding after a disaster to pre-disaster mitigation and preparedness,there has been less deaths and loss of properties in recent years in the coastal districts of Bangladesh. The paper also looks into various coping strategies of the local community and the government's emphasis on them and argues that community based disaster management instead of traditional top-down approach is another paradigm shift which did lessen deaths and damages due to a disaster.

Keywords: Coping strategy; Disaster Management; Disaster Risk Reduction; and Emergency Response

1. Introduction

Due to its geographic location and geophysical conditions, Bangladesh has turned out to be one of the most disaster-prone countries in the world. The location of the off-shore islands and the triangular funnel shape of the Bay of Bengal have made the coastal areas susceptible to cyclone and tidal surges. Out of 35 million people in 710 km long stretched coastal areas of Bangladesh, 7 million people live in high disaster risk. Government has made considerable success in managing natural disaster in Bangladesh. Although, the loss of properties was huge during the cyclones of *Sidr* in 2007 and *Aila* in 2009, the loss of human lives were only 3,406 and 190 respectively due to effective networking and coordination between and among various levels of the Government and NGOs concerning disaster risk reduction and preparedness programs. During the earlier days, loss of lives and properties was very severe during disasters like floods and cyclones. Cyclones of 1970 and 1991 killed as many as 300,000 and 138,882 people respectively in the coast of Bangladesh (Bangladesh Met Office 2009).However, due to effective disaster management during pre-disaster, disaster and post-disaster period, loss has been substantially reduced. It is to be noted that the disaster management practices have evolved from largely a top-down relief and response approach to a more inter-sectoral risk management approach (Yodmaniundated). Disasters are no longer seen as extreme events created entirely bynatural forces but as manifestations of faulty development processes. There has been a paradigm shift in disaster management from post-

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disaster relief operation and rehabilitation to disaster risk reduction.In the currentparadigm of risk management approaches, there is more room than ever foraddressing the issues of risk reduction.

Disaster Management includes all aspects of planning and response to disasters. It refers to the management of both the risk and the consequences of disasters. It suggests prevention and preparedness measures are taken in anticipation of known hazards ("pre-disaster" situation). There is a long-term rehabilitation (often referred to as "post-disaster reconstruction")programme in order to prepare the local community face the wrath of disaster with confidence.

Traditional policy planners used to put emphasis mostly on disaster relief operation, which later gradually changed to an emphasis on preparedness measures, such as stockpiling of relief goods, preparedness plans and a growing role for relief agencies such as the Red Crescent. This contingency planning approach certainly improved the efficiency of the volunteers and relief agencies but left a lot to be desired in terms of appropriateness and effectiveness of relief.Till a few decades ago, disasters were viewed as one-off events and responded by the governments, donor agencies and relief agencies without taking into account the social and economicimplications and causes of these events. With significant advancement in ourunderstanding of the natural processes that underlie the hazardous events, a moretechnocratic paradigm came into existence. These approaches looked at disasters as exceptional events.

Over the four decades from the sixties, till the nineties there was an exponentialincrease in human and material losses from disaster events, though there was no clearevidence that the frequency of extreme hazard events had increased. This indicatedthat the rise in disasters and their consequences was related to the rise in thevulnerability of people all over the world that was induced by faulty development practices. Noteworthy also was the recognition that this increase invulnerability was not uniform. There were large variations across regions, nations,provinces, cities, communities, socio-economic classes, castes and even genders.

From this realization that people's vulnerability is a key factor determiningthe impact of disasters on them, emphasis shifted to using "vulnerability analysis" asa tool in disaster management. In recent years, a more comprehensive approach thatof disaster risk management has emerged. This approach has three distinct but interrelatedcomponents: hazard assessment, vulnerability analysis and enhancement ofmanagement capacity and is more closely integrated with the ongoing developmentprocesses. Disasters are no longer viewed as extreme events created entirely bynatural forces but as unresolved problems of development. It is now recognized thatrisks (physical, social and economic) unmanaged (or mismanaged) for a long timelead to occurrence of disasters.
This evolution of approaches from relief and response to risk management has begunto influence the way disaster management programmes are now being planned andfinanced. There are initiatives aimed at reducing social and economic vulnerabilityand investing in long-term mitigation activities. Unfortunately, such initiatives aimedat prevention and mitigation are few, poorly funded and insignificant in comparisonwith money spent by donors and development banks on humanitarian assistance andrelief, as well as on post disaster reconstruction.Therefore, in the current paradigm of risk management approaches,there is more room than ever before for addressing the issues of risk reduction for thepoor. This is also in consonance with the paradigm shift in the mainstreamdevelopment practice, which is now characterized by emphasis on good

governance,accountability and greater focus on bottom-up approaches.Similarly, community based disaster management, a term coined by the development practitioners also gaining ground as increasing emphasis was given on the local knowledge and practices in disaster management.

2. Global Scenario

Disaster loss is on the rise with grave consequences for the survival, dignity andlivelihood of individuals, particularly the poor, and hard-won development gains. Disasterrisk is increasingly of global concern and its impact and actions in one region can have animpact on risks in another, and vice versa. Against the backdrop of such an alarming situations, the World Conference on Disaster Reduction was held in 2005 adopted the Hyogo Framework for Action (HFA) 2005-2015. It urged all countries to pursue an integrated multi-hazard approach for sustainable development to reduce the incidence and severity of disasters.The Conference provided a unique opportunity to promote astrategic and systematic approach to reducing vulnerabilitiesand risks to hazards.Itunderscored the need for, and identified ways of, building the resilience of nations andcommunities to disasters.

"Sendai Framework for Disaster Risk Reduction (2015-2030)" adopted at Sendai, Japan in March, 2015 is built on elements which ensure continuity with the work doneby States and other stakeholders under the HFA and introduces a number of innovations as called for during the consultations and negotiations. Many commentators haveidentified the most significant shifts as a strong emphasis on disaster risk managementas opposed to disaster management, the definition of seven global targets, the reductionof disaster risk as an expected outcome, a goal focused on preventing new risk, reducingexisting risk and strengthening resilience, as well as a set of guiding principles, includingprimaryresponsibility of states to prevent and reduce disaster risk, all-of-society andall-of-State institutions engagement. In addition, the scope of disaster risk reduction hasbeen broadened significantly to focus on both natural and man-made hazards and relatedenvironmental, technological and biological hazards and risks. Health resilience is stronglypromoted throughout.

International community also recognized contribution of indigenous knowledge and practices in disaster risk reduction, climate change and natural resource management. Sendai Framework for Disaster Risk Reduction (2015-2030) put emphasis on indigenous knowledge and practices and coping strategy of the local community in facing challenges of natural disaster.

3. Bangladesh Scenario

During the start of the new century, a series of plans, policies and action plans were taken by the government targeting reducing disaster impacts. In line with Hyogo Framework for Action (HFA) 2005-2015, Bangladesh adopted the Standing Orders on Disaster (SOD) in 2010describing the role and responsibilities of Committees, Ministries, Divisions, Departments and other orgnizations involved in disaster risk reduction and emergency response management. SOD detailed out risk reduction; activities to be undertaken by various agencies during the warning period; during disaster and post disaster period. SOD has become a unique document for the volunteers and officials engaged in disaster management. Due to shift from relief and rehabilitation to disaster warning and disaster risk reduction, as laid down in SOD, casualties decreased a lot. Another

important document, the National Plan for Disaster Management (NPDM) 2010-2015 of Bangladesh undertook a simplistic model to guide disaster risk reduction and emergency response. The model has three key elements, defining the risk environment; managing the risk environment; and responding to the threat environment. NPDM promoted understanding the social, political and community environment; established likely threats; examine likely consequences; ranking risks and identified actions to eliminate, reduce or manage risk. The second element promoted community based adaptation programme; and the third element helped the disaster management officials to articulate the difference between risk reduction and emergency response (NPDM 2010). Response included warning period (alert and activation); disaster onset (response); and post-disaster period (relief, early recovery and rehabilitation).The government adopted the Bangladesh National Disaster Management Guidelines in 2015, whichin its objectives, put more emphasis on disaster risk reduction, food and livelihood security. The Guidelines laid emphasis on adaptation to climate change and overall disaster risk reduction.

Plans and policies cannot be enforced unless followed by legislations. Accordingly the Disaster Management Act 2012 was enacted, which made provision of setting up of an authority to try the offenders responsible for failure to reduce disaster risks; failure in protecting lives and livelihoods of people; failure to predict and undertake contingency measures relating to natural disasters etc. The act suggested a national fund for disaster response, relief and rehabilitation activities and it could declare an area as a "Distressed Area" in order to prevent people from undertaking any destructive activities. Earlier, embankments were damaged, holes were made allowing intrusion of saline water for shrimp cultivation which caused serious damages to embankments during storm surges. It would create water logging and there was no punishment for the offenders. Under this act, offenders could be tried, a major breakthrough in disaster management.

4. Community-based Disaster Management

According to Pandey (Undated), Community Based Disaster Management (CBDM) approach promotes a bottom-up approach working in harmony with the top-down approach, to address the challenges and difficulties. Community based disaster risk reduction aims to reduce the vulnerability and enhance the resilience of local communities to the impacts of disaster (Gero*et al* 2010). The approach helps the local communities to analyze their hazardous conditions, vulnerabilities and capacities as they see themselves in the face of a disaster. In case of disasters, the people at the community level have more to lose because they are the ones directly hit by disasters, whether major or minor. They are the first ones to become vulnerable to the effects of such hazardous events. The approach provides opportunities for the local community to evaluate their own situation based on their practical experiences initially. Under this approach, the local community not only becomes part of creating plans and decisions, but also becomes a major players in its implementation. Furthermore, by incorporating local knowledge, communities are far more likely to be engaged and actively participate in the project.

How do they survive during and after a cyclonic disaster? What are the indigenous survival strategies? In a study conducted on the people of the coastal islands, it was revealed that the islanders have developed certain short term survival strategies of their own (Hassan 2000). Simple tactics like holding onto and binding themselves to trees; looking for comparatively more

dependable places like embankments and polders; using floating items such as timber, thatched roof, straw piles and bunches of coconuts represent spontaneous survival strategies. People of the locality have also devised appropriate methods for food preservation during cyclones and tidal surges. Emergency dry foods like *Chira* (flattened rice) and molasses are wrapped up in polythene and kept in earthen pots buried under the earth. They become handy when the water is gone. Self-protection instinct dominated the indigenous survival strategy. The women prefer putting on *Salwar* and *Kamiz* dress instead of *Saris* (traditional female dress in South Asia), as the later makes it difficult to swim. During aftermath of a disaster, coping strategies work well with the help of the community members to their mutual benefit. Generally, outside help and relief goods appear 2/3 days after the disaster. What do they do during this intervening period? People eat stems and roots of edible plants. For drinking purposes, they drink rain water, as cyclones are always followed by rain for several hours. In absence of rainwater, they share coconut water. Due to non-availability of medicines, generally, the victims depend on herbs and other local substances for treating minor injuries, fever and diarrheal diseases.

Among structural measures, the people in the coast are seen using roofing materials and design (sloping the wind direction). They plant local varieties of plants surrounding their homesteads. In Sandwipisland, people plant *Hurma* (*Persimmon*) trees, which are strong and can withstand tidal waves. Lives of many people were saved during the April 1991 cyclone, as they held on to trees of mangrove species, like *Keora (Sonneratiaapetala*) and *Sundari* (*Heritierafomes*).Another interesting phenomenon was that during tidal surges, people tied rafts to coconut trees so that they rose and fell with the level of the water (Haque 2000).

5. Future Challenges

Future challenges in effecting the paradigm shift could be as follows:

a) The mindset of the people, the victims are to be changed. Primitive notion that the donors would come with relief materials is no more in disaster parlance these days. Under the disaster risk reduction, people are prepared for the pre-disaster and post-disaster period;

b) There is also another notion that distribution of relief materials among the victims is the sole responsibility of the government and the voluntary agencies during the period of disaster needs to be changed as well. According to SOD, various committees at village and upazilla levels are entrusted with the responsibilities to prepare people to face a disaster. Trained volunteers are there to rescue people from the disaster;

c) Sometimes it is found that the associated administrators are not willing to accept the opinion of illiterate but wise and experienced local people in policy formulation process and it needs to be changed;
d) Regular training of national and local volunteers is required and allocation of adequate financial resources is necessary;

e) In absence of common forum, lack of inter-agency coordination, confusion of jurisdiction of work, lack of mutual trust and respect often pose threats for community based disaster management;

f) Women do not want to leave their residence and take shelter in the cyclone shelters during the disaster mainly due to lack of privacy and sanitation facilities for them;

g) Effecting coordination between and among various agencies of the government at all levels and the non-government agencies continue to remain a challenge; and

h) Continuation of good environmental governance is a big challenge, which needs to be overcome.

6. Conclusion

A disaster-prone country like Bangladesh over the years was able to decrease the number of deaths and loss of properties, mainly due to this paradigm shift reflected in various plans, policies and action plans adopted by the government on disaster management. Bangladesh's disaster management model did attract attention of the global community, as they have been striving to lessen casualties due to increasing disasters. The challenge remains on effective implementation and updating of the standing order and rigorous monitoring of the authorities on its enforcement. In order to overcome these challenges, good environmental governance is necessary, which would be transparent, pro-people and taking all policy measures and legislations following discussions in the Parliament. Such policies and plans are to remain unchanged irrespective of changes in the government.

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Implementation of Green Business Practices in Bangladesh

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Abstract

The paper presents the extent listed companies in five sectors of Bangladesh have complied with green business practices and the effects of its compliance to the financial performance of the company. Research has been carried out to test whether businesses attempting to comply with green practices have been able to serve its profit objective simultaneously. The second fold of the paper identifies the industry most relevant for green business due to its current environmentally detrimental attributes and the necessity of doing such. It is found that there is a weak positive relationship between green business compliance and profitability. And the most relevant industry for green business is the one that is most accountable for environmental contamination. Tannery industry is the industry that plays a huge role for negative impacts in the environment. Secondary data has been used such as annual reports, journals, magazines and so on.

Keywords: green business compliance, green business, profitability

1. Introduction

The issue of "Green Business" originated during the mid 1960s and appeared in the 20th century. These are some of the definitions "an establishment that produces green output" (Brown, Ratledge, 2011) and , Makower and Pyke, stated that "a green business requires a balanced commitment to profitability. The least possible functions such as enhance or ensure environment of the country, provides safe working place with proper benefits and wages to its workers, provides safe and environmentally friendly products or services to its consumers and ensures the wellbeing of the society makes it distinct.

Environmental concerns have been addressed earlier in developed nations and various laws have been enacted considering the hazardous destructive effects of industrial activities. But it has been a vital issue for a developing country like Bangladesh. This country is prone to many naturally disasters such as, floods, water, air, soil and noise pollution due to uncontrolled industrialization and increasing population growth. The concept of „Green Business" will give the perfect solution to the environmental problems that will help Bangladesh build a healthy for future generations. As these businesses are based on sustainable principles that has fewer or no negative effect on the environment, community, society or economy, it improves the quality of life for their customers, employees, communities and the life on earth.

Moreover, the performance of a business is not only evaluated based on its financial consequences, but also with regards to its involvement to guard and enhance the environment. Environmental issues also have become an imperative factor used by the investors and creditors to verify the risk related with their investment. It is crucial to take responsibility of environmental costs that may have arisen due to rapid consumption of natural resources for industrialization

2. Sample Selection and Methodology

Here only secondary data were used . To collect secondary data 100 companies listed in DSE have been checked . It is found that only 10 ISO 14001 certified company. The annual reports of 2014, 2013 and 2012 have been taken to search environmental reporting disclosure in those companies. All the information taken from relevant books, journals, articles, seminar papers, magazines, daily newspapers and different websites have been properly quoted.

2.1 Sampling Technique

This study covers 100 companies that has been chosen randomly and total 300 years" annual report. So total sample size is 100. All the data for analysis has collected from annual report

2.2 Sample Design

Sector	Sample Companies	ISO 14001 Certified Companies
Construction	26	4
Food	6	0
Fuel & Power	7	1
Jute	3	0
Misc	4	1
Paper	2	0
Pharmaceutical	10	3
Tannery	5	0
Textile	37	0

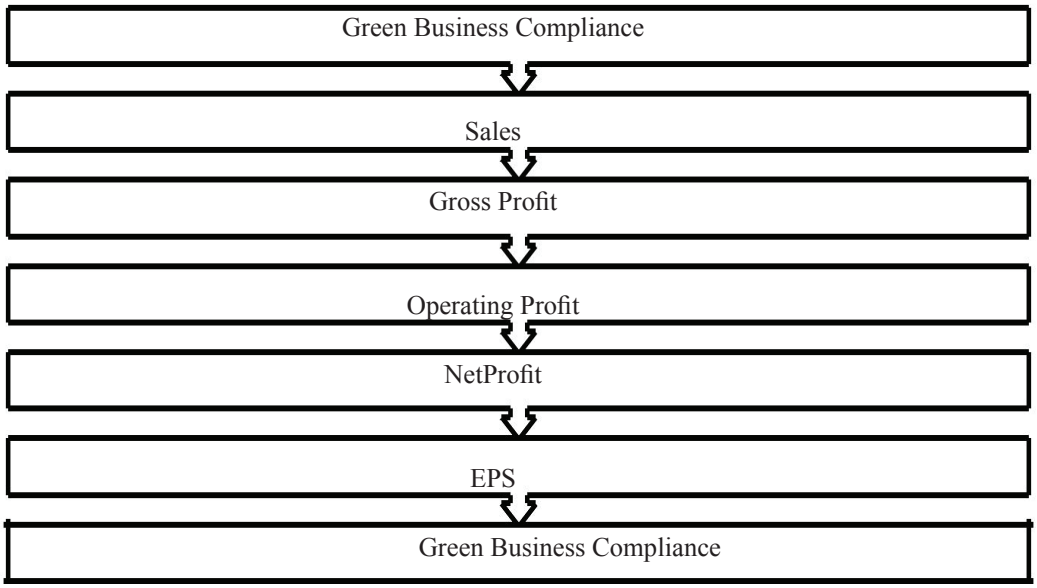
2.3 Analytical Tools

MS Excel was used to accumulate data. Then these data was used as SPSS input to further analyze our study. As a result, these are the tools used to derive the statistical conclusion:

- Regression Analysis
- Pearson correlations

Moreover, descriptive statistics have been comprehended through the application of tables and charts in the report.

2.4 Variable Design



3. Prior Research and Literature Review

This paper is related to the very substantial body of research on various aspects of sustainability. Prior research by Mukhtar Ahmad presented comprehensive study on the conception of green business practices which are crucial for improving environment and the profitability of the business. The followings were the findings that green business enhances the use of business activities which are favorable for the environment and facilitate in establishing environmental efficacy. It also helps identifying the payback that business will get by greening its activities. Moreover, Green business helps in making a balance between environmental sustainability and financial performance of the business, Green business principles facilitate in restraining the harmful environmental effect of business practices, Green business principles aid in escalating yield and lower costs. Green business will also assist in growing productivity in operations; Green business will assist in conservation of natural resources. Labor Standards, environment health, safety and sound economic transactions.

And it also addresses the following challenges that may arise due to implementation of green business principles such as environmentally-friendly products advertising and manufacture requires high initial investment, Green products can be accessible to consumers at costs that are higher in compare to other goods, Lack of assistance from the government, Lack of awareness about the availability, usage and benefit of green products or services.

Another study by Collins C. Ngwakwe (South Africa) have worked on identifying the function of green investment principles on sustainable development and the attributes of a structure to Aid green investment acceptance. As a result, this paper is central since the factors impel

for climate transformations impact such as population growth, financial factors (e.g income per capita, regional variances), industrial f actors (energy provision, energy efficiency), land utilization (farmland, energy biomass), energy factors (coal, oil, gas, renewable, nuclear) and agriculture necessitate to be in effect exploited in line with climate alleviation agendas (Karl and Trenberth, 2003; Houghton, 2007)

4. Results and Analysis

The study began by surveying the annual reports of a number of companies in each of the six sectors of Bangladesh such as the construction, Food, Power, Textile, Tannery, Pharmaceutical industry, Jute, Paper and Other miscellaneous. The activities of these companies have been investigated to find out whether they are environmentally compatible and perform functions such as employment of natural resources, efforts towards removal of environmentally harmful material, ensure minimal emissions of carbon and so on. Then these activities have been quantified based on its level of compliance in order to get the association with the firm‟s financial performance in terms of profitability.

According to previous research, the greening process should give profitability benefits such as high marketability of Green products, operational costs savings, minimized Green risks, and financial instruments and so on. Thus, implementation of Green business principles should result in increased market share and high resource efficiency and can conclude to financial benefits to green investment.

That means if firms with high environmental consciousness may also help to achieve high profits which are the main concern of a business. As the Green Business solutions will result in lower environmental penalties, environmental license, the firms in Bangladesh will be able to provide sustainable products in the world market. And so in order to test this theory, the following relationships have been scrutinized.

Green business will help to keep the financial position of the business and environmental standards in line. It is supposed to help lower costs and improve productivity.

Internal Operations refers to the firm‟s responsibility towards its employees and environment, community contribution refers to the contribution done by firms for the society, Green compliant product refers to the extent the company‟s products are green and these variables are briefly elaborated in Table-5. Pearson correlation has been conducted to find out the following relationships between the Profit variables (Sales, Operating Profit, Profit before Tax, Net profit, EPS and Gross Profit) and Green Compliance variables (internal operations compliance, community contribution, Green Compliant product, consumer responsibility and other green compliances) to verify the associations concluded by previous researchers.

v Operating Profit has the following Pearson relationship with the green business compliance variables

- It has a weak positive relationship with internal operations compliance, community contribution, green compliant product and other green compliances

- It has a weak negative relationship with consumer responsibility

v Profit Before Tax has the following Pearson relationship with the green business variables

- It has a weak positive relationship with internal operations compliance, community contribution, green compliant product, consumer responsibility and other green compliance.

v Net profit has the following Pearson relationship with the green business variables

- It has a weak positive relationship with internal operations compliance, community contribution, green compliant product and other green compliance,

- It has a weak negative association with consumer responsibility

v EPS has the following Pearson relationship with the green business variables

- It has a weak positive relationship with internal operations compliance, community contribution, green compliant product and other green compliance,

- It has a weak negative association with consumer responsibility

v Gross Profit has the following Pearson relationship with the green business variables

- It has a weak positive relationship with internal operations compliance, community contribution, green compliant product and other green compliance,

- It has a weak negative association with consumer responsibility

Prior research by Mukhtar Ahmed explained that endorsement and use of environmental friendly techniques will differentiate the business separate from its eco-friendly products hich helps attract and retain new customers. So it can be concluded that compliance of Green Business Principles should result in increasing sales and show a positive relationship between them. Hence, a Pearson correlation between Sales and Green Business compliance variables like internal operations compliance, community contribution, Green Compliant product, consumer responsibility and other green compliances has been carried out to validate their relationship.

v Sales has the following Pearson relationship with the green business compliance variables

- It has a weak positive relationship with internal operations compliance, community contribution, consumer responsibility, green compliant product and other green compliances

- It has a weak negative relationship with consumer responsibility

- Internal Operations compliance has the following Pearson relationship with Sales and the Green business compliance variables
    - It has a weak positive relationship with Sales, consumer responsibility and other green compliances
    - It has a moderate positive relationship with community contribution.
- Community contribution has the following Pearson relationship with Sales and the Green business compliance variables
    - .It has a weak positive relationship with Sales, consumer responsibility, other green compliances
    - It has a moderate positive relationship with internal operations compliance.
- Consumer responsibility has the following Pearson relationship with Sales and the Green business compliance variables
    - .It has a weak positive relationship with other green compliances, Internal operations compliance and community contribution.
    - It has a moderate positive relationship with Green compliant product
    - It has a weak negative relationship with Sales.
- Other green compliance has the following Pearson relationship with Sales and the Green business compliance variables
    - .It has a weak positive relationship with internal operations compliance and community contribution. Green compliant product and Sales.

Since, the sample size for the Food, Power, Textile, Tannery and Pharmaceutical industry is significantly large. Therefore, a comparison of Green Business principle compliance has been done between these industries. Furthermore, the involvement of firm‟s green investment practices have been scrutinized that is investments made in green energy technologies, buildings, financial products, waste management, energy savings and research and development.

Hence, it is found that the highest level of implementation of Green business activities are found in the construction industry (26 per cent) and the second highest level of compliance of Green Business activities is found in the Pharmaceutical industry (12.71 per cent)

The lowest level of compliance of Green Business activities can be found in the Tannery industry is 6.24 per cent.

Although, all the industries need to participate in Green business activities as the level of compliance

is very poor and has scope for improvement, but as the chart-1 shows the Food, Power, Tannery and Textile industry has lower-mid level of Green Business practice compliance. As mentioned above, Tannery industry has the lowest level of compliance of Green business principles, on the contrary, it is estimated that the leather exports in Bangladesh have grown on an average $41 million in value per year.

However, Tannery industry makes a huge contribution to the poor condition of the community. It exposes hazardous chemicals to the environment that harms the health of the workers and the communities nearby the tannery factories. It results in skin diseases, respiratory diseases, diarrhea as well as air, water and soil pollution. Hazaribagh tanneries account to 90 percent of the tanneries in Bangladesh. And according the estimation by the government 21000 cubic meters untreated effluent are released from Hazaribagh tanneries each day. Relocation of these tanneries based on government plan has led to a number of bureaucratic hurdles. Thus, it can be concluded that Tannery industry need the upmost attention to apply the principles of green Business.

For the Power industry, the most important issue is the power station and around 80 percent of the power station is gas based and 20 percent of the power station is based on coal, liquid and furnace oil. The emissions from coal combustion Carbon dioxide (CO), nitrogen oxides (NO), sulfur oxides (SO), chlorofluorocarbons (CFCs), and air- borne inorganic particles such as fly ash, soot, and other gas species. Hence, this particular industry should also pursue Green Business principles and can make significant positive impact in the natural health of Bangladesh.

For the Textile industry, the environmental challenges faced by Bangladesh is the quality in water sources as it uses unsafe dyes and chemicals and amounts high costs of effluent treatment. These problems have arisen due to the deficiency of National Effluent Quality Standards (NEQS) and lack of environmental rules and monitoring. However, the textile industry plays a key role in Bangladesh economy. It is estimated that around 78 per cent of the country‟s export incomes comes from textile. The water pollution due to textile industry have affected the livelihood of farmers and fishermen since wastes accumulate in crop lands and water bodies.

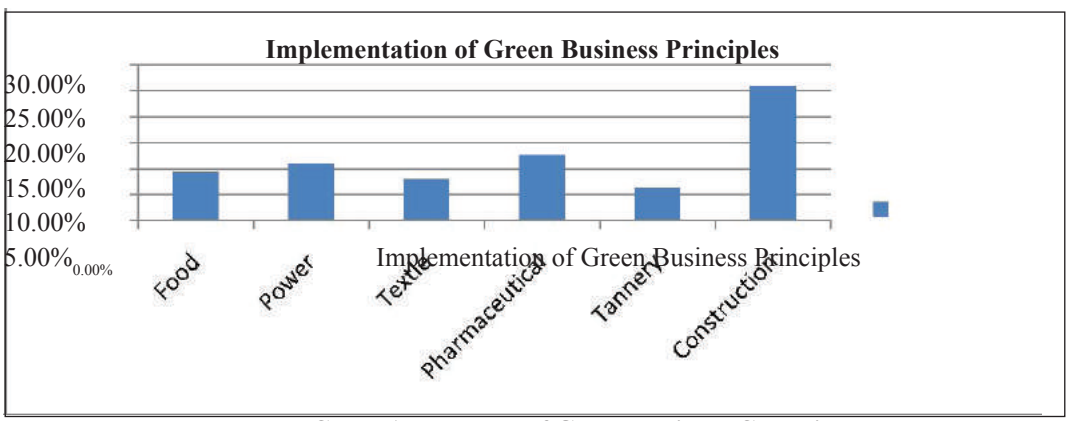


Chart-1: The level of Green Business Compliance

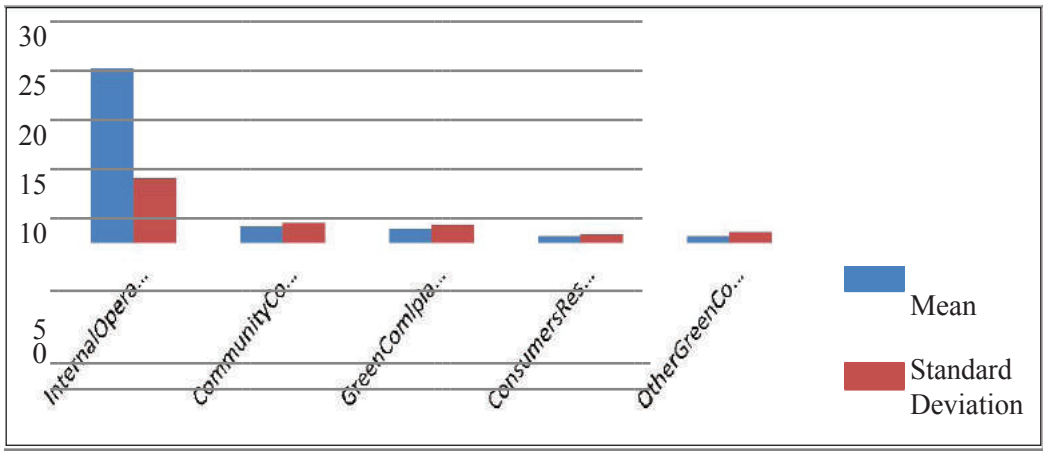


Chart -2 : Average Green Business Compliance Level and Standard Deviation

5. Robustness Tests

A model is considered to be good if the value of R-square is close to 1.

The results of the robustness test of the models seems to be very poor, as the association between the Sales and Green business compliance variables (internal operations compliance, community contribution, Green Compliant product, consumer responsibility and other green compliances) is far from 1. The relationship of Operating Profit, Profit before Tax, Net Profit, Gross Profit, EPS and Green compliance variables also seems very unsatisfactory as it is quite far from 1 as well.

6. Conclusion

The study was conducted to find out whether businesses can maintain or improve their profitability through application of green business principles. The results show that mostly Profit has a positive relationship with Green compliance variables that means firms can expect higher profits in response to application of Green Business principles. As the level of compliance of Green business practice increases, the level of Profit rises however, this association is very weak and that could have been due to lower application of these Green principles by the companies in the samples. As, the highest level of Green Business principle compliance has been only 26 per cent in the construction industry is not very material, so it is difficult to conclude whether it has a significant contribution to the increasing profitability of the business.

The Tannery industry with the lowest level of Green Business compliance plays a huge role for the environmental pollution and thus it is most suitable for application of Green Business. It is extremely crucial to control the environmental impact from this industry as this will solve 80 per cent of the environmental problem in Dhaka. And Green business plan will help tanneries

to be designed that will make the least negative impact in the environment. Proper waste water treatment plant, trained workers for environmental purposes, effluent treatment plant and other Green procedures can help monitor most of the environmental problem in Bangladesh.

The positive relationship does show that there is a scope of higher profitability if the compliance level rises and hence could lead to a strong relationship. There is a scope for further research in this area

07. Tables, figures, equations, and lists

Sales= 1.59+1.34(IOP)+ 4.09(CC)+2.49(GCP)-1.17(CR)+1.68(OGC) Model-1

Operating Profit= 2.55+1.24(IOP)+ 8.78(CC)+6.48(GCP)-1.77(CR)+1.71(OGC) Model-2

Profit Before Tax = 1.61+1.33(IOP)+ 1.42(CC)+ 7.06(GCP)-1.44(CR)+3.94(OGC) Model-3

Net profit= 1.39+8.40(IOP)+ 9.62(CC)+5.74(GCP)-1.07(CR)+1.60(OGC) Model-4

EPS= 4.38+0.05IOP)+ 0.088(CC)+0.72(GCP)-1.12(CR)+0.39(OGC) Model-5

Gross Profit=5.37+1.91IOP)+ 2.25(CC)+1.28(GCP)—3.07(CR)+2.54(OGC) Model-6

7.1 Types of Variables

Tab-1: Details of Variables

Notation	Independent (Green Compliance Variables)	Notation	Dependent (profit Variables)
IOP	Internal Operations Compliance	None	Sales
CC	Community Contribution	None	Gross Profit
GC	Green Compliant Product	None	Operating Profit
CR	Consumer Responsibility	None	Profit Before Tax
OGC	Other Green Compliances	None	Net profit
		None	EPS

7.2 Measurement Details

Tab-2 Comprehensive measurement of variables

Variables	Measurement
Sales	Total Sales derived from Income Statement
Gross Profit	Total Gross Profit derived from Income Statement
Operating Profit	Total Operating Profit derived from Income Statement
Earnings Per Share (EPS)	EPS derived from Income Statement

Net Profit	Total Net Profit derived from Income Statement
Internal Operations (IOP)	Referred to Table-5
Community Contribution (CC)	Referred to Table-5
Green Complaint Product (GC)	Referred to Table-5
Other Green Compliances (OGC)	Referred to Table-5

7.3 Pearson Relationship

Tab-3:Pearson relationship between Sales and Green Business Variables

		Sales	InternalOperationsCompliance	CommunityContribution	GreenComlpiantProduct	Consumers Responsibility	Other Green Comlpiance
Pearson Correlation	Sales	1.000	.089	.037	.028	-.068	.030
	Internal Operations Compliance	.089	1.000	.391	.120	.244	.064
	CommunityContribution	.037	.391	1.000	.112	.185	.051
	GreenComlpiantProduct	.028	.120	.112	1.000	.385	.186
	ConsumersResponsibility	-.068	.244	.185	.385	1.000	.080
	OtherGreenComlpiance	.030	.064	.051	.186	.080	1.000

Tab-4: Pearson relationship between Net Profit and Green Business Variables

		Net profit	Internal Operations Compliance	Community Contribution	GreenComlpiantProduct	Consumers Responsibility	Other Green Comlpiance
Pearson Correlation	Netprofit	1.000	.065	.042	.099	-.036	.053
	Internal Operations Compliance	.065	1.000	.403	.139	.242	.081
	Community Contribution	.042	.403	1.000	.098	.188	.060
	Green Comlpiant Product	.099	.139	.098	1.000	.352	.189
	Consumers Responsibility	-.036	.242	.188	.352	1.000	.070
	Other Green Comlpiance	.053	.081	.060	.189	.070	1.000

Green Business Plan	
	Minimize waste generated by business

Internal Operations	Reduce greenhouse gas emissions
	Conserve natural resources as part of operations
	Conserve energy
	Create a green supply chain
	Create green job opportunities
	Hire from underserved population
	educate employees about green initiatives
	monitor and report progress on your green initiatives
	Ensure a safe working environment for its employees
	Received a safety award
	Award for environmental protection e.g ISO 14001, Carbon label.
	Entertainment fascilities for its employees
	Information about support for day care, maturity and paternity level, holidays and vacations
Community Contribution	Statistics of employee turnover
	offer job-training services, which could enhance job skills for the unemployed
	Give back to the community through services,
	donate a percentage of profits
	Donate products or services
	business or facilities contribute to redevelopment in distressed communities or urban areas
	Funding scholarship programs or activities
	Aiding disaster victims (donation cash, product etc.)
Green Compliant Product	Use locally sourced materials to produce it
	Use sustainable or recycled products to produce it
	Educate consumers about environmental issues
	Provide consumers ith the opportunity to reduce their environmental impact
	Minimize the waste and harm to the environment during the manufacturing process
	Prizes/awards received e.g. ISO 9002, 22000, ISO/IEC 17025, GMP/HACCP/ HALAL, BRC
Consumers	Ensure safest ingredients to keep their customers and clients
	The value added staetment must be featured on the website
	Ensure proper feed back from consumers
Others	

Tab-5: Details of Green Business Practices

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Just In Time Production Practices in Garments and Textile Industries in Bangladesh: Factor Analysis of Some Selected Variables

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Abstract

Bangladesh has been endeavoring to industrialization. It faces manifold major problems, one of, those is how to control cost of production. Most of these costs as we know incur in the form of what is known as 'system losses' or non-value added activities. The industrial managers have been trying to implement modern tools and techniques that result in reduction of opportunities for errors, waste reduction and ultimately contribute in cost minimization and provide competitive advantages. Success of JIT system in the manufacturing environment has been documented by a large number of researchers. Much has been written regarding the positive strategic influence of JIT especially on the Japanese manufacturing sector and other developed countries like USA, UK, and Australia. However the implementation of quality management practices like JIT is yet to be explored in a developing country like Bangladesh. This paper emphasizes on the output of factor analysis as a data reduction statistical tool and examines the interdependent relationships among variables with their underlying factors. The respondents' ratings of 78 statements were factor analyzed to determine the underlying factors for JIT supporting/facilitating variables. From factor analysis, 17 (seventeen) factors emerged from the present study. The study revealed that JIT supporting factors exist in the RMG and Textile industries in Bangladesh. Moreover, this smaller set of 17(Seventeen) factors can be used for further study in the same field by the researchers.

Keywords: Just in Time, factor analysis, empirical research, garments, textile, exportprocessing zones, Bangladesh.

1. Introduction

JIT is a Japanese management philosophy, which has been applied in practice since the early 1970s in many Japanese manufacturing organizations. It was first developed and perfected within the Toyota manufacturing plants by Taiichi Ohno as a means of meeting consumer demands with minimum delays. Taiichi Ohno is frequently referred to as the father of JIT (Cheng and Podolsky, 1993). The idea of JIT is very simple: "producing the necessary items, in the necessary quantities at the necessary time" (Monden, 1993). Under different names, including Toyota Production System (Monden, 1993), Lean Production (Womack et al., 1991), Zero Inventory, the Stock Less Production System (Hall, 1983) and World Class Manufacturing (Schonberger, 1986), JIT manufacturing systems have been developed with various techniques to support the basic principle. Managers now-a-days have learned that cherished ways of doing business do not work any more and that major changes must be made in how organizations are managed. It is necessary to have an appreciation of the ways in which organizations are transforming themselves to become more competitive. The last two decades have been a period of tremendous upheaval

and change in the business environment. Competition in many industries has become worldwide in scope, and the pace of innovation in products and services has accelerated. This has been good news for customers, since intensified competition has generally led to lower prices, higher quality, and more choices. Since the early 1980s, many companies have gone through several waves of improvement programs, starting with Just-in-Time (JIT) and passing on to Total Quality Management (TQM), Lean production, Six Sigma, Process Reengineering, Theory of Constraints (TOC), and so on. When properly implemented, these improvement programs can enhance quality, reduce cost, increase output, eliminate delays in responding to customers, and ultimately increase profits (Garrison and Noreen 2003).

Bangladesh as one of the developing countries has already experienced many sophisticated and technological advancements in recent years. Many manufacturing concerns are producing their products in the Export Processing Zone (EPZ). EPZ is treated as the right action taken towards industrialization.

2. Objectives

The main objective of this article is to explore, identify and examine the interdependent relationships among variables with their underlying factors/statements those facilitate implementation of Just-in-Time production practices in some selected Garments and Textile manufacturing companies situated in different Export Processing Zones (EPZ) of Bangladesh and 100% export oriented companies out side EPZ listed in the Dhaka Stock Exchange (DSE). The more specific objective is to factor analyze the underlying factors for JIT supporting/facilitating variables in the RMG and Textile industries in Bangladesh; and make recommendations in the light of the findings of the present study. Among different statistical tools emphasis is given on factor analysis as a data reduction tool, which can also be used for further study by the researchers.

3. Methodology

a. The Variables

An extensive literature review relating to supporting variables of Just in Time production practices in the manufacturing concerns was conducted to identify the variables for the present article. The objectives of the present study were also in view while identifying the variables.

Based on literature review eight variables measuring supporting environment for Just in Time production practices have been constructed as scales, namely, JIT awareness (jitaw), corporate culture (jitcc), management commitment and support (jitmcs), leadership (jitld), human resource management (jithrm), automation (jitaut), logistic support (jitlos), and quality standards (jitqs).

b. Study Population

Out of a total population size of 139 companies in the relevant industry as identified from the list collected from Bangladesh Export Processing Zones Authority (BEPZA) and Dhaka Stock Exchange (DSE), a total of 33 companies had been selected primarily as sample companies using

the random digit table. Before this, the sample size of respondents as well as companies was determined through the approach based on confidence level (CL) and precision rate (PR) and the formula prescribed by Guilford and Fruchter (1978). At 95% CL and 6% PR, the respondent number became 267. Assuming an average eight functional level management people would be selected to fill in the questionnaire and for interview from a sample enterprise, a total number of 33 (267/8) enterprises have been selected and thus the respondent number became (33X8) = 264. However, due to many negative factors especially like non co-operation by the respondents in different companies, finally the data had been collected from 30 companies and from a total respondent number of 182.

c. The Questionnaire

A close-ended five point Likert scale questionnaire containing 78 statements of 8 broad categories/ variables were developed. Each statement could be replied by checking any one of the five answers „strongly agree", „agree", „neither agree nor disagree", „disagree" and „strongly disagree". The scoring weight ranged from 1 to 5 and thus the highest score, lowest score and the neutral score under each variable depended on how many statements are there under each variable.

d. Statistical Tools Used

Often among the many variables, a few are more related to each other than they are to others. Factor analysis allows us to look at these groups of variables that tend to be related to each other and estimate what underlying reasons might cause these variables to be more highly correlated with each other (Jeff Miller, vice president, consulting and analytical, Burke, Inc. Malhotra, K. Noresh, 2003) . In factor analysis, variables are not classified as independent or dependent. Instead, the whole set of interdependent relationships among variables are examined (Malhotra, K. Noresh, 2003). Costello, B. Anna and Osborne, W. Jason (2005) suggested that, factor analysis is preferable to principal component analysis, and components analysis is only a data reduction method. The choice of rotation method is an important issue for factor analysis. The goal of rotation is to simplify and clarify the data structure. As with extraction method, there are a variety of options. However varimax rotation by far is the most common choice (Costello, B. Anna and Osborne, W. Jason, 2005). This study, thus particularly focused on factor analysis. Moreover factor analysis was also done to calculate the eigenvalue of the factors under each variable to measure the construct validity of the questionnaire. In addition Cronbach"s Alpha Coefficient and mean value of the variables were also calculated to measure reliability and criterion related validity of the question items.

4. Findings and Analysis

a. Reliability and Validity Issues
The reliability and validity analysis is an important issue when conducting empirical research.

b. Reliability:
It is an estimate of measurement consistency. It measures the degree in which question items would give consistent or repeatable results. Cronbach"s alpha coefficient (1951) has been calculated for each scale to evaluate the reliability (Table-1).

The widely accepted social science cut-off is that alpha should be 0.70. But some use 0.75 or 0.80 while others are lenient as 0.60.
(www2.chass.nesu.edu/garson/pa765/standard.htm)

Table-1: Cronbach's Alpha Coefficient of the Variables

Measures for JIT Supporting Factors	Cronbach's Alpha Coefficient
1. Awareness	0.81
2. Corporate Culture	0.87
3. Management Commitment and Support	0.84
4. Leadership	0.92
5. Human Resource Management	0.90
6. Automation	0.84
7. Logistic Support	0.82
8. Quality Standards	0.65

The alpha coefficient as evident from Table-1 is greater than 0.70 for all the variables except quality standard (alpha 0.65) and greater than 0.80 for most of the cases. This reveals that overall reliability test is highly acceptable.

c. Validity:

Ensures whether or not question items measure what they are intended to measure. The validity of measurement scales can be tested against *content, construct and external criteria.*
d. Content validity: An extensive literature review had been undertaken measuring JITsupporting factors, and JIT implementation factors to ensure content validity.

e. *Construct validity:* Construct validity had been examined through factor analysis with criteria for example, a minimum Eigenvalue of 1 (Table-2) and item factor loading in excess of 0.4 (Bhattacharjee 1992; Phan and Matsui, 2007).

f. *Criterion-related validity:* Criterion-related validity measures how closely the measurementinstrument is related to the relevant criterion. As the correlations were highly significant (Table – 3), indicated the acceptable degree of criterion-related validity.

Table-2: Eigenvalue of Factors for all the Variables

Sl.No.	Variables	Eigenvalue		
		Factor-1	Factor-2	Factor-3
	JIT Supporting Environmental Factors			
1.	Just-in-Time Awareness	2.674	2.621	1.724
2.	Corporate Culture	3.331	2.157	1.983
3.	Management Commitment and Support	3.245	2.254	
4.	Leadership	4.403	4.396	
5.	Human Resource Management	3.803	3.109	
6.	Automation	3.190		
7.	Logistic Support	2.522	2.519	
8.	Quality Standards	1.745	1.437	

Note: Eigenvalue against Single Factor - Extraction Sums of Squared Loadings Eigenvalue against more than Single Factor - Rotation Sums of Squared Loadings

g. JIT Supporting Environmental Factors

An attempt was made in the present research to examine the existence of JIT supporting environmental factors in the Garments and Textile industries in Bangladesh. A total of eight JIT supporting environmental factors were identified through review of contemporary literature. These are JIT awareness, corporate culture, management commitment and support, leadership, human resource management, automation, logistic support and quality standards. These were put on a Likert type interval scale on a continuum from „strongly agree" to „strongly disagree" with a view to measuring the extent of the existence of these JIT facilitating factors.

Table-3: Mean Value Score of the Variables
JIT Supporting Environmental Factors

Just-in-Time Awareness	4.74
Corporate Culture	4.26
Management Commitment and Support	4.43
Leadership	4.43
Human Resource	4.33

Management	
Automation	4.33
Logistic Support	4.48
Quality Standards	3.67

The research revealed high mean value scores (Table-3) for JIT supporting environmental factors, indicating that these variables very much exist in the RMG and Textile industries in Bangladesh.

5. Findings and Factor Analysis

a. JIT Awareness

It is imperative to measure first the awareness stage of the respondents regarding JIT. When someone has awareness regarding something, would try to have knowledge about the same, her/his attitude towards this would change and then the person would take initiatives to implement the subject in concern. Therefore, at the first step the awareness stage of the respondents regarding JIT should be measured. In addition, if the respondents do not have the awareness regarding JIT, the question items would not measure what they are intended to. For the present study fourteen statements measured JIT awareness. These were, for example, awareness of the respondents regarding maintenance of minimum inventory of raw material, purchase of required quantities of raw material, shortest throughput time, immediate shipment of finished goods to customers, benefit of keeping optimum inventory, producing defect free/zero defect products, proper plant layout, management commitment and support, necessity of top management support, team work, free flow of information, communication among management and workers, bottom-up decision making process, and quality production process.

Factor analysis with varimax rotation for JIT awareness (Table-4) revealed that from the fourteen statements for measuring JIT awareness variable, three factors are extracted. Six statements with high factor loadings and minimum coefficient of 0.50 constituted factor-1. The factor loading/coefficient ranged from 0.50 to 0.77. The factors are titled or labeled as per the statement got the highest factor loading. Accordingly factor-1 is labeled as „quality production processes". Factor-2 is consisted of another six statements with minimum factor loading of 0.42 and the maximum of 0.78. Factor-2 is titled as „JIT shipment of finished goods". Factor-3 contains two statements with lowest factor loading 0.69 and highest 0.78. Factor-3 is labeled as „JIT purchase of raw materials". The eigenvalue for all these three factors are more than 1. The cumulative percentages of variances explained by these factors are 50.13%.

Table-4: Factor Analysis with Varimax Rotation for JIT Awareness Factors Statements Measuring Just-in-Time Awareness

	1	2	3
Quality production process and performance is required for maximizing customer satisfaction.	.771	.067	.197
Machineries should be placed in such a way that workers do not have to move to and fro unnecessarily.	.701	.243	-.055
Supervisors, linemen and workers should be encouraged to produce defect free/zero defect products.	.611	.460	-.218
Teamwork is essential for high productivity	.589	.109	.217
Free flow of information helps in building trust among employees	.536	.151	.403
The throughput time should be shortest as possible.	.502	.367	-.027
Finished goods should be shipped to customers immediately after production.	.075	.781	.068
Proper communication among management and workers is required to increase productivity.	.244	.667	.156
Top management support is necessary for the implementation of quality related programs.	.209	.664	.130
Optimum inventory minimizes waste & reduces cost.	.206	.513	.228
Involvement of lower level managers and supervisors in decision making process helps in implementation of strategies	.101	.436	.419
Management commitment is essential for quality.	.369	.425	.249
Required quantity of raw materials should be purchased only as we get the customer order.	.173	.071	.782
We should always have minimum inventory of raw materials for production.	-.021	.206	.691
Rotation Sums of Squared Loadings			
Eigenvalue	2.674	2.621	1.724
Percentage of variance	19.100	18.719	12.317
Cumulative percentage	19.100	37.819	**50.136**

Harber et al., (1993) asserted that quality programs would be more successful if the organizational climate is modified and managed to elicit employee commitment and satisfaction consistent with the values of JIT. In particular, improved intra-organizational communication is a critical part of JIT (Klassen 1993, Miller and Cangemi 1993, Powell 1995, Allen and Brady 1997). Dean and Bowen (1994) also pointed out that collaboration between managers and non-managers, between functions (or departments), and between customers and suppliers is an important principle of JIT.

Labor or worker is one of the main elements of production of an industrial concern. Optimum capital, modern machine, best quality materials can produce nothing without the labor force of the operational units. So, organized, skilled and professional workers are also vital in the growth and development of the industry (Solaiman, 1991).

b. JIT Corporate Culture

Factor analysis with varimax rotation for corporate culture (Table-5) revealed that from the twelve statements for measuring corporate culture variable, three factors are extracted. Six statements with high factor loadings and minimum coefficient of 0.54 constituted factor-1. The factor loading/ coefficient ranged from 0.54 to 0.87. The factors are titled or labeled as per the statement got the highest factor loading. Accordingly factor-1 is labeled as „socio-culture". Factor-2 is consisted of another three statements with minimum factor loading of 0.53 and the maximum of 0.84. Factor-2 is titled as „over time payments". Factor-3 contains three statements with lowest factor loading 0.44 and highest 0.90. Factor-3 is labeled as „working hours". The eigenvalue for all these three factors are more than 1. The cumulative percentages of variances explained by these factors are 62.25%.

Table-5: Factor Analysis with Varimax Rotation for JIT Corporate Culture

Statements Measuring JIT Corporate Culture	Factor		
	1	**2**	**3**
Employees are encouraged to celebrate special days and social gathering.	.875	.068	.067
Management participates with the employees in different social gathering.	.822	.033	.170
Mid-level management participation is encouraged in the decision making Process	.644	.238	.138
Management has a positive attitude to receive complaints and suggestions from the employees.	.612	.337	.220
Employees place priority on organizational interest rather than on individual interest.	.589	.348	.163
Employees usually view the organization just like a family	.54 8	.451	.273
Over time payments are duly paid	.073	.843	.036
Management keep their promises most of the time	.250	.740	.223
Management has a concern for employees	.376	.530	.353
Employees like to work longer hours when necessary	.069	.093	.901
Employees are supportive when they are asked to work longer hours	.237	.181	.769
Employees in our organization are committed to their work	.426	.279	.449
Rotation Sums of Squared Loadings			
Eigenvalue	3.331	2.157	1.983
Percentage of variance	27.756	17.975	16.522
Cumulative percentage	27.756	45.731	**62.253**

For successful implementation of JIT, a change in corporate culture has been regarded as one of the major, common infrastructure supports (Lau, 2000). Manoochehri (1988), MusselWhite, (1987), and Gettel-Riehl et al., (1987) argue that culture is the most critical element to the successful JIT implementation by Japanese. Japanese workers are totally committed to their work and company. They are loyal, cooperative, flexible and willing to work long hours when needed. Japanese management is characterized by lifetime employment, approaching decision making from bottom-up, respect for their workers, and a paternalistic approach towards workers. This distinction between workers and managers has helped Japanese management implement JIT successfully (Ramarapu et al., 1995). Yet another major cultural difference that may have negative impact on implementing the JIT/kanban process in Australia is the adversary relationship between employees and management. Australia is a nation where people work because they are forced to. On the contrary, Japan is a country where workers often refer to their company as uchi-home. Here, "Lifetime" employment at the same large firm has been a national ideal and a reality for about one fifth of the work force (Schonberger, 1993: 37). Culture is also manifested in the continual gradual improvement component of Japanese JIT programs. In the case of Toyota, the JIT program has been in operation for over 25 years and is still been refined and fine-tuned (Monden, 1983). Some of the US companies have adopted a Japanese culture approach to JIT implementation and have reported success (Sakurai and Huang, 1984; Suzaki, 1985).

c. Management Commitment and Support

Factor analysis (Table-6) with varimax rotation for management commitment and support revealed that from the nine statements for measuring management commitment and support variable, two factors are extracted. Six statements with high factor loadings and minimum coefficient of 0.50 constituted factor-1. The factor loading/coefficient ranged from 0.50 to 0.83. The factors are titled or labeled as per the statement got the highest factor loading. Accordingly factor-1 is labeled as „management commitment for quality". Factor-2 is consisted of another three statements with minimum factor loading of 0.64 and the maximum of 0.85. Factor-2 is titled as „quality related seminars and training". The eigenvalue for all these factors are more than 1. The cumulative percentages of variances explained by these factors are 61.10%.

Table-6: Factor Analysis with Varimax Rotation for Management Commitment and Support

Statements Measuring Management Commitment and Support		
Factor	**1**	**2**
Management has strong commitment for quality	.830	.082
Management has strong support for quality	.772	.261
Top management supports middle management for quality performances	.757	.298
Top management provides support for implementation of quality related programs.	747	.295
Management always has a positive attitude towards solving any problems concerned with workers.	.642	.200
Senior managers provides directions for doing things	.503	.352

Senior managers attend JIT, Lean and quality related seminars and workshops Senior managers provide	.244	.859
JIT/ quality- related training /workshops	.270	.832
The lower level managers/supervisors conduct daily meeting before starting the work **Rotation Sums of Squared Loadings**	**.173**	**.640**
Eigenvalue	3.245	2.254
Percentage of variance	36.050	25.050
Cumulative percentage	36.050	**61.100**

Starting a journey towards quality management practices requires total support and commitment from the top-level management (Rahman, 1999). Management commitment to and leadership for quality are considered to be one of the foundations of JIT production (Flynn et al., 1994; Deming, 1986 & Leonard et al., 1982). Vora and Saraph (1990) have stressed the significance of top management involvement and proper employee training as essential for the successful implementation of JIT. Flynn et al. (1995), defined management support as a necessary infrastructure component to JIT finding that, it is positively related to both throughput and quality performance. Full acceptance by top management is required to empower middle management to overcome the inevitable roadblocks in implementation of JIT (Hay, 1988). Most authors put top management support as the most important factor in achieving long term and complete implementation of JIT (Hall, 1983, Harber, et al. 1990, Hay, 1988, Lee & Ebrahimpour, 1984, Sohal, 1993).

Workforce management is always a pre-requisite for good management. Workforce management is concerned with training, empowering and compensating workers based on skills. Careful attention to selection, training, consultation and communication, single status facilities, harmonized terms and conditions, the minimization of job classes, and individual appraisals emphasizing co-operation, team work and flexibility such factors are emphasized in Japanese Human Resource Management Policies (Forza, 1999). JIT rely on team concept. In a JIT system cannot produce another unit until the worker at the next station signals that another unit is needed. All workers must act as a team, rather than as individual (Heard, 1986) and performance must be evaluated in terms of the output of the entire group rather than that of the individual (Groebner & Merz, 1994). Teamwork and group problem solving allow decision making to be decentralized and therefore variance and uncertainty is managed more easily (Flynn et at., 1994). Under JIT employees become more self-managing than in a command-and-control factory. They investigate process improvements and monitor quality themselves; they consequently enjoy immediate feedback regarding their own performance (Klein, 1989). Researchers have documented some factors that could break or make the implementation of JIT. Vora and Saraph (1990) have stressed the significance of top management involvement and proper employee training as essential for the successful implementation of JIT. Billesbach and Schniederjans (1989) advocated training administration as well as production workers to facilitate the implementation of JIT. A recent working paper series developed by Schultz, Juran and Boudreau (1997) looked into the JIT separately. They have tried to show that JIT has effects on the development of productivity norms. This research is also important to the understanding of group dynamics in the workplace and to the modeling and management of low-inventory systems.

d. Leadership

Table-7 for factor analysis with varimax rotation for leadership revealed that from the fourteen statements for measuring leadership variable, two factors are extracted. A total of seven statements with high factor loadings and minimum coefficient of 0.63 constituted factor-1. The factor loading/ coefficient ranged from 0.63 to 0.78. The factors are titled or labeled as per the statement got the highest factor loading. Accordingly factor-1 is labeled as „quality leadership". Factor-2 is consisted of another seven statements with minimum factor loading of 0.54 and the maximum of 0.86. Factor-2 is titled as „leadership activities". The eigenvalue for all these factors are more than 1. The cumulative percentages of variances explained by these factors are 62.85%.

Table-7: Factor Analysis with Varimax Rotation for Leadership

Statements Measuring Leadership	Factor	
	1	2
Quality leadership reduces employee absenteeism	.782	.181
Quality leadership has reduced employee turnover in our company	.778	.223
Effective leadership results in product quality	.737	.232
Quality leadership ensures achievement of production target	.723	.306
Quality leadership reduces grievances	.713	.301
Effective leadership results in cost reduction in our organization	.654	.474
Managers" leadership quality ensures quality production process in our organization	.639	.440
Our leaders guide the workers specifically as what to do	.181	.860
In our organization leaders specify work goals to the employees	.254	.825
Leaders lead the workers towards commitment and loyalty for the organization	.320	.807
Our leaders posses expertise in his/her own field	.240	.716
Our leaders influence maintaining group process	.329	.663
Leaders influence attempts supporting individuals" needs	.441	.580
In our organization leaders encourage social activities	.465	.545
Rotation Sums of Squared Loadings		
Eigenvalue	4.403	4.396
Percentage of variance	31.453	31.401
Cumulative percentage	31.453	**62.854**

Quality leadership models where the responsibility for quality lies in the firm and directly relates to organizational aspects of infrastructure as described by both Hayes and Wheelwright (1984) and Hill (1989). Empirical research has supported the link between quality leadership and improved quality and productivity (Dale & Duncalf, 1995).

e. Human Resource Management

Table-8 for factor analysis with varimax rotation for human resource management revealed that from the eleven statements for measuring human resource management variable, two factors are extracted. A total of eight statements with high factor loadings and minimum coefficient of 0.56 constituted factor-1. The factor loading/coefficient ranged from 0.56 to 0.73. The factors are titled or labeled as per the statement got the highest factor loading. Accordingly factor-1 is labeled as „skill and performance-based compensation and reward". Factor-2 is consisted of three statements with minimum factor loading of 0.78 and the maximum of 0.85. Factor-2 is titled as „communication and coordination among employees". The eigenvalue for all these factors are more than 1. The cumulative percentages of variances explained by these factors are 62.83%.

Table-8: Factor Analysis with Varimax Rotation for Human Resource Management

Statements Measuring Human Resource Management	**Factor**	
	1	**2**
Compensation and reward is based on skill and performance	.738	.144
Reward is given to employees for creative ideas and constructive suggestions	.729	.069
Feedback is given properly to the employees where necessary	.707	.446
Management gives careful attention for the recruitment of employees	.698	.376
Follow-up of assignments are regularly done	.669	.416
Regular training is provided to employees	.634	.328
Harmonized employment and promotion related terms and conditions apply for all	.610	.406
Employees work as team rather than individual in our company	.569	.549
There is strong communication and coordination among employees	.185	.853
Strong communication and coordination exist among management and employees	.309	.812
Employees take their own interest to do the work	.254	.780
Rotation Sums of Squared Loadings		
Eigenvalue	3.803	3.109
Percentage of variance	34.575	28.263
Cumulative percentage	34.575	**62.839**

The successful implementation of JIT is in need of a conductive organizational climate and infrastructure (Bright and Cooper 1993, Emery et al., 1996, Glover 1993, Morries 1994, Sakakibara et al., 1997) and extensive changes in human resource management (Schonberger 1994, Shetty 1989). Organizational climate is often understood as an enduring characteristic of a company that is reflected in the attitudes employees show toward the policies, practices and conditions in the work environment (Lau 2000). Harber et al., (1990) stressed the need for open management and an ability to accept comments and criticism from employees, as well as a need to move away from adversarial roles to a sharing of information and goals for successful implementation of JIT. Wantuck (1983), identified two basic elements underpinning JIT: elimination of waste and respect for people. While the former element emphasized technical aspects of JIT, the later one made JIT possible by emphasizing the human contributions (Shingo 1981).

Schwartz and Davis (1981) found that an organizational climate incompatible with the intended change could result in a strong level of resistance and even jeopardize the most well planned change process. The implication of their findings suggested that successful implementation of JIT would require a fundamental change in workforce practices. Human resource management practices are essential for improvement efforts such as JIT (Spencer and Guide 1995, White et al.1999). In particular, management is often viewed to be responsible for creating a reward system for more employee involvement. Munzberg (1990) argued that the most effective way of tapping into the creative potential of the organization and empowering employees is through the use of cross-functional, multi-level teams. Thus JIT rely on the team concept as well as employee participation and empowerment.

Given their important contribution to JIT implementation, the research focus in recent has turned toward the more subtle human factors rather than the technical aspects of JIT (Power and Sohal 1997).

Aggarwal and Aggarwal (1985) considered employee motivation and cooperation is being critical along with a strict sense of discipline and coordination both vertically and horizontally. The study of Koufteros et al., (1998) found that employee involvement was an essential element for pull production system, which is a major characteristic of a JIT system. Employee involvement can be encouraged if managers or supervisors show true interest in the suggestions made (Forza, 1999) and provide feedback to employees (Ashford and Cumming 1984). Opportunities of meetings with managers and technicians are frequent in JIT and TQM work environment in which the exchange of information both informal and formal is considered to be very important (Flynn et al., 1994).

f. Automation

Table-9 (Annex-5) for factor analysis with extraction method for automation revealed that from the five statements for measuring automation variable, a single factor is extracted with minimum coefficient of 0.66. The factor loading/coefficient ranged from 0.6 to 0.73. The factors are titled or labeled as per the statement got the highest factor loading. Accordingly factor-1 is labeled as „automation and training". The eigenvalue for this factor is more than 1. The cumulative percentage of variances explained by this factor is 63.79%.

Table-9: Factor Analysis (Extraction Method) for Automation

Statements Measuring Automation	Factor 1
We provide training to our employees as to how to operate the new automated machineries	.852
Workers are motivated to use technology.	.839
Computer Integrated Manufacturing (CIM) is used for all purposes	.822
New mechanical and automated equipments are used for production	.797
New mechanical and automated equipments are used for stock movements.	.669
Extraction Sums of Squared Loadings	
Eigenvalue	3.19
Percentage of variance	63.790
Cumulative percentage	**63.790**

A study conducted by Yasin and Wafa (1996) revealed that process oriented automated systems are required for successful implementation of JIT; and successful JIT firms invested significantly more in integrating these automated systems.

g. Logistic Support

Table-10 for factor analysis with varimax rotation for logistic support revealed that from the eight statements for measuring logistic support variable, two factors are extracted. A total of three statements with high factor loadings and minimum coefficient of 0.80 constituted factor-

1. The factor loading/coefficient ranged from 0.80 to 0.91. The factors are titled or labeled as per the statement got the highest factor loading. Accordingly factor-1 is labeled as „adequate support for forwarding, freight forwarding and clearing services". Factor-2 is consisted of remaining five statements with minimum factor loading of 0.50 and the maximum of 0.80. Factor-2 is titled as „availability of machineries, spare parts and others". The eigenvalue for these factors are more than 1. The cumulative percentages of variances explained by these factors are 63.01%.

Table-10: Factor Analysis with Varimax Rotation for Logistic Support

Statements Measuring Logistic Support	Factor 1	2
Adequate clearing and forwarding services are available.	.913	.201
Freight forwarding services are adequate.	.864	.205
We have our own warehouse facilities.	.803	.200

Spare parts of machineries are usually available as and when needed.	.212	.809
Transportation is available to support shipment.	.255	.781
Raw materials are usually available as and when needed.	.075	.769
For any kind of logistics support we do not have to follow the bidding process.	.143	.539
Quality cartons are always available as required.	.401	.501
Rotation Sums of Squared Loadings		
Eigenvalue	2.522	2.519
Percentage of variance	31.527	31.487
Cumulative percentage	31.527	**63.014**

Some JIT practitioners and researchers came to realize that JIT success depends on the performance of the system as a whole. Thus, the integration among the various functions becomes critical (Bartezzaghi et al., 1989; Graham, 1988; Westbrook, 1988). Because JIT crosses many functional lines within an organization, support from the various functional groups is essential if JIT is to achieve its full potential (Hall, 1981; Schonberger, 1982; Ansari, 1986; Giunipero & Law, 1990; Higginson & Bookbinder, 1990).

Vickery (1989) noted the importance of the presence of a logistical planning system for the successful implementation of JIT. The purchasing department appears to be in a unique position to facilitate the creation of a „seamless" JIT logistics channel which utilizes external logistics service providers in order to achieve full JIT related benefits (Spencer et al., 1994). Under JIT, purchasing seeks to move away from the traditional adversarial role by establishing and managing supplier-partners. Purchasing of transport and logistics services is not really different from purchasing materials. In spite of this, the literature suggests that only a small percentage of JIT firms actually view logistics providers as supplier-partners (Graham, 1992).

The systems viewpoint of JIT is especially significant with respect to the purchasing function. Successful JIT places new demands on the purchasing department. Recent research highlights the importance of functional integration: "Through interviews with purchasing and materials management executives, it became apparent that purchasing and materials management involves more than assuring the continuous flow of materials into an organization; it has become a critical component to the development of a firm"s competitive position. As such, purchasing and materials management activities are beginning to integrate with a series of simultaneous activities of a total materials supply system" (Reck et al., 1992).

h. Quality Standard

Table-11 for factor analysis with varimax rotation for quality standard revealed that from the five statements for measuring quality standard variable, two factors are extracted. A total of three statements with high factor loadings and minimum coefficient of 0.70 constituted factor-

1. The factor loading/coefficient ranged from 0.70 to 0.78. The factors are titled or labeled

as per the statement got the highest factor loading. Accordingly factor-1 is labeled as „ISO certification". Factor-2 is consisted of remaining two statements with minimum factor loading of 0.47 and the maximum of 0.89. Factor-2 is titled as „maintenance of rules and regulations as prescribed by customers". The eigenvalue for these factors are more than 1. The cumulative percentages of variances explained by these factors are 63.64%.

Table-11: Factor Analysis with Varimax Rotation for Quality Standard

Statements Measuring Quality Standard	Factor	
	1	**2**
Our organization is ISO certified	.787	.117
We follow other quality standards like ERP.	.720	.034
We comply with ISO 9000 series of standards for improving our products" quality.	.704	.259
We strictly maintain the rules and regulations prescribed by our customers to ensure quality standards.	-.001	.891
Regular third party audit (by e.g. ITS, CSCC, PWH, GSC) is conducted in our organization to ensure quality standards.	.335	.749
Rotation Sums of Squared Loadings		
Eigenvalue	1.745	1.437
Percentage of variance	34.910	28.732
Cumulative percentage	34.910	**63.642**

A dominant feature of JIT manufacturing systems is their emphasis on quality. Such an approach cannot operate successfully without high levels of quality. The emphasis on quality was also a central feature of Ford"s MTPS (Model „T" Production System) and the quality levels attained were a remarkable achievement for that period. Ford organized that high volume production was dependent on having component parts, which were truly interchangeable. Without this critical feature mass production would be both difficult and costly; and a production line requiring invariant operation time would be impossible (Ford and Crowther, 1926). Ford recognized that quality was critical to increasing production and efficiency and much of his focus was on attaining the levels necessary to allow mass production. Quality was critical for manufacturing needs. The parts simply could not be put together if they did not fit properly. Materials, men and machineries all had to operate within rigorously identified limits if the system and its products were to function properly. Ford played a key role in recognizing this and in identifying a suitable product for the market.

The factor analysis of the present study revealed the following summary:

Table – 12: Extracted JIT Factors from Factor Analysis

	JIT Supporting Factors	Statements Identified from Factor Analysis
1.	JIT Awareness	1. Quality production process and performance is required for maximizing customer satisfaction. 2. Finished goods should be shipped to customers immediately after production. 3. Required quantity of raw materials should be purchased only as we get the customer order.
2.	Corporate Culture	4. Employees are encouraged to celebrate special days and social gathering. 5. Over time payments are duly paid 6. Employees like to work longer hours when necessary
3.	Management Commitment and Support	7. Management has strong commitment for quality 8. Senior managers attend JIT, Lean and quality related seminars and workshops
4.	Leadership	9. Quality leadership reduces employee absenteeism 10. Our leaders guide the workers specifically as what to do
5.	Human Resource Management	11. Compensation and reward is based on skill and performance 12. There is strong communication and coordination among employees
6.	Automation	13. We provide training to our employees as to how to operate the new automated machineries
7.	Logistics Support	14. Adequate clearing and forwarding services are available. 15. Spare parts of machineries are usually available as and when needed.
8.	Quality Standards	16. Our organization is ISO certified 17. We strictly maintain the rules and regulations prescribed by our customers to ensure quality standards.

8. Conclusions and Implications

The present study has shown that many different supporting factors for the implementation of JIT production practices exist in the RMG and Textile industries in Bangladesh. Researchers and academicians have been continuously striving to find out modern tools, techniques and production practices as survival strategy for the manufacturing concerns in the competitive global market. As an effort to reduce non value added activities and/or unproductive activities which results in cost reduction, often the question of maintaining minimum inventory or zero inventory

through ensuring the congenial environment to support Just-in-Time being emphasized by the social scientists, academicians, and leading industrialists. The owners and the managers should try to take steps for continuous improvement and development of these JIT supporting factors. Therefore, ensuring the supporting environments to implement quality programs like JIT will ensure its practices/implementation.

The study explored and identified eight broad JIT supporting/facilitating variables as exist in the RMG and Textile industries in Bangladesh. The eight variables were defined by a total of seventy eight statements. As a data reduction tool, factor analysis finally reduced these seventy eight statements into seventeen factors only which are more related to each other than they are to others. This implies that these seventeen statements are more highly correlated with each other. These small sizes of statements and variables can be used by researchers and academicians for further study.

One important out come of this study is that the Government, owners, managers, and other stakeholders of the RMG and Textile industries should put more concentration on human factors like corporate culture, management commitment and support, leadership, human resource management, and criteria of suppliers comparing to technical/mechanical factors. Thus a labor friendly corporate culture, conducting regular development training programs, enhancing leadership quality, forwarding management support and other human issues will refrain the employees and workers from frequent migration from one company to another and will also save the costs.

A smooth, defect free, and uninterrupted production process is the very essence for minimizing the non-value added activities like maintaining buffer stock, sloppy production, machine break-down, shortage of raw material, labor unrest, inefficient and untrained labor force and employees and many more.

The present study has an interesting implication for both the researchers and managers. It provides researchers the framework and methodology to study JIT and other quality management programs like lean manufacturing, TQM, and others. For manufacturing managers especially in the Textile and RMG sector, this research finding provide tool to evaluate their JIT production practices. The results of the present study show that management improvement activities play a vital role in the Textile and RMG industries in Bangladesh. Beside manufacturing-business strategy linkage, the manufacturers in the Textile and RMG industry should put emphasis carrying out management improvement activities such as JIT since this study provides empirical evidence that JIT is a powerful tool for Bangladeshi manufacturers for global competition and survival strategy.

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An Empirical Analysis of Multivariate Causality between Foreign Aid, Electricity Consumption and Economic Growth: Evidence from Bangladesh

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Abstract

The concept of aid-effectiveness has been extensively investigated by researchers and policy makers all around the globe. Foreign aid is considered as one of the life bloods of developing nations those are on the verge of undergoing structural transitions but are constrained by inadequate capital to finance the investments necessary for rapid economic growth and development. In addition to foreign aid being a determinant of economic growth of a nation, c[12]onsumption of electricity also plays a crucial role in expediting the growth rate. Furthermore, energy is a crucial factor in attainment of the Social Development Goals (SDGs).However, Bangladesh has been historically facing electricity deficits whereby its growth prospects are being hampered to a major extent. Foreign aid inflow is expected to resolve this crisis boosting the country‟s overall electricity generation. The aim of this paper is to investigate the causal relationships between foreign aid inflow, electricity consumption and economic growth in Bangladesh incorporating relevant data from 1980 to 2013. Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests are used to test the stationarity of all the concerned variables and it is found that they are stationary in the first differenced form. Johansen cointegration test is employed to determine the long run relationships between the variables. Moreover, using Granger causality test, we observe various long run causal relationships between the variables included in our model while the Vector Error-Correction Model (VECM) approach provides the short run causalities. Our results reveal that economic growth in Bangladesh is attributed to consumption of electricity which is in line with the "growth hypothesis."

Keywords: Causality, Electricity, Foreign Aid, Economic Growth, Cointegration

1. Introduction

Clean and affordable energy availability has been enlisted in one of the seventeen Sustainable Development Goals (SDGs). Thus, energy and its conservation are considered to be the utmost important tool of economic development and its sustainability. Electricity is the major form of energy used in Bangladesh and it is tapped to do almost everything. On the other hand, it is believed that economic growth attributes to achieving almost all developing objectives. Moreover, underdeveloped nations like Bangladesh are reliant on foreign assistances to pursue their growth

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strategies. Thus, the concept of „aid effectiveness[1]" is to be understood since aid, if not utilized properly, would not be effective in attaining the underlying development goals behind flow of assistive capital across nations. Foreign Aid (FAID) is considered as one of the life bloods of less developed economies those are on the verge of undergoing structural transition but are constrained by inadequate capital to finance the investments necessary for economic growth and development. As understood from a number of empirical studies, foreign aid has been both a blessing and a curse for the aid-recipient nations. Some studies have found positive linkages between volume of aid inflow and degree of economic growth while other studies concluded the opposite.[2]According to Sachs (2005), aid has immense potential and works as a „Big Push" to tackle the vicious circle of poverty in less developed countries whereby economic development can be ensured effectively. This view was contradicted by conclusions of studies by and Easterly (2003) and Easterly et. al (2003) referring the concept of poverty eradication via foreign assistance as a myth. A number of studies by Collier and Dollar (2001) and Addison *etal.* (2005) also pointed out aid as "conditionally" effective in generating economic growth provided conducive monetary, fiscal, and trade frameworks exist in the recipient country which should ideally follow a pro-poor growth strategy. In contradiction to their views, Gibson *et al.* (2005) proposed „Samaritan"s Dilemma[3]" which said that aid reduced incentives to invest since aid was assumed to flow unceasingly and would be sufficient to be used in future.

Economic Growth (EG) has been chosen as one of the two key economic variables in our study with the presumption that the ultimate goal of capital assistance is to ensure growth of the aid-recipient nation. It is strongly believed in economic literatures, like Papanek (1972), Chenery and Strout (2001) and Meier and Stiglitz (2001), that aid is definitely capable of spawning wonders for a poor economy if the inflow of external funds could be used optimally from a social perspective. Otherwise, it would leave no stones unturned
in generating adversities making the host economy worse-off compared to the pre-aid stage. The ambiguous findings on this aid-growth nexus make their causal relationships an interesting topic of debate and further inquiry.

Electricity Consumption (EC) has also been selected as the other foremost economic variable due to the fact that energy consumption, especially electricity power, is a crucial determinant of economic growth which has been acknowledged in numerous energy-augmented economic

1 Aid effectiveness is referred to as the usefulness of development aid in achieving economic development as well as human development. International aid system commenced following the World War II when the United States used their funds to rebuild the war affected European nations. For more clear understanding of aid effectiveness see Tarp (2006) and Arndt *et al.* (2009).

2 For understanding the positive impacts of foreign aid on economic growth see Burnside and Dollar (2000) Sachs (2005). Conversely, see White (1992) and Easterly (2001) for the negative influences of foreign aid on growth of the economy.

3The Samaritan's dilemma was introduced by James Buchanan, an economist, who asserted that people are in a dilemma regarding use of money received as charity. Resources received as charity can either be spent to be better-off at present or be negligible due to having the presumption that charity would flow unceasingly in future. This view has been linked with foreign aid-ineffectiveness in the manner that aid is viewed to be the same as charity whereby people become ignorant to use the aid to invest instead of consuming it at present. Thus, Samaritan's dilemma is believed to have negative impacts on economic growth in aid-recipient countries. For more information see Gibson et al. (2005) and Raschky and Schwindt (2008).

growth models. Since, economic growth theories assert that economic growth is synonymous to industrialization of the economy, the role of electricity and other sources of power become extremely vital as these are used as industrial inputs whereby the process of industrialization is expedited. Various studies on the relationship between electricity consumption and economic growth have stated a positive correlation between the two variables and referred electricity as a catalyst of economic growth. For instance, Oh and Lee (2004) found bidirectional causality between electricity consumption and economic growth in Korea, Morimoto and Hope (2004) discovered causality running from electricity production to economic growth in Srilanka, while Ang (2008), Karangfil (2008) and Abosedhra and Baghestani (1989) concluded in favour of causality running from economic growth to aggregate energy consumption in Malaysia, Turkey, and the United States respectively. Moreover, there are also evidences suggesting that foreign funds flowing into the underdeveloped nations are utilized in generating electricity which coincides with the notion of increase in electricity consumption as well. Thus, inclusion of electricity consumption as an imperative economic variable is indeed a justified decision. Four economic growth hypotheses in affiliation with energy consumption are conferred later on in our paper which would provide more support for the addition of electricity in our analytical model.

1.1 Energy-Growth Hypotheses

Based on empirical findings by various economists and policy makers, four hypotheses have been postulated describing the electricity consumption-economic growth interconnectedness. The first of these hypotheses is referred to as the „Growth Hypothesis" which assets that causality runs from electricity consumption to economic growth but not the other way round. Thus electricity and other energy sources are considered to be determinants of growth. Secondly, „Conservation Hypothesis" suggests that the causality runs from economic growth to economic growth only. This implies that the more the growth attainment the greater the consumption of electricity. This hypothesis is put forward with the understanding that as a nation gains economic growth, its income per capita rises. Following this rise in disposable income consumers as well as producers are able to demand and consume more electricity. Thus a positive linkage between these two variables should be visible. The third hypothesis, „Feedback Hypothesis," says that there exists a two-way causality between electricity consumption and achievement of economic growth. This implies that these variables are determinants of one another. Finally, „Neutrality Hypothesis" explains that there is no causality from any direction between electricity consumption. Hence, in line with this hypothesis, electricity is not a determinant of economic growth which in reality seems to be impractical.

1.2 An Overview of the Electricity Sector in Bangladesh

Developing countries like Bangladesh, those are striving hard for rapid development of their economies, are heavily reliant on Electricity supply. Table A.1 in Appendix A, shows a clear recent picture of the power sector of Bangladesh giving further support on the scope of foreign aid-financed electricity consumption induced economic growth. It can be seen that there is a difference between installed capacity and derated capacity which indicates that electricity generation is constrained by some technical factors in Bangladesh. However, we can see that derated capacity rose by 11.38% according to Bangladesh Power Development Board (PDB), depicting

improvements in the country‟s associated power sector. Bangladesh, in similarity with most less developed countries, experiences high population growth and density. As a result, both household and industrial demand for electricity shows a progressive trend as expected. This can be identified from the table as it can be seen that per capita electricity generation and consumption, electricity demand and maximum electricity demand all grew with rise in the total number of consumers. Moreover, it is also seen that despite the positive improvements in the power sector, load shedding still exists which can be an economic growth constraint too. There are many reasons behind this gap in quantities of electricity demanded and supplied in Bangladesh. One of the factors could be inadequacy of investment in the power sector which is understandable since Bangladesh is a less developed nation that relies on external finance to fill its resource gap. Many empirical studies have therefore highlighted foreign aid as a potential source of finance that could mitigate this difference between electricity demand and supply and restore equilibrium.

This paper aims to analyse the causal relationships between foreign aid, electricity consumption and economic growth in context of Bangladesh over the period 1980 to 2013.[1] The following questions are precisely addressed in this paper:

1) Is there any long run relationships between the foreign aid, electricity consumption and economic growth in Bangladesh?

2) What are the directions of causalities between these variables?

The remainder of the paper is organized as follows. The next section provides the literature review followed by the section that discusses the attributes of data and the methodology of research. Moving on, the subsequent sections provide discussions on econometric results and finally followed by concluding remarks and policy recommendations.

2. Review Of Literature

Section 2 is split into between two main subsections- Theoretical Frameworks and Empirical Findings. Over the years, the causal relationships between foreign aid, electricity consumption and economic growth have been examined by researchers all around the globe. However, there has not been any general consensus on these relationships as the results varied from country to country.

2.1. Theoretical Frameworks in Context of Foreign Aid Impacts on Economic Growth

There have been many theories suggesting foreign aid being a catalyst of economic growth in the aid-recipient less developed nations. Historically, foreign aid in the early 1940s existed which was interrupted with the initiation of World War II. Following the World War II, foreign aid reincarnated with the Marshal Plan[2] under the Organization for European Economic Co-operation (OEEC)

1 Due to unavailability of data for the year 2014 we had to limit our period of reference up to 2013.

2 Ofiicially called the European Recovery Program (ERP), the Marshall Plan was an initiative of the United States to provide aid to the Western European countries worth 120 billion US dollars (in current dollar value, June 2016) which was about 2-3% of US national income. For more information see De Long and Eichengreen (1991).

whereby the United States transferred a portion of its national income to restore the economy of the war-affected Europe. The tremendous success of this plan later on also gained popularity amongst the developing countries and as a result economic growth attainment strategies via the channel of foreign aid were implemented from 1960 onwards. According to John Maynard Keynes[1] in 1930s, the growth prospects of developing countries are mainly constrained by inadequacy of capital accumulation condemning the amount of investment required for boosting the economy. Foreign aid is interconnected with economic growth attainment in the sense that it fills out the gaps experienced by the developing countries. Three types of gaps were identified responsible for upholding economic growth in the less developed countries.

The Savings-Investment Gap: The gap theory discussed in Harrod-Domar[2]model of economicgrowth assumed that poor developing countries usually have nominal income levels and as a result have low savings as well. Therefore, their required levels of investments are inhibited by this resource constraint. This implies that there exists a resource gap as savings is less than the desired value of investment in monetary terms. Thus, foreign assistance in the form of aid and/ or foreign direct investment can be the financial solution to this anti-growth factor (Meier and Stiglitz, 2001).

The Foreign Exchange Gap: Chenery and Strout (1966) developed a „dual-gap" gap model inwhich they identified another resource gap, in addition to the savings gap, which was known as

the foreign exchange gap. The core theory behind this gap is that less developed countries usually do not have adequate export receipts that could be used to import capital goods. Thus, deficits in the foreign exchange reserves of these countries restrain their growth prospects as capital accumulation is believed to be a major determinant of growth. Following this notion, foreign aid, which is synonymous to inflow of foreign currency, can easily sort out this gap and help financing of the required capital goods.

The Fiscal Gap: The third resource gap, as discovered by Bacha (1990) and Taylor (1990),restricting economic growth is created due to the deficit in a developing country"s government revenue compared to its proposed expenditure. In the less developed countries those are open to external finance there is a tendency in their governments to declare deficit budgets with the hope that the excess expenditure costs would be financed through foreign capital inflows. Moreover, these governments are sometimes incapable of generating enough revenues through taxation policies which is also a reason attributing to the fiscal gap. Once again, foreign aid can be useful in supplementing this deficit which would stimulate investments and contribute to growth.

Rostow"s (1990) economic growth model also acknowledges the role of foreign aid in transforming an economy with the intention of gaining growth. According to Rostow, the fact that underdeveloped countries are capital-deficient and are not self-sufficient in in pooling essential

1 Keynes asserted that government can finance capital investments in the economy which is a pre-requisite for achieving economic growth. From this notion, many other economists added that since developing countries have inadequate savings, foreign capital can be the solution to catalyze investments and attain growth. For more information on Keynesian economics see Palley (1996).
2 See Domar (1947) and Harrod (1948).

resources necessary for economic growth-investments, external intrusion in the form of aid is a pre-condition for taking-off into economic prosperity. In simple terms, a developing country has to undergo structural transformation from being a traditional agrarian economy to being a modern industrial economy within a five-stage framework. In order to do so, capital is essential to finance investments which can be provided through foreign financing as domestic finance is not adequate.

2.2 Theoretical Frameworks in Context of Energy Consumption-Economic Growth Nexus

Economic theories have not yet managed to master the task of modeling energy-macroeconomic associations (Finn, 2000). There is no significant model exclusively specifying the relationship between economic growth and electricity consumption. However, a number of empirical studies exist those depict relationship between energy consumption as a whole and economic prosperity. The effects of energy on economic growth and other macroeconomic variables are seen as the responsiveness of those variables following energy supply and price shocks. This is considered as the basis while computing any model to analyse the energy-led growth hypotheses. There are a few such models which were used in empirical studies over the years.

Energy Augmented Computable General Equilibrium (CGE) Model: Conventional CGEmodels[1] are economic models that are put to use for estimating the manner in which the economic variables react to transitions in policy frameworks, technological advancements, and external shocks. These models are augmented with energy in the sense that energy supply and energy price shocks are incorporated into these models to test their impacts on the economy as a whole. These furthermore examine the inter-connectedness between economic and energy related activities such as energy production, consumption, energy-led pollution creatinh environmental hazards etc. Several studies like those of Alves and Periera (2006), Bhattacharya (2006), Naqvi (1998) for Pakistan, Fisher-Vanden*et al.* (1997) for India and Bruvoll and Ibenholt and Ibenholt (1997) for Norway used CGE models to analyse the linkage between energy shocks and economic growth,

Energy Augmented Dynamic Stochastic General Equilibrium (DSGE) Model:

Conventionally, DSGE models tend to explain macroeconomic indicators like economic development and growth, Real Business Cycle (RBC), and so on. Energy is augmented in such DSGE models in order to analyse the effects of energy price shocks on RBC models. RBC models are the building blocks of all DSGE models. The RBC model is just a simple neo-classical growth model. These models are called micro-finded macro models.

Kim and Loungani (1992) Model: In their paper, Kim and Loungani used a DSGE model inwhich energy, in the form of input and an exogenous variable was augmented into a standard RBC model. The underlying notion behind this model was that energy as an input in the production process would supplement the conventional labour and capital inputs. Hence, they referred energy as one of the prime determinants of output at the aggregate level and their model tried to capture the energy price shock impacts on the overall RBC model following Kydland and Prescott‟s (1991) approach. .

1 Further clarifications on CGE models are put forward in Alves and Pereira (2006).

Ghali and El-Sakka (2004) Model: They modified the traditional two-inputslabour-capital neo-classical growth model and augmented it with energy with the notion that labour and capital in the absence of energy would not be able to perform at their true potential levels. Thus, energy was considered to be a growth-restricting factor if the availability cannot be ensured.

2.3 Empirical Findings on Foreign Aid Impacts on Electricity Consumption and Economic

The relationship between foreign aid-induced electricity consumption and its impact on economic growth of Nepal had been precisely examined by Dhungel (2014)..He used conventional time series Nepalese data between 1974 and 2011 and established a causality direction for this relationship. A simple three-variable linear model was used in this paper where electricity consumption was regressed against foreign aid and Gross Domestic Product (GDP). GDP was used to measure economic growth of Nepal during the period of study. He employed unit root test and Johansen cointegration test to check the stationarity of the data and to check whether or not the variables are cointegrated. In addition, OLS estimation techniques were also used to estimate the slope coefficients/elasticity of the explanatory variables. Furthermore, Error-Correction Model (ECM) was also considered to generate the long run relationship in the model. His findings depicted clear evidence of a strong positive relationship between foreign aid and electricity consumption and between GDP and electricity consumption. It was learnt that the foreign aid elasticity of electricity consumption was 0.27 while the GDP elasticity of electricity consumption stood at 2.27. Moreover, he found that long run equilibrium occurred and previous period disequilibrium got corrected at a pace of 72% annually.

Dhungel (2014) further revealed both the long run and short run association between foreign aid inflow in Nepal and its electricity consumption. Following his earlier paper the period of reference for collection of time series data was chosen from 1974-2011. He estimated a simple bivariate model where electricity consumption was a function of the only explanatory variable foreign aid. Unit root and cointegration tests were run on the data set and acceptable results were found. ECM was used to investigate the long run relationship between the variables. Moreover, OLS methods were tapped to estimate the slope coefficient of the independent variable. Results showed that the relationship sustained in the long run. More importantly, a strong positive connection between electricity consumption in Nepal and its inflow of foreign aids existed as following a 1% change in foreign aid volume led to approximately 0.48% change in the nation‟s electricity consumption. Thus, the hypothesis that presumed existence of a relationship between the two variables was proved absolutely correct. Moreover, his results showed that both short run and long run equilibrium existed and any equilibrium, in case there is disequilibrium, in the long run is restored at a rate of 33.6% annually.

Ekanayake and Chatrna (2010) conducted a study to evaluate the potential effects of foreign aid on economic growth in aid-dependent developing countries. They pooled panel data incorporating 85 countries across Asia, Arica, Latin America and Caribbean for the timespan 1980 to 2007. Their hypothesis was in line with the economic theory that causality runs from foreign aid to economic growth. The relationship was econometrically examined using two models: a foreign aid augmented production function and an economic growth model following Karras (2006). They resorted to use of panel least squares estimation tools to conclude on this association. It is to be

pointed out that the authors tried to see the changes in the effects foreign aid generated over time and as a result they estimated their models for different shorter time periods, geographic regions, and income levels of the developing countries. The results showed that the effects of foreign aid in stimulating economic growth in those developing countries were ambiguous. In some countries a negative relationship was found which corroborated empirical findings of Burnside and Dollar (2000) and Brautigam and Knack (2004). Conversely, positive relationship was also witnessed in some of the developing countries which was in line with findings of Lim (2001), Dowling and Hiemenz (1982), Gupta and Islam (1983), Hansen and Tarp (2000), Gomanee*et al.* (2000), Dalgaard*et al.* (2004), Karras (2006), and Papanek (1973). Moreover, the impacts of foreign aid varied from country to country with respect to different time periods, regions, and income levels.

Amin (2008) used time series data of Bangladesh to probe the causality between economic growth and electricity consumption being motivated by studies on the same causal relationship by Kraft and Kraft (1978), Ferguson *et al.* (2000), Ghosh (2002), Shiu and Lam (2004), Moritomo and Hope (2004), Jumbe (2004), Wolden-Rufael (2004), Narayen and Smith (2005) and Yoo (2005). He presented a simple bivariate linear model to generate the direction of causality between the two variables during the time period 1974 to 2006. Real GDP was used as a measure of economic growth in Bangladesh while electricity use was considered as a measure of electricity consumption. Unit root tests were done on the variables to check on their stationarity but it was found that all the variables were non-stationary as expected. Furthermore, the data set was tested for possible cointegration between the two variables and was found to be present during the reference time period. Finally, Granger causality test confirmed that causality ran from economic growth to electricity consumption in Bangladesh and as a result it was recommended that Bangladesh can pursue an energy conservation policy since it would not adversely affect the nation‟s economic growth prospects.

Electricity consumption and economic growth associations in context of the South Asian country India was carefully investigated by Ghosh (2000). He used annual data from 1950/51 to 1996/97 to test the direction of causality between per capita electricity consumption and per capita GDP. He employed a bivariate model incorporating these two variables. He followed Oxley and Greasly (1998) and divided his econometric analysis into three stages. At first, he conducted ADF and PP tests to determine the stationarity status of his data and found that the data were non stationary at both levels and first differences. Then, he explored bivariate cointegration using VAR approach of Johansen (1988, 1991) and Johansen and Juselius (1990) and found traces of cointegration and found traces of cointegration between the two variables considered in his model. Finally, Granger causality was tested and the test results confirmed causality running from economic growth to electricity consumption in context of India. Moreover, although uni-directional causality was discovered, no evidence suggesting long run equilibrium between the variables was found.

Viederpass and Andersson (2007) attempted to solve the aid effectiveness puzzle evaluating the impacts of foreign aid in theoretical framework of output production. They tried to understand how inflow of foreign aid determined the production efficiency of the aid-recipient countries which in turn is correlated to economic growth attainment. They considered 60 countries belonging to Sub-Saharan Africa, East Africa, North Africa and the Pacific, Latin America and the Caribbean, Middle East and South Asia. A multiple input-single output production model using an intertemporal

frontier approach[1] was tapped to draw conclusions. They used annual input and output data of all these countries during the time period 1995 and 2000. Data Envelopment Analysis (DEA)[2] technique was used to analyse country-specific production efficiency which was later on linked to foreign aid. According to the findings, counties reliant on labour and energy inputs showed lower production efficiencies compared to their counterparts capital intensive countries. Moreover, no clear linkage between foreign aid and efficiency could be established from the study results. Thus, aid-economic growth relationship was concluded to be inconclusive too. An empirical analysis by Gupta and Sahu (2016) showed that electricity consumption had positive impacts on economic growth in India using annual time series data between 1960 and 2006. They put forward the Engle Granger Causality Model (1987) and showed the direction of causality between the two variables. It was basically a bivariate model in which GDP, a proxy for economic growth, was expressed as a function of electricity consumption. They used ADF and PP tests to determine the existence of unit root in the data set and also tapped Granger causality test to conclude on the direction of causality. Their findings were in line with the results obtained from studies by Altinay and Karagol (2005) in context of Turkey, Morimoto and Hope (2001) for Srilanka and Aqueel and Butt (2001). Furthermore, this study proposed future recommendations regarding energy, especially electricity, conservation policies for India since lack of energy supply may lead to adverse effects on the country‟s economic growth.

Shahbaz and Feridun (2012) conducted an empirical test on electricity consumption and economic growth using Pakistani annual time series data between 1971 and 2008. They used a bivariate model taking economic growth and electricity consumption as the variables. They followed ARDL bounds testing approach to cointegration developed by Pesaran and Pesaran (1997), Pesaran*et al.* (2000), and Pesaran*et al.* (2001) in order to estimate the long run relationship between these two variables. In addition, Ng-Perron and Clement-Montanes-Reyes tests had been used to check the stationarity and order of integration of the data. Moreover, parameter stability tests following Pesaran (1997) and Brown *et al.* (1975) were also employed in the model. Finally, they also resorted to use of Toda Yamamoto[3] and Wald-test[4] causality tests and determined the direction of causality running from one variable to the other. The findings of this study, which were in line with findings of Ghosh (2002), Fatai*et al.* (2004) and Hatemi and Irandoust (2005) but in contradiction to findings by Erol and Yu (1987), Narayan and Singh (2007), Wolde-Rufael (2009) and Apergis and Payne (2009), showed that there is long-run equilibrium between the two variables and also a uni-directional causality was found running from economic growth to electricity consumption.

Olusegun (2008) explored the energy consumption and economic growth nexus in context of Nigeria using a bounds testing cointegration approach which is based on Autoregressive Distributed Lag (ARDL) procedure.[5] He referred to the country‟s annual time series data from

1 Intertemporal efficiency estimation concept was first defined and labeled by Tulkens and Eeckaut (1991). For more information on applications on intertemporal frontiers in a developing economy context see Veiderpass (1997) and Isgutet al. (1999).

2 For more information on DEA method see Banker et al. (2013).

3 For more information on this causality test see Toda and Yamamoto (1995).

4 Wald test is a parametric statistical test named after the Hungarian statistician Abraham Wald. For more information see Engle

5 According to Khalil and Dombrecht (2011), ARDL cointegration method, developed by Pesaran and Shin

1970 to 2005. Basically, a two variable VAR model was analysed and tested in which economic growth, measured in terms of GDP, was held to be a function of energy consumption, which was disaggregated into oil gas and electricity consumption. In addition to bound testing tools, he employed Ng and Perron (2001) Modified unit root test in order to check for stationarity and order of integration of the data. Moreover, Toda Yamamoto (1995) test was tapped to determine the short run causality between the variables. The results expressed unidirectional causal relationship running from aggregate energy consumption to economic growth. Similar results were found for relationship between oil consumption and economic growth and between gas consumption and economic growth which is in line with neutrality hypothesis of growth. However, electricity consumption had no causal relationship with economic growth. As per cointegration test results, there was long term relationship between total energy consumption and economic growth which held in the cases of both oil consumption-economic growth nexus and gas consumption-economic growth nexus. Conversely, no long term association between electricity consumption and Nigerian economic growth was found.

Hossain (2014) attempted to investigate the effects generated by foreign aid on economic growth of Bangladesh during 1980 to 2012. However, four separate models were used using sub periods within the reference period of 1980 to 2012 for precise examinations. Following Ekanayake and Chatrna (2010), Islam (1999) and Quazi (2005), he used a foreign aid augmented production function, with labour and capital as the other two inputs, in all the four segments of analysis. OLS method was considered and applied to estimate the coefficients of the explanatory variables which were then used to draw conclusions on the relationship between the foreign aid and economic growth. The results showed that foreign aid inflow in Bangladesh generated positive impacts on its economic growth which was confirmed by the fact that all the estimated coefficients were positive and in most cases statistically significant too.

The long run cointegrating relationship between energy consumption and economic growth was analysed by Belke*et al.* (2010). Their study was based on 25 member countries belonging to the Organization for Economic Cooperation and Development (OECD)[1] and they used annual data from 1981 to 2007. It is to be noted that this paper also incorporated energy prices[2] in the analysis of the energy consumption-economic growth nexus following Masih and Masih (1997), Asafu-Adjaye (2000), and Mahadevan and Asafu-Adjaye (2007). An autoregressive multivariate model was estimated using recently developed panel-econometric methods. Initially, conventional ADF and PP tests, as well as Kwiatkowski, Phillips, Schmidt and Shin (1992) (KPSS) test were employed to examine the presence of unit root in the data. Moreover, first generation panel unit root tests suggested by Levin, Lin and Chu (2002) (LLC) and by Im, Pesaran and Shin (2003) (IPS) were also used to explore stochastic trends in the idiosyncratic components of cross-section

(1999) and Pesaran*etal.* (2001), is used to see cointegration between variables in the long run and is applicable irrespective of whether the regressorvariables are I(0), I(1) or mutually cointegrated.

1The OECD, formed in 1948, is a unique forum where the governments of 30 market democracies work together to address the economic, social and governance challenges of globalization as well as to exploit its opportunities. For more information on OECD see <https:// www.oecd.org/about>.

2 Exclusion of energy prices in models depicting association between energy consumption and economic growth provides biased regression estimates, as argued by Masih and Masih (1997) and Asafu-Adjaye (2000).

data. Modified Johansen cointegration test proposed by Riensel and Ahn (1992) and Reimers (1993) was tapped to make concluding remarks on cointegration between the variables considered in the study. Dynamic Ordinary Least Squares (DOLS) estimation tool proposed by Mark and Sul (2003) provided the nature of long run relationship between the variables. Finally, a panel-based error-correction was estimated for determining Granger causality running from one variable to another. The main finding of this study revealed that there was evidence in favour of a bi-directional causality between energy consumption and economic growth in all the 25 countries. This result was in line with findings in studies by Ghali and El-Sakka (2004) for Canada, Lee (2006) for the United States, Glasure and Lee (1998) for South Korea and Singapore, Lee *et al.* (2008) for 22 OECD countries, Paul and Bhattacharya (2004) for India and Lee and Lee (2010) for 25 OECD countries.

A summary of the empirical literature reviewed is shown in table A.2 (see appendix).

3. Empirical Model and data Description

In accordance to Dhungel (2014) a three variate model is chosen where electricity consumption is held to be a function of foreign aid and economic growth. Foreign aid data was gathered from WDI 2016 and was measured in terms net official development assistance and official aid received (current US$). In addition, crucial data regarding electricity consumption (measured in kWh) and economic growth (measured using the GDP proxy in current $US units) were also acquired from WDI 2016.

$\mathbf{EC_t = \beta_0 + \beta_1 (FAID)_t + \beta_2 (GDP)_t + \varepsilon_t}$(3) Where EC refers to electricity consumption at aggregate level; FAID is used as a proxy for foreign aid and GDP refers to gross domestic product which is used as a measure of economic growth. Both of the two macroeconomic indicators, electricity consumption and economic growth, were chosen because empirical studies have highlighted their relationship with foreign aid and have provided justifications for their inclusion in aid-effectiveness investigations. Summary statistic of our data set is provided in table A3 (see appendix).

4. Methodology

To begin with, Augmented Dickey Fuller (ADF) and Phillips-Perron (PP)[1] tests were used to confirm the stationarity of the variables in both the models. Then, these were followed by Johhansen Cointegration test in order to figure out whether there is long term relationship or not between the variables in both models respectively. Once satisfied with the long run cointegration test results, Granger causality test was used to show the directions of causality running from one variable to another.

ADF and PP Tests: All the variables were tested for unit root in order to check the stationarityof the variables that were considered in our study. We used ADF and PP unit root tests to detect existence of unit roots, if any, in our data set. Once the variables were found to be stationary, cointegration test was run to find possible linear combinations of the variables which could be considered stationary. It is important to test data, especially time series data, for stationarity since

1 See Phillips and Perron (1988) for more information on tests for stationarity of data.

non stationarity of time series data leads to spurious regression unless the residual of the model is found to be stationary. If the p-values were found to be less than 10% only then the null hypothesis, which is that unit root exists, can be rejected implying stationarity of the data.

Johansen Cointegration Test: Furthermore, the Johansen procedure was applied to test for longrun cointegration, which is known to provide a unified framework for estimation and testing of cointegration relations in the context of VAR error-correction models.We estimated an Unrestricted Vector of Autocorrelation of the following form for this purpose:

$$\Delta x_t = \Gamma_1 \Delta x_{t-1} + \Gamma_2 \Delta x_{t-2} + \Gamma_3 \Delta x_{t-3} + \ldots + \Gamma_{k-1} \Delta x_{t-k-1} + \Gamma_k \Delta x_{t-k} + u_t$$

where Δ is the difference operator; x_t is a (n x 1) vector of non-stationary variables (in levels); and U_t is the (n x 1) vector of random errors. The matrix θ_k contains the information on long run relationship between variables, for instance, if the rank of $\theta_k = 0$, the variables are not cointegrated. On the other hand if rank (usually denoted by r) is equal to 1, there exists one cointegrating vector and finally if $1 < r < n$, there are multiple cointegrating vectors. Johansen (1990) derive two tests for cointegration, namely the trace test and the maximum Eigen value test. The trace statistic test evaluates the null hypothesis that there are at most r cointegrating vectors whereas the maximal eigen value test, evaluates the null hypothesis that there are exactly r cointegrating vectors in x_t.

Granger Causality Test: According to cointegration analysis, when two variables arecointegrated then there exist at least one direction of causality. Granger-causality, introduced by Granger (1969, 1980, 1988), is one of the important matters that has been much studied in empirical macroeconomics and empirical finance. The presence of non stationarity can lead to ambiguous or misleading conclusions in the Granger causality tests (Engle and Granger, 1987). Only when the variables are cointegrated, it is possible to deduce that a long run relationship exists between the non-stationary time series. When we take y and x as our variables of interest, then the Granger causality test (Granger, 1969) determines whether past values of y add to the explanation of current values of x as provided by information in past values of x itself. If previous changes in y do not help explain current changes in x, then y does not Granger cause x. In a similar way, we can examine if x Ganger causes y just be interchanging them and carrying out this process again. There could be four probable outcomes: (i) x Granger causes y (ii) y Granger causes (iii) Both x and y granger causes the other and (iv) neither of the variables Granger causes the other.

In this paper, the causality tests among all the concerned variables are conducted. For this the following two sets of equation are estimated:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \ldots + \beta_l y_{t-l} + u_t$$

$$y_t = \lambda_0 + \lambda_1 y_{t-1} + \ldots + \lambda_l y_{t-l} + \delta_1 x_{t-1} + \ldots + \delta_l x_{t-l} + v_t$$

We consider the above sets of equation for all possible pairs of (*x, y)* series in the group. The reported F-statistics are the Wald statistics for the joint hypothesis

$$\beta_1 = \beta_2 = \beta_3 = \ldots = \beta_l = 0$$

Vector Error-Correction Model (VECM): Engle and Granger (1987) showed that a vectorerror correction model (VECM) is an appropriate method to model the long-run as well as short-run dynamics among the cointegrated variables. Causality inferences in the multi-variate framework are made by estimating the parameters of the following VECM equations.

□*Y*

m n 0 *p* □□□□□□*i*□*Yt* □ *i* □□□□ *j*□*Xt* □ *j* □□□□ *M s* □□

□□*N* □□*Zt* □1□□*t* (i) *i*□1 *k* □1 *l* □1 □*X*

m *n* 0 *p*

□ *a* □□*bi*□*Y* □□*cj*□*Xt* □ *j* □□*d*□ *M s* □□*e*□*N* □ *fZt* □1

□□*t* (ii) *i*□1 *j* □1 *k* □1 *l* □1

z_{t-1} is the error-correction term which is the lagged residual series of the cointegrating vector. The error-correction term measures the deviations of the series from the long run equilibrium relation. For example, from equation (i), the null hypothesis that X does not Granger-cause Y is rejected if the set of estimated coefficients on the lagged values of X is jointly significant. Furthermore, in those instances where X appears in the cointegrating relationship, the hypothesis is also supported if the coefficient of the lagged error-correction term is significant. Changes in an independent variable may be interpreted as representing the short run causal impact while the error-correction term provides the adjustment of Y and X toward their respective long run equilibrium. Thus, the VECM representation allows us to differentiate between the short- and long-run dynamic relationships. The Chi-Square test statistic is used to determine the short run causalities between pairs of variables in the model.

We resorted to use of the EViews 7.1 software for carrying out all econometric tests in our study.

5. Results And Findings

The unit root tests results confirmed that all of the variables in the model were found to be stationary at their first difference levels which ruled out the possibility of the regression being spurious. The ADF test results are given in table 1A and the graphs are given in Figure A1 (see appendix).

Table 1: Augmented Dickey Fuller (adf) Unit root test (Lag=8)

Panel 1: Levels - I(0)

Variables	ADF Statistics (only constant)	ADF Statistics (constant and trend)	Decision on stationarity
EC	4.79298	0.49228	Non-stationary in both constant and constant and trend
FAID	-1.6223	-1.7535	Non-stationary in both constant and constant and trend
GDP	7.0348	2.7683	Non-stationary in both constant and constant and trend
	Panel 2: First Difference - I(1)		
Variables	**ADF**	**ADF Statistics**	

	Statistics (only constant)	(constant and trend)	Decision on stationarity
EC	-3.55135	-5.8885	Stationary in both constant and constant and trend
FAID	-6.5403	-6.5813	Stationary in both constant and constant and trend
GDP	-1.6668	-3.6869	Stationary on in constant and trend

Note: All regressions are estimated with and without trend. Selection of the lag is based on Schwartz Information Criterion (SIC). EViews 7.1 software automatically selects the most significant lag length based on this criterion.

The Johansen Cointegration results show that there are long run relationships between our concerned variables. The results are shown in table 2.

Table 2: Johansen Cointegration Test (Lag=1)

Johansen Test for Cointegration (Trace Test)

Null	Alternative	Trace Statistic	95% Critical Value	Conclusion
r = 0	r = 1	28.89	29.80	1 cointegrating equation
r <=1	r = 2	6.88	15.49	
r <=2	r = 3	0.05	3.84	

Johansen Test for Cointegration (Maximum Eigenvalue Test)

Null	Alternative	Max-Eigen Statistic	95% Critical Value	Conclusion
r = 0	r = 1	22.01	21.13	1 cointegrating equation
r <=1	r = 2	6.83	14.26	
r <=2	r = 3	0.05	3.84	

According to our finding from the Granger Causality test, we observed that unidirectional causalities on three occasions running from electricity consumption to economic growth, electricity consumption to foreign aid, and economic growth to foreign aid. Therefore, we can say that electricity is a determinant of growth in Bangladesh which coincides with the growth hypothesis. This could be because Bangladesh is striving for rapid industrialization of its economy for which power supply, electricity in particular, is a decisive requirement. Thus positive trends in economic growth rates in Bangladesh over the years can be associated with consumption of electricity,

especially in the industrial sector. Moreover, the other two causalities imply that electricity supply and economic growth are determinants of foreign aid in Bangladesh.

Table 3: Granger Causality Tests (Lag=1)

Null Hypothesis	F-Statistic	P-Value	Granger Causality
FAID does not Granger Cause EC	0.00145	0.9699	Unidirectional Causality EC FAID
EC does not Granger Cause FAID	3.42478	0.0741	
GDP does not Granger Cause EC	0.56395	0.4585	Unidirectional Causality EC GDP
EC does not Granger Cause GDP	3.43095	0.0738	
GDP does not Granger Cause FAID	3.74349	0.0625	Unidirectional Causality GDP FAID
FAID does not Granger Cause GDP	1.30244	0.2628	

The VECM results show that in the short run, there is no causality between foreign aid and electricity consumption and between foreign aid and economic growth. This implies that foreign aid is somewhat ineffective in influencing these two variables in the short run. However, we find a unidirectional causality running from electricity consumption to economic growth in the short run. This implies that electricity is a determinant of economic growth in Bangladesh.

Table 4: Vecm Test Results (Lag=1)
Causality Test Statistics between FAID and EC

Dependent Variable	Null	Chi-square Statistic	P-Value	Conclusion
D(EC)	FAID does not cause EC	1.55	0.46	No short run causality between
D(FAID)	EC does not cause FAID	0.24	0.89	FAID and EC
Causality Test Statistic between FAID and GDP				
Dependent Variable	**Null**	**Chi-square Statistic**	**P-Value**	**Conclusion**
D(GDP)	FAID does not cause GDP	0.12	0.94	No short run causality between FAID and GDP
D(FAID)	GDP does not cause FAID	1.39	0.50	

Causality Test Statistics between EC and GDP				
Dependent Variable	**Null**	**Chi-square Statistic**	**P-Value**	**Conclusion**
D(GDP)	EC does not cause GDP	7.32	0.03	Unidirectional short run causality
D(EC)	GDP does not cause EC	0.12	0.94	EC GDP

6. Conclusions

Electricity consumption is found to be effective in attainment of economic growth in Bangladesh both in the short run and the long run holding the growth hypothesis true. The reason behind electricity consumption being associated with economic growth could be because Bangladesh is effectively striving for rapid industrialization of its economy for which power supply, electricity in particular, is a decisive requirement. Thus positive trends in economic growth rates in Bangladesh over the years can be associated with consumption of electricity, especially in the industrial sector. Moreover, the other two causalities imply that electricity supply and economic GDP growth are determinants of foreign aid in Bangladesh. As far as the effects of foreign aid in Bangladesh are concerned, the unidirectional causality from electricity consumption to economic growth suggests that Bangladesh has justified the inclusion of energy as a crucial input for output production. Thus, energy augmented production functions are pretty realistic from Bangladesh‟s perspective which calls for the urgency of boosting the power generation capacities in near future. Foreign aid could be one of the solutions and contributors to power generation in Bangladesh. The foreign currency could be best utilized if used to develop both existing and new power plants in the country.

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APPENDIX

Table A.1: Overview of the key Power Sector Parameters of Bangladesh

Parameters	Year 2013-2014	Year 2014-
Installed Capacity	10416 MW	11534 MW
Derated Capacity	9821 MW	10939 MW
Maximum Demand	9268 MW	10283 MW
Maximum Peak Generation	7356 MW	7817 MW
Per capita Generation	271 kWh	290 kWh
Per capita Consumption	233 kWh	251 kWh
Total No. of Consumers	2901235	3157030
Maximum Load Shedding	932 MW	307 MW

Source: Ministry of Power, Energy and Mineral Resources, Peoples Republic of Bangladesh

STUDY	PERIOD	COUNTRIES	MODELS / ECONOMETRIC TOOLS	RESULTS
Dhungel 2014	1974-2011	Nepal	A tri-variate model; Unit root test, Johansen cointegration test, OLS estimation, ECM	Strong Positive relationship between electricity consumption and the explanatory variables foreign aid and GDP (used as proxy for economic growth). Foreign aid elasticity of electricity consumption was 0.27

				and GDP elasticity of electricity consumption was 2.27 (all values in % terms).

Dhungel 2014	1974-2011	Nepal	A bivariate model; Unit root test, Johansen cointegration test, OLS estimation, ECM	Strong Positive relationship between electricity consumption and foreign aid. Foreign aid elasticity of electricity consumption was 0.48 (all values in % terms)
Ekanayake and Chatrna (2010)	1980-2007	85 developing countries of Africa, Asia, Latin America, and Caribbean	A production function in which output depended on Capital (K), Labour (L), and Foreign aid (A), an economic growth model following Karras (2006); Panel least squares estimation method.	Foreign aid had both positive and negative effects on economic growth in developing countries. The effects were ambiguous depending on the time period of study, regional segmentation, and income levels.
Amin (2008)	1974-2006	Bangladesh	Bivariate model; Unit root test, Cointegration test, Granger Causality test	Uni-directional causality, Economic growth Granger causes electricity consumption.

Ghosh (2000)	1950/51-1996/97	India	Bivariate model using VAR technique; Three stage Causality testing following Oxley and Greasley (1998)- ADF, PP, Johansen cointegration, and Granger causality tests.	Causality runs from economic growth to electricity consumption and therefore energy conservation policies are applicable for India.
Viederpass and Andersson (2007)	1995-2000	60 countries of Sub-Saharan Africa, East Africa, North Africa and the Pacific, Latin America and the Caribbean, Middle East and South Asia	Multiple inputs-single output production model using intertemporal frontier approach; Data Envelopment Analysis (DEA) technique.	Energy and Labour intensive countries are less efficient in resource utilization compared to capital intensive countries. No clear linkage between foreign aid and economic efficiency and therefore aid and economic growth analysis was insignificant.
Gupta and Sahu (2016)	1960-2006	India	Engle Granger Causality Bi-variate Model (1987); ADF test, PP test, and Granger Causality test.	Positive relationship between electricity consumption and economic growth.
Shahbaz and Feridun (2012)	1971-2008	Pakistan	Bi-variate model; ARDL Bound testing approach to cointegration, Ng-Perron and Clement-Montanes-Reyes test, Toda Yamamoto test, and Wald	Long run equilibrium exists between electricity consumption and economic growth. Uni-directional causality

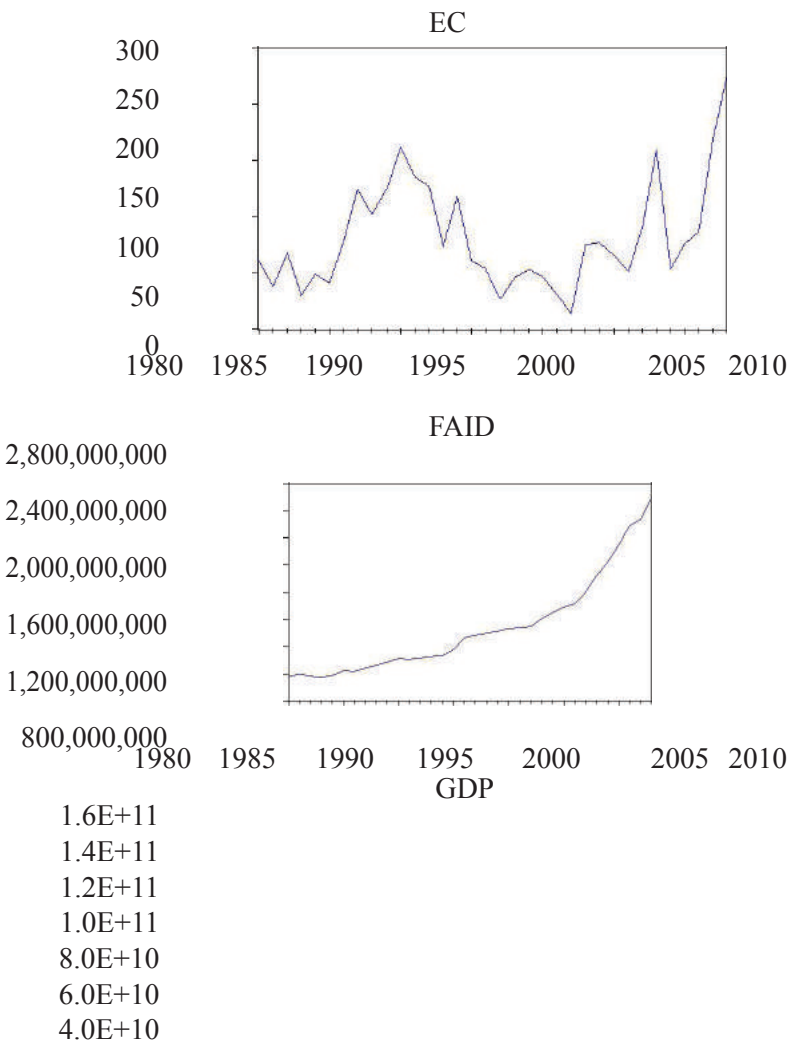
			test.	found running from economic growth to electricity consumption.
Olusegun (2008)	1970-2005	Nigeria	Two variable VAR model; Bound testing cointegration approach based on ARDL procedure, Ng-Perron modified unit root test, and Toda Yamamoto test.	Uni-directional causal relationship running from aggregate energy consumption to economic growth but no long run association was found.
Hossain (2014)	1980-2012	Bangladesh	Foreign aid-augmented production function; OLS estimation methods,	Foreign aid generated positive impacts on economic growth.
Belke*et al.* (2010)	1981-2007	25 OECD countries	An autoregressive multi-variate model; Panel econometric methods, ADF test, PP test, KPSS test, LLC test, IPS test, modified Johansen cointegration test, DOLS tools were used, and pane-based error-correction method.	Bi-directional causality between energy consumption and economic growth in all 25 countries.

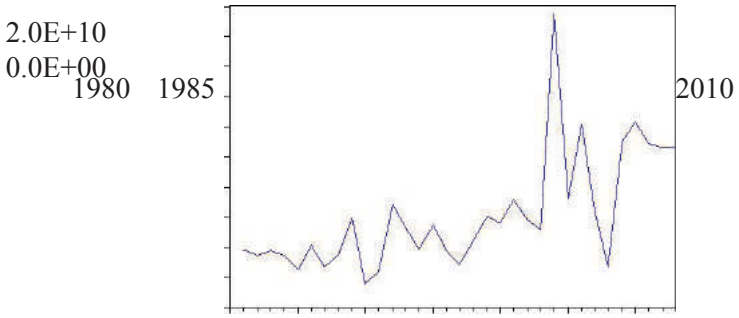
Table A3: Descriptive Statistics

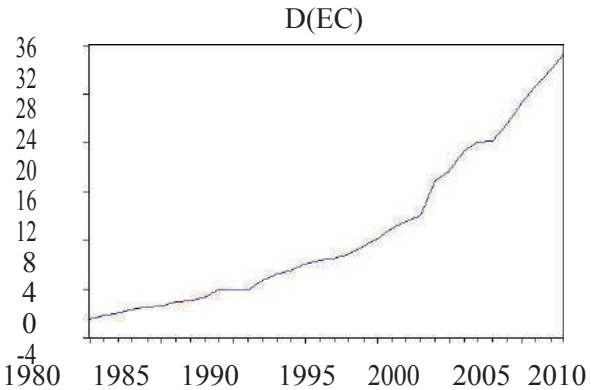
	EC	FAID	GDP
Mean	109.0473	1.46E+09	5.42E+10
Median	80.55541	1.36E+09	4.73E+10
Maximum	293.0247	2.63E+09	1.50E+11
Minimum	18.70602	9.06E+08	1.76E+10

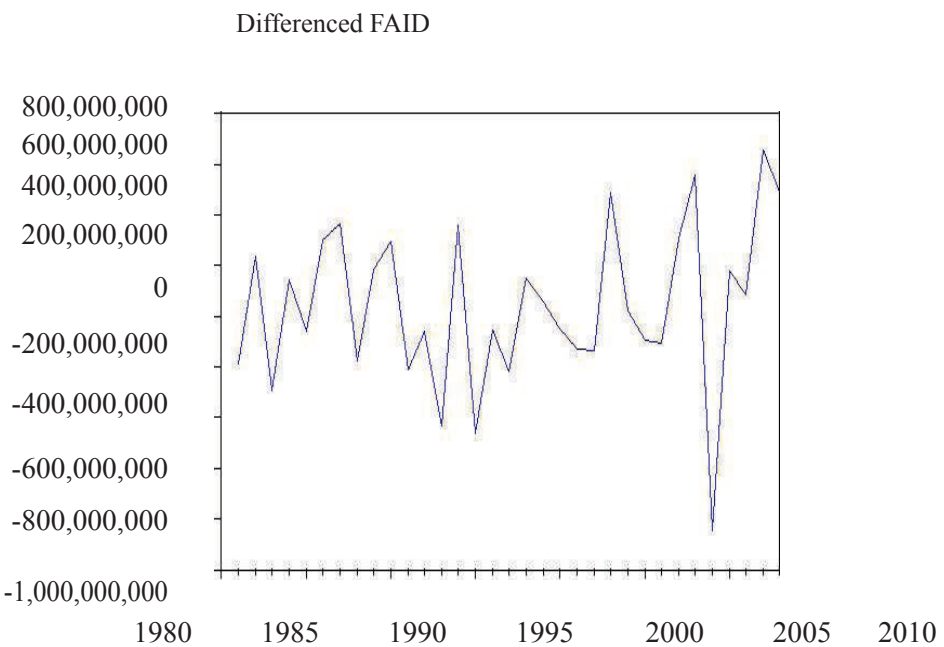
Std. Dev.	81.73737	3.87E+08	3.62E+10
Skewness	0.839037	1.098768	1.164112
Kurtosis	2.442900	3.865380	3.439242
Jarque-Bera	4.428912	7.902228	7.952539
Probability	0.109213	0.019233	0.018755
Sum	3707.609	4.95E+10	1.84E+12
Sum Sq. Dev.	220472.9	4.93E+18	4.33E+22
Observations	34	34	34

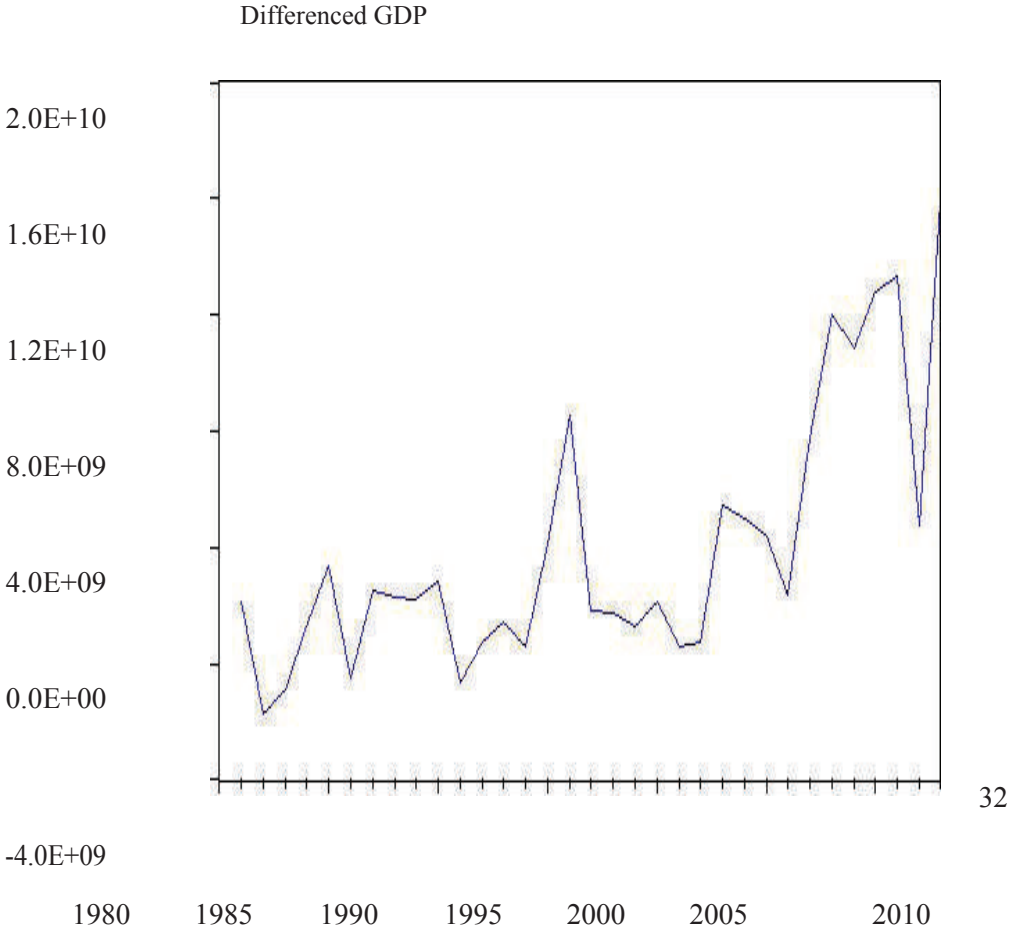
Figure A1: Graphs of all the Variables Considered




2.0E+10
0.0E+00
1980
1985
2010


D(EC)
36
32
28
24
20
16
12
8
4
0
-4
1980
1985
1990
1995
2000
2005
2010


Differenced FAID
800,000,000
600,000,000
400,000,000
200,000,000
0
-200,000,000
-400,000,000
-600,000,000
-800,000,000
-1,000,000,000
1980
1985
1990
1995
2000
2005
2010


Differenced GDP
2.0E+10
1.6E+10
1.2E+10
8.0E+09
4.0E+09
0.0E+00
-4.0E+09
1980
1985
1990
1995
2000
2005
2010
32

Challenges of White Pollution for Green Chittagong City

Dr. Sarmistha Das[1], Ms. Ananya Nandy[2]

Abstract

Widespread use of plastic bags in the unorganized retail sector is a growing concern in Chittagong City of Bangladesh. Among many environmental problems created by plastic bags, poor drainage system, water clogging and flood are the major concerns for the city dwellers. Regardless the ban on plastic bags in 2002 by Bangladesh Government, low quality plastic bags are very much visible in daily shopping of fruits, vegetables and groceries, fish and meat from the local market. The buyers in the market places receive the bags at free of cost and on the other hand due to storage and weight convenience the sellers are also prone to use the plastic bags. So control of such white pollution demands a win-win solution along with blanket ban policy. Under such scenario this paper intensively studied people"s attitude towards the random use of plastic bags in the unorganized retail market of Chittagong city, Bangladesh. Primary data was collected using two separate structured questionnaires for both buyers and sellers from different categories of non branded retail shops in five different markets of Chittagong city were collected. The exploratory factor analysis is used to analyze awareness, knowledge and behavior of both the groups separately in respect to required action and their ethical responsibility to control rising white pollution of the city.

Keywords: *White pollution, attitude, behavior, unorganized retail, seller, buyer,green city*

1. Introduction

Widespread use of plastic bag among the people is a common issue in Bangladesh. Since 1980"s with these bags introduction in the country this practice has become the very common nature of the common people (Earth Policy Institute 2013).

The well known fact in literature is that the plastic bags affect the environment by clogging the waterways such as river, drains, canals which leading blocks of drain, causes floods, spread mosquito borne diseases etc. Since last 30 years the environmental scientists are trying to make us aware about the fact that a polythene bag takes 100 to 400 years to vanish in the earth and while the plastics are disposed off as solid waste, burring the plastic bags in land fill sites releases toxic and harmful green house gases and finally damaging the fertility of the land (Sun Online Desk 2015). Hence for our sustainable living in this earth unanimously accepted concern is to control the use of plastic bags both at quality and quantity level.

Like the other places in the world polythene bags stuck in the waterways, creates water logging and hinders the drainage and sewerage system of the major cities in Bangladesh (Khan 2015). This was identified as a major cause behind massive flood during 1989 and 1998 in Bangladesh. Both the international and national media highlighted this crude reality that time (Earth Policy Institute 2013). In this regards the Bangladesh Government in January, 1 2002 imposed ban on the use of plastic bags. Under the BangladeshEnvironment Conservation Act 1995, Section 6A production

and use of any kind of polybasic thinner than 55 micron is illegal in the country. But with approved thickness it is allowed for a few specific packaging purposes in the market. Policy of Ban on the use ofplastic bag was imposed but initiative to enact such ban was insufficient, very insignificant throughout the country till date.

The city is burdened by indiscriminate use of plastic bags which is accelerating existingwaste management problem. Anotherburning challenge for Chittagong city is waterlogging during monsoon. The plastic bags, especially low quality bags, fly away quickly. Hence disposal of thin plastic bags is a challenge for the city. Unplanned disposal of polythene bags by the city dwellers leads to block the drains, canals to large extent in the city (Huda 2014).

Some parts of the city have massive problem of water logging and it is also estimated that Karnafuli river has lost the depth by 70 feet due to dumped plastic bags (BDnews24 2016**)**. Unfortunately all these detrimental effects are aggravating due to uncontrolled use of plastic bags year after year.

2. Literature Review

The white pollution is a worldwide problem. Several empirical research has been done not only to estimate the intensity of the problem but also to analyze the effectiveness of policies to handle the problem and responsibilities at government and non--government level. Studies are also made in different parts of the world especially developing countries. Ayalon et al. (2009) noted business as usual scenario and several environmental hazards due to extensive use of plastic bag distributed by shop owners in Israel. In Israel plastic bags were provided free of cost, people have a tendency to use those bags excessively. Several policy measures (imposition of levy on its use and many more) are being designed to control this pollution. Ferdous and Das (2013) studied the knowledge, attitude and behavior of the grade eight students in Balkumari, Lalitpur district in Nepal. This study identified a gap between peoples‟ knowledge and behavior regarding effectiveness of policy implication for controlling the use of plastic carry bags. And identified that control of white pollution is highly dependent on bridging the gap among knowledge, behavior and attitude is essential. Several studies have been undertaken on the effectiveness of policy implementation. It is observed that along with the blanket ban on the use of these bags some regulatory instruments such as mandatory pricing of plastic bags, taxes at manufacturing level and stores from where it is sold, awareness campaigns have been suggested in several literature. Gupta and Somanathan (2011) has strongly argued against the blanket ban to regulate the use of plastic bags especially in the developing countries. A number of complementary approaches like awareness about the harmful effect of such pollution, cash back scheme, etc. were implemented and tested by them to control the use of plastic bags for fruits and vegetables and grocery shops in Delhi. This study concludes that availability of substitutes and subsidies (taxes) on the use of reusable bags along with low cost information interventions can act as a crucial role to control the use of plastic bags. The government of South Africa has imposed the levy on the use of plastic bag. But Dikgang , Leiman and Visser (2012) argued that it had been successful to control the demand of plastic bag only short run. Kumaruddin and Yusuf (2012) estimated attitude among Shah Alam community of the policy to observe Saturday as “No plastic bag day” by the Senegal Government. This study recommended that need based practical instruments can improve knowledge and awareness among people can work positively against the “White Pollution”.

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Attitude is considered as precursor of behavior. It is guided by the knowledge the people have about the product or service. Thinking in this light a discussion on policy initiative against white pollution few studies extensively supported for the influence of people‟s attitudes for a product on their behavior (Dikgang, Leiman & Visser 2011; Kamaruddin &Yusuf, 2012; Gupta & Somanathan 2011). But these studies concentrate mainly on theattitude of the customers who demand plastic bag in the market or consumer who use plastic bags. In the developing countries plastic bags are provided by the seller and accepted by the buyers in the market. Das and Saha (2015) segregated the users of plastic bags in two groups---consumers/buyers who demand or accept the plastic bags in the market and shopkeepers /sellers who provide the bags to their customers. This study has identified existence of an attitudinal gap in both buyers as well as sellers in the unorganized retail outlets in Kolkata, India and hence put emphasis on filling up the gap as major demanded action for any policy implementation regarding control on the use of plastic bags.

A green and clean city requires strong policy implementation towards sustainable environmental up gradation with need based awareness generation programmes for environmental consciousness. In this context the above discussion strongly supports for vivid picture of business as usual scenario which can through light to understand problem from the stakeholders‟ perspectives. Finally this can help to accomplish a more practical and need based policy implementation of the problem. In the context of Bangladesh nosuch initiatives has been observed earlier in literature on the use of plastic bags and its evil effects. Therefore this study is a sincere attempt to fill up this gap.

3. Objective of the study

Like the other city the buyers maximize utility and sellers minimize cost to use plastic bags in the market place in Chittagong. In the organized sector the sellers are providing the cloth or paper bags. But the picture is awful in the markets like non branded grocery, fishand meat, vegetable and fruits, local fast foods etc. Here plastic bags of 20-30 micron arecommonly used in all market areas.

An informal interview with the plastic bag manufacturers unveils the fact that being aware about the ban on plastic bag production they still manufacture and supply low quality plastic bags in the local market as demand is there and there is no government initiative to implement the ban. This confirms that the gap between enforcement of Government lawand use of plastic bag still exists and widening.

Therefore in the context of indiscriminate use of plastic bags in the Chittagong city the above discussion strongly argued for an in depth discussion on present scenario of plastic bag use from the perspective of knowledge, attitude and behavior of users. Therefore this study initiated with the objectives to

- Understand the scenario of the awareness level regarding the ban of plastic bags in the unorganized sector
- Study attitude of the both buyers and sellers regarding the use of plastic bags, their opinion about needful action against it and interest in individual initiative for alternative use of plastic bags.

4. Methodology

It is a cross sectional study based on the response of the users of plastic bags in Chittagong city, Bangladesh. It is two sample based study and non-probability sampling, purposive sampling technique is used to select sampling unit from the seller and buyers separately. Two sets of structured and closed ended questionnaires are designed to survey both buyers as well as sellers in the market places of Bakoliya,Halishahar,Khulshi,Kotwali,Pahartaliand Panchlaish. The study is confined with the sellers and buyers of grocery, Fish andmeat, sweets and fast food from unorganized retail shops. All types of shops observed in the market places of Chittagong such as rented, self owned, temporary arrangement in the footpath are covered in this survey. Sample size for buyers is 215 and Sample size for sellers is 154.The relevant variables pertinent to the study were selected from the pilot survey and also from the empirical works on this problem in different countries mentioned in literature. Illiteracy is observed among both buyers and sellers in the pilot survey. This entailed the researcher to incorporate such factor in the context of educational qualification of both the samples. Apart from that other demographic variables discussed in this survey are age, sex and occupation (for buyers). To measure attitude 5 point Likert scale is used along with four basic scales in the questionnaire. Software used is SPSS and Excel.

5. Data Analysis

4.1 Demographic features:
The analysis of demographic feature helps to get an idea about the true picture of the sample and also the popularity of the plastic bags among people. A brief discussion demographic feature of both buyers and sellers pertinent to the context of the use of plastic bags is presented below both for buyers and sellers.

5.1.1Buyer:
It is estimated that 69% of the buyers in this study are male and the rest are female. Majority (91%) buyers are from age varies between 20-39 years. The buyers in this sector are mainly from service (37%) and business class (31%). The following Table -1 represents occupation wise educational qualification of the buyer.

Table: 1- Occupation Wise Educational Qualification

Education	Business (%)	Service (%)	Self-employed (%)	Home maker (%)	Others (%)
Illiterate	0	1	0	0	0
Secondary level	5	0	4	11	20
Higher Secondary level	38	19	27	84	60
Graduate	55	73	69	5	20
Post graduate	2	6	0	0	0
Total	100	100	100	100	100

It is clear from the above Table 1 that majority of the respondents of this study are mainly graduate or with higher secondary qualification irrespective of their occupation. Although very insignificant in number illiteracy is also observed among the respondents. Here it should be mentioned that in Chittagong city illiterate people are significantly involved in the service sector especially in the garments sector which has been reflected in our study above Table 1.

5.1.2 Seller:

On the other hand the average age of the sellers in this study is estimated 30-39 years. Unlike the buyers the sellers‟ educational qualification is observed to be higher secondary (42%) and secondary level (33%). Instead of 1% (for buyers) more than 10% of the sellers are found illiterate. Here it has already been mentioned that seller data has been collected, in this study, from different types of non-branded shops such as grocery, fruits and vegetables, meat, fish, sweet &fast food etc. in different market places of Chittagong. It is observed that the majority of the sellers, irrespective of the type of product they sale, are having the rented shop. A very few have individual ownership. Average years of running business for the majority of the sellers irrespective of their type are estimated 6-10 years. The pavement sellers in all the markets concerned in this study are observed to offer the low quality plastic bags to their customers. Hence this survey included them as respondent.

It is very surprising to note that only 1% of the sellers of this study have correct knowledge about the government policy of plastic bag ban. More than 79 % of the buyers have notion that all types of plastic bags are banned in the country. On the other hand in spite of the ban the use of plastic bags especially low quality bags is popular in the unorganized sector in the city and the demand is originating from both the ends. The sellers as well as buyers were asked to rank several noteworthy causes, observed in pilot survey, responsible for their demand for plastic bag. The final rank after calculation of weighted sum of their responses for each aspect are shown in the following Table 2 & 3:

Table: 2 - Factor for Sellers

Factor for Sellers	**Rank**
Easy to serve	1
Cost effectiveness	2
Other sellers are providing	3
Customer`s demand	4

Table: 3- Factor for Buyers

Factor for Buyers	Rank
Easy to carry	1
Availability at free of cost	2
Durability	3
Easy to dispose	4

It is evident from the above Table-2 and Table -3 that in the unorganized retail sector of Chittagong easy to carry and cost effectiveness are the main two factors that drives both the buyers and sellers to use plastic bags. This behavior is prominent in spite of their knowledge about the non- ecofriendly feature of the bag. However demand from the customer end and behaviors of other sellers positively influence the sellers in this respect. Hence a proper awareness generation programme on plastic ban policy along with choice of best possible alternatives can be effective to control the use of plastic bags.

According to Fisbein and Ajzen (1975) attitude is a predisposition to answer or respond in a consistently favorable or unfavorable manner with respect to a given item. Hence any policy implementation to control the stated problem needs a study on the attitude of both buyers and sellers in the unorganized retail sectors of the city. It includes knowing their behavior towards using the product, opinion for alternative action and also their eagerness for individual initiatives. So an initiative is taken in the following section to investigate further. Opinion of buyers and sellers were taken for a group of statements stated below in Table-4. The statements were formed based on informal discussion with them during pilot survey and informal discussion with them. A brief literature survey on the attitude of the users of plastic bags in different countries helped in this context.

Table 4: Statements Asked to the Buyers and the Sellers and of Unorganized Retail Outlets

Code	Statements for Buyers
B1	Instead of plastic bag it is the sellers who can provide eco friendly bags to us.
B2	Action from Govt. is essential to stop the use of plastic bag
B3	I am ready to accept good quality bags (need based) against deposit of minimum amount of money from the customers
B4	Payments can be made for the eco-friendly bags.
B5	Not only government, initiative from general public is also utmost important to stop environmental degradation from plastic bags
B6	We the general public must carry our own bags to control use of plastic bags

B7	To visit the shops where plastic bag are provided at free of cost is always preferred
B8	For eco friendly alternatives I am ready to pay for up to Tk 5 for purchase of Tk 100.

Code	**Statements for Sellers**
S1	I am interested to provide eco-friendly alternative of plastic bags to customers
S2	As the Customers demands the plastic bags in the shop so actions are required to be taken in this respect.
S3	Any alternative that is easy to store like plastic bags can be provided to the customers
S4	Easy availability of plastic bags encourage to offer it to customers
S5	Customers in the unorganised retail shops bring their own bag to stop the use of plastic bags
S6	Attitude of the other seller in the market influence us to behave in the same way i.e to offer plastic bags
S7	We offer plastic bags as it is economic to serve
S8	I am willing to provide refundable jute/nylon bags

It is evident from the above discussion that a method of data reduction technique is required to define the attitude of both the buyers and sellers for grouping the statements. The factor analysis is a well-known multivariate statistical tool. According to Joseph (1999) this technique helps to generate a smaller set of new composite variables based on a number of original variables with a minimum loss of information. So Exploratory Factor Analysis is applied separately for both sets of data (buyers and sellers) in this study. The results are shown below.

The Anti-Image Correlation Matrix is computed here to check the adequacy of the data. Here the partial correlations are very low indicating that true factor existed in the data. The following Table 5 and Table 6 show the anti image correlation matrix for both buyers and sellers respectively.

Table no 5: Anti-image Matrices (buyers)

		B1	B2	B3	B4	B5	B6	B7	B8
Anti-image Correlation	B1	0.722[a]	-0.201	-0.091	-0.155	0.029	-0.095	-0.139	-0.048
	B2	-0.201	0.659[a]	-0.095	0.031	-0.310	-0.033	-0.045	-0.101
	B3	-0.091	-0.095	0.589[a]	-0.086	-0.015	0.131	0.096	-0.261
	B4	-0.155	0.031	-0.086	0.702[a]	-0.100	-0.194	-0.135	-0.227
	B5	0.029	-0.310	-0.015	-0.100	0.588[a]	-0.302	-0.007	0.120
	B6	-0.095	-0.033	0.131	-0.194	-0.302	0.638[a]	0.066	-0.131
	B7	-0.139	-0.045	0.096	-0.135	-0.007	0.066	0.531[a]	0.023
	B8	-0.048	-0.101	-0.261	-0.227	0.120	-0.131	0.023	0.631[a]

Table no 6: Anti-image Matrices (Sellers)

		S1	S2	S3	S4	S5	S6	S7	S8
Anti-image Correlation	S1	.504 [a]	-0.108	0.276	-0.056	0.026	0.019	-0.025	0.085
	S2	-0.108	.571[a]	-0.186	-0.202	-0.217	0.093	0.003	-0.019
	S3	0.276	-0.186	.525[a]	-0.117	0.028	0.085	0.063	-0.164
	S4	-0.056	-0.202	-0.117	.691[a]	-0.143	-0.22	0.237	0.158
	S5	0.026	-0.217	0.028	-0.143	.674[a]	-0.154	-0.026	-0.099
	S6	0.019	0.093	0.085	-0.22	-0.154	.629[a]	0.42	-0.041
	S7	-0.025	0.003	0.063	0.237	-0.026	0.42	.653[a]	0.014
	S8	0.085	-0.019	-0.164	0.158	-0.099	-0.041	0.014	.506[a]

a. Measures of Sampling Adequacy (MSA)

On the other hand the values between 0.5 and 1.0 of Kaiser-Meyer-Oklin (KMO) index satisfies adequacy of the data for using Factor Analysis (Malhotra 2002).In this study the KMO statistic value has come 0.644 and 0.622 for the buyers and sellers respectively, shown below in Tables-7and-8.

The result of Bartlett Test of Sphericity shown in Tables 7 and 8 confirms the overall significance of correlation matrix and statistical probability of both the data set.

Table no 7: KMO and Bartlett's Test (Buyer)

Kaiser-Meyer-Olkin Sampling Adequacy		Measure of 0.644
Bartlett's Test of Sphericity	Approx. Chi-Square 176.356	

	df	28
	Sig.	.000

Table no 8: KMO and Bartlett's Test (Seller)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.622
Bartlett's Test of Sphericity	Approx. Chi-Square	144.971
	df	28
	Sig.	.000

Therefore all results shown in Table 7 and 8 validate the adequacy of dataset for both the samples to use the data reduction technique, Factor Analysis. Hence the set of 8 statements each for buyers and sellers mentioned in Table 5 and 6 were subjected to Factor Analysis.

4.1.3 *Extraction of the Factors*

Principal Component Analysis (PCA) is used to both the samples. The relationship between the factors and individual variables is represented by the Varimax Rotation which is shown in Table 9 and 10.

Table no 9: Rotated Component Matrix (Buyer)

	Components			**Comm unalities**
	1	**2**	**3**	
B1	0.240	0.311	0.552	0.459
B2	0.578	0.206	0.154	0.400
B3	-0.039	0.779	-0.070	0.613
B4	0.330	0.414	0.418	0.455
B5	0.818	-0.095	-0.008	0.678
B6	0.729	0.053	0.052	0.537
B7	-0.077	-0.180	0.869	0.794
B8	0.098	0.755	0.107	0.591

Table no 10: Rotated Component Matrix (Seller)

	Components			Communalities
	1	2	3	
S1	-0.093	0.201	-0.738	0.594
S2	-0.060	0.851	0.041	0.729
S3	0.014	0.313	0.695	0.582
S4	0.608	0.468	-0.080	0.596
S5	0.230	0.602	0.046	0.417
S6	0.840	0.023	-0.017	0.706
S7	-0.822	-0.049	-0.067	0.683
S8	-0.066	0.034	0.602	0.367

The above results, shown in Table 9 and Table 10, reveal a model of three factors derived for both the samples—buyers and sellers. The correlation between the variable and the factors is represented by the factor loadings. Here signs are just like any other correlation coefficient. The variable with highest correlation in included in that factor. Present study has assigned symbolic labels to the factors. The interpretation of each factor along with their incorporated corresponding variables is discussed in the next section.

6. Policy Implications:

The following Table 11 and Table 12 represent factors along with their factor loadings values, mean and standard deviation of the variables under different factors for both buyers and sellers respectively.

Table no 11: Factor Loading For Buyers

Factors	Code	Factor loading	Statement	Mean	Standard Deviation	Opinion
Attitude towards the use of plastic bag	B1	0.552	Instead of plastic bag it is the sellers who can provide eco friendly bags to us	4.62	0.62	Strongly Agree
	B4	0.418	Payments can be made for the eco-friendly bags.	3.65	1.16	Agree
	B7	0.869	To visit the shops where plastic bag are provided at free of cost is always preferred	2.69	1.14	Neutral
Demanding actions to be taken	B2	0.578	Action from Govt. is essential to stop use of plastic bag	4.44	0.91	Agree
	B5	0.818	Not only government , initiative from general public is also utmost	4.16	0.97	Agree

			important to stop environmental degradation from plastic bags			
	B6	0.729	We the general public must carry our own bags to control use of plastic bags	3.96	1.01	Agree
Factors	**Code**	**Factor loading**	**Statement**	**Mean**	**Standard Deviation**	**Opinion**
Individual responsibility	B3	0.779	I am ready to accept good quality bags (need based) against deposit of minimum amount of money from the customers	3.56	0.90	Agree
	B8	0.755	For eco friendly alternatives I am ready to pay for up to Tk 5 for purchase of Tk 100	3.25	1.06	Neutral

Factor 1: Factor 1 represents buyers‟ attitude towards acceptance of plastic bags from the unorganized retail shops. It shows that the buyers are least concern about what type of bag is provided to them as the bag is available at free of cost. Rather they are interested to get those from the shops they visit. They strongly feel that it is the sole responsibility of the seller to provide a bag to their customer for carrying shopped goods. In this context they have agreed to accept eco friendly bags if it is provided by the seller. This means concerning the evil effect of plastic bags the buyers have shown positive attitude towards their acceptance of alternative of plastic bags for which they can pay as well.

Factor 2: This factor speaks about the buyers‟ opinion towards the required action to control the problem. Here the buyers in the Chittagong City emphasized in favor of Government action along with robust initiative from the general people. In this context it is good to mention that carrying own bag by the customers also agreed by them which is a positive indication from buyers end for policy implementation to control the problem.

Factor 3: It highlights about the individual responsibility of the buyers for acceptance of alternative to plastic bags. We know the alternatives such as nylon bag, jute bag are costlier then plastic bags to both buyers and sellers compared to plastic carry bag. Here the policy of the use of good quality bags against deposit of money from the customer is agreed by them. But they are neutral for the payment of eco friendly alternative.

Hence the above discussion confirms that the buyers are ready to accept any policy action to control the use of plastic bags will be acceptable. Regarding the use of plastic bags they are indirectly dependent on the seller. Any action to stop the use of low quality plastic bags from the sellers end will be accepted by them. Besides they require a bag from the sellers end for their convenience for which they are ready to pay money as deposit.

Table no 12: Factor Loading For Seller

Factors	Code	Factor loading	Statement	Mean	Standard Deviation	Opinion
Attitude regarding plastic bag usage	S4	0.608	Easy availability of plastic bags encourage to offer it to customers	3.70	0.87	Agreed
	S7	0.840	We offer plastic bags as it is economic to serve	3.81	0.84	Agreed
	S6	0.602	Attitude of the other seller in the market influence us to behave in the same way i.e. to offer plastic bags	3.07	1.18	Neutral
Demanding action: Burden on consumer in the market	S2	0.851	As the Customers demands the plastic bags in the shop so actions are required to be taken in this respect.	3.53	0.94	Neutral
	S5	0.602	Customers in the unorganised retail shops bring their own bag to stop the use of plastic bags	3.66	0.97	Agreed
Individual responsibility	S1	0.738	I am interested to provide eco-friendly alternative of plastic bags to customers	4.30	0.71	Agreed
	S8	0.602	I am willing to provide jute/nylon bags	3.99	1.22	Agreed
	S3	0.695	Any alternative that is easy to store like plastic bags can be provided to the customers	3.70	0.75	Agreed

Factor 1: This factor represents attitude of the sellers towards the use of low quality plastic bags. Here sellers agree the fact that easy availability and cost effectiveness encourages them to use these bags in their shops. But they are neutral about the use of it as it is used by other sellers of this sector. Hence it is confirmed that their attitude to the use of low quality plastic bags is not influenced by the attitude of the other sellers.

Factor 2: Regarding the action to control the intensity of the use of these bags the seller put the burden on the customer. Though they are neutral about the use of plastic bags their shop on customers demand. But they agreed the customers‟ initiative to bring their own bags in the shop is also required to stop its random use.

Factor 3: Here the sellers agreed about their individual responsibilities to stop the use of low quality plastic bags. The use of ecofriendly alternatives of plastic bag is happily agreed by them. But it is significant to note that like the buyers they agreed to use refundable jute or nylon bags. Moreover they have keen preference for the alternatives which is also easy to store like plastic bags they use now.

The following points can be highlighted from the above analytical discussion----

- Proper knowledge about the ban on plastic carry bags is lacking among the buyers.
- Easy handling and cost effectiveness of the plastic bags are the motivating factors for the use of and demand for plastic bags in these sectors.
- For both the groups no attitudinal gap is observed between behavior and knowledge regarding the use of plastic bags in this sector.
- In spite of poor educational background both buyers and sellers have positively shown their individual ethical responsibility towards environment.
- Use of own bags is an acceptable needful action supported by both the buyers and the sellers.
- Use of refundable jute bag or nylon bag in against of deposit money is mostly accepted alternative action agreed by both the buyers and sellers. But instead of refundable alternative bags buyers are not ready to pay for any alternatives.

Hence in this sector the positive and coincidental attitude of the buyers and sellers towards control of indiscriminate use of plastic bag demands activation of need based properly planned initiatives. It is knowledge which is the pillar of attitude building and behavioral change. In this respect simultaneous supervision of the government for the enforcement of the law along with public awareness programme regarding the ban at different levels is the need of the hour.

7. Conclusion

The easy handling and cost effectiveness are the two major driving factors for the white pollution in the unorganized retail sector of Chittagong city. Considering the evil effect of plastic bags steps are required to be taken. But good quality plastic bags cannot be wiped out from the market as customer may still generate demand it for carrying meat and fish products. Therefore effective state interventions for proper awareness programs and introduction of incentive based alternatives of plastic bags can narrow down the burden of waste disposal problem and the harmful effect white pollution on the city dwellers. Bangladesh is rich and famous for her jute production. So a proper policy initiative to enhance the use of jute bags in this sector can control plastic bags use. This can be a win-win solution for both employment generation and environmental benefit.

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A Participatory Sensing Framework for Environment Pollution Monitoring and Management

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Abstract

Effective monitoring and management of environment pollution is the key to the development of modern metropolitan cities. To sustain and to cope with the exponential growth of the cities with high industrialization, expert decision making is very essential in this process. A good governance system must be supported by an actively participating population. In participatory sensing, individuals and groups engages in the data collection actively and the helps the city governance to make proper decisions. In this paper, we propose a participatory sensing based three-tier framework to fight environment pollution in urban areas of Bangladesh. The framework includes an android application named 'My City, My Environment', a server for storage and computation and also a web server for the authority to monitor and maintain environmental issues through expert decision making. We have already developed a prototype system and deployed it to a small scale and demonstrated the effectiveness of this framework.

Keywords: Environment Pollution, Participatory Sensing, Smart Phones

1. Introduction

Community participation enables citizens to become active entity in the decision making and action process (Organization et al. 2002). It is built on collective awareness and active thought process of the population. Nobel Prize winner Elinor Ostrom in her 'Governing the Commons' theory has emphasized on the support of users (citizens) for effective monitoring and enforcement of rules (Ostrom 1990). She also stressed on low cost process through which the use of resources by humans is to be monitored and information is verified. These have encouraged the modern authorities to design an active participatory framework for governance. Communities that maintain frequent face-to-face communication and dense social network are engaged actively in the governance.

Participatory sensing (Burke, Estrin, Hansen, Parker, Ramanathan, Reddy & Srivastava 2006, Campbell, Eisenman, Lane, Miluzzo & Peterson 2006) is the concept where individu- als, groups and communities engages in the data collection actively to construct knowledge. This is mostly done in two ways: using a large sensor network and using the available de- vices (e.g. mobile phones) to build ad hoc networks. In this paper, we address the issue of participatory sensing in the governance context of Bangladesh.

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Many developing countries like Bangladesh are going to a rapid phase of industrialization and urbanization. In the process of these, comes the issue of environment. Almost every direction in the development triggers some environmental issue. The explosion of urbane population adds to it and makes it more unmanageable. In metropolitan cities like Dhaka, the capital of Bangladesh, even garbage management is sometimes not done properly. Many bins are left full roadside and it brings terrible experience for the city-dwellers. There are other environmental issues like noise, air, water, visual, light etc.

In the traditional way of management, except for scheduled work, there is a lack of proper communication for the incidents happening (e.g. environment pollution) and accountability after the measures are taken. Corrupt authority adds more to spoil the broth. In many cases, the use of social media or social network (e.g. Facebook, Twitter) has been successful in creating awareness among the community through active participation of the people in re- porting and supporting the cause. A successful example of such is the BP oil spill incident in Mexican Gulf in 2010 (Starbird, Dailey, Walker, Leschine, Pavia & Bostrom 2015). Interna- tional reports (Declaration 1992) have also emphasized the necessity of active participation of all users to move towards sustainable development.

The solutions adopted in sensing and monitoring environment pollution employed in large cities involve high cost of development due to the required infrastructure. Even in the cases of participatory sensing or crowd-sourcing the systems often come with sophisticated sensor devices (Hasenfratz, Saukh, Sturzenegger & Thiele 2012, Rana, Chou, Kanhere, Bulusu & Hu 2010). Crowd-sourcing and participatory sensing in the context of Bangladesh is rater underutilized. Some applications include fighting sexual harassment (Ahmed, Jack- son, Ahmed, Ferdous, Rifat, Rizvi, Ahmed & Mansur 2014) and data collection through monetary incentive given to the participants (Bell, Ward, Killilea & Tamal 2016).

In this paper, we propose a participatory sensing framework for environment pollution monitoring and management in large metropolitan cities like Dhaka, capital of Bangladesh. We propose a three tier application framework that will ensure the participation of the responsible citizen through a mobile phone based application, a server that collects and analyzes data from end-users in real time and a web based application for the city governance to help with decision making regarding the monitoring and management of environment pollution.

Using the mobile phone based application; an end user will be able to report any nearby incident of environment pollution or hazard by taking a photo or video of the problem and submitting it to the server. Each report will be tagged using some meta information and location using positioning system provided by GPS of the mobile phone. The trust issues will be solved using social community based reporting and reliable user ratings. The system will also offer anonymity and ensure privacy of the end-users. In the medium tier, the server collecting the information will categorize and analyze the information posted by end-users automatically using intelligent algorithms. It will provide map-based meta information to the other two tiers of the framework. The end-users will be able to watch and support the reports submitted by other users. The mobile phone based application will also have a social network based interface to ensure the participation of other users through already established popular social network services like Facebook, Twitter

and blogs. The application in the third tier will help the municipality governing authority to monitor and detect potential threats (short term and long-term) by visualizing them based on meta-information and community trust and the application will help them to take decisions based on an expert decision system. Our framework is supported by a feedback system by the end-users which will in effect increase the accountability of the city governing body. We have developed a prototype for our proposed system and tested it with sample data and demonstrate the usability of the system.

2. Related Work

Collective participation of citizens is very essential in management and assessment of environmental issues (Declaration 1992). With the advent of modern technology and a global boom in the number of mobile devices (phones etc.) and low cost sensors participatory sensing (Burke et al. 2006) and crowd-sourcing (Campbell et al. 2006) are in application to solve the problem of effective data acquisition and assessment in fields like health, urban planning, environment, education etc. There has been a number of successful applications of crowd-sourcing all over the world ranging from collecting epidemiological data in England (Aanensen, Huntley, Feil, Spratt et

al. 2009) to food security data in Africa (Enenkel, See, Karner, A lvarez, Rogenhofer, Baralde`s-Vallverdu´, Lanusse & Salse 2015).

There are several challenges in crowd-sourcing mobile phone data in urban spaces re- lated with incomplete samples, unknown contexts, user privacy, trustworthiness of data and conservation of energy (Kanhere 2011). Moreover, most of these applications comes with use of sensor devices, those though low cost comes with extra added expense in terms of money and maintenance.

Among other fields participatory sensing and crowd-sourcing has been used effectively in monitoring road and traffic conditions (Mohan, Padmanabhan & Ramjee 2008), crime watch (Williams 2013), disaster management (Horita, Degrossi, de Assis, Zipf & de Albuquerque 2013), disease spread (Chen, Hossain, Butler, Ramakrishnan & Prakash 2016). Even scientific problems like optical character recognition (Narula, Gutheim, Rolnitzky, Kulkarni & Hartmann 2011) and protein structure prediction (Khatib, DiMaio, Cooper, Kazmierczyk, Gilski, Krzywda, Zabranska, Pichova, Thompson, Popovic´ et al. 2011) are solved effectively by crowd-sourcing and participatory sensing applications.

Environment pollution is an area where participatory sensing can play a lead role in data collection and management (Kanhere 2011). Effective waste management in urban area is handled in (Offenhuber & Lee 2012, Kuba´sek, Hreb´˘ıc˘ek et al. 2013). The air quality control or monitoring applications often comes with low cost sensors interfaced with mobile phones or devices. Such examples are Gas-Mobile (Hasenfratz et al. 2012), Common Sense (Dutta, Aoki, Kumar, Mainwaring, Myers, Willett & Woodruff 2009) and P-sense (Mendez, Perez, Labrador & Marron 2011). An air temperature monitoring system was proposed in (Overeem, R Robinson, Leijnse, Steeneveld, P Horn & Uijlenhoet 2013) that collect air temperature from the temperature of the mobile phone batteries. A successful application of crowd-sourcing and participatory sensing in water monitoring in World Water monitoring challenge. It includes 1458517 participants from 142

countries in the world reporting 70,927 water bodies (International 2005). Creek Watch (Kim, Robson, Zimmerman, Pierce & Haber 2011) uses iPhone application to employ users to aid water management. Iphone camera is also used in reporting water quality in (Leeuw 2014).

An WebGIS framework is used to monitor and manage soil and water in (Werts, Mikhailova, Post & Sharp 2012). NextDrop (Kumpel, Sridharan, Kote, Olmos & Parikh 2012) is used to track water distribution and supply in Indian communities. Ear-Phone (Rana et al. 2010) was proposed a low cost solution to urban noise mapping through participatory sensing. NoiseTube (Stevens & D'Hondt 2010), a mobile based sensing application and a web-based community memory was deployed as a proposed solution to monitor noise pollution in ubiq- uitous urban setting. London heatmap was generated using crowd-sourcing in (Chapman, Bell & Bell 2016). Among other successful applications are light pollution (Hintz, Hintz, Almomen, Adounvo & D'Amato 2014) and oil reporter (Star bird et al. 2015). The applications in Bangladesh are under-utilized (Ahmed et al. 2014) and sometimes involve monetary incentive given to the participants (Bell et al. 2016). Our approach is a cost-effective one since it does not use extra sensors and only based on the mobile phone devices and include the effective social network interaction for effective management.

3. Paper Organization

Rest of the paper is organized as follows: Section 2 describes our methodology and details of the framework; in Section 3, we present the implementation and discuss the findings and results that we gathered from the application that we developed and Section 4 concludes the paper with an indication of possible future work and delineating the limitations of the current system.

4. Methodology

In this section, we describe the methodology of the framework that we have proposed and developed in this research.

5. Architecture

This section demonstrates the system design of our proposed participatory sensing frame- work for environmental pollution monitoring and management. The framework is basically composed of three tiers as shown in Figure 1. The first tier is a mobile application built for Android based mobile phones which will be used for collecting reports from end users. These report are stored and analyzed in the second tier. The third tier provides municipality authorities with regular reports on pollution and a map to pinpoint the location of the reports from the end users.

6. Smart Phone Application

A mobile application name *My City My Environment* (available at: www.kipailam.com/app/mcme.apk) is built to provide end users a responsive interface so that they can sub- mitincidents of reports on environmental pollution and provide user rating on existing re- ports. The application is built using JAVA language for smart-phones running on Android OS. Following is the list of

resources whose permissions are required for installation of the application:

- **Camera**: Used for taking photos and videos to attach with submitted reports.
- **Microphone**: Video recording requires permission for accessing microphone of the phone.
- **Location**: Required for adding GPS based location information along with pollution reports.
- **Storage**: This resource was required for accessing files from phone's storage to bindevidences of pollution.

The phone has an immensely user friendly interface to communicate with the framework. Users are required to login before they use the application. They will find a homepage which is news feed showing recent posts on environment pollution submitted by other users.

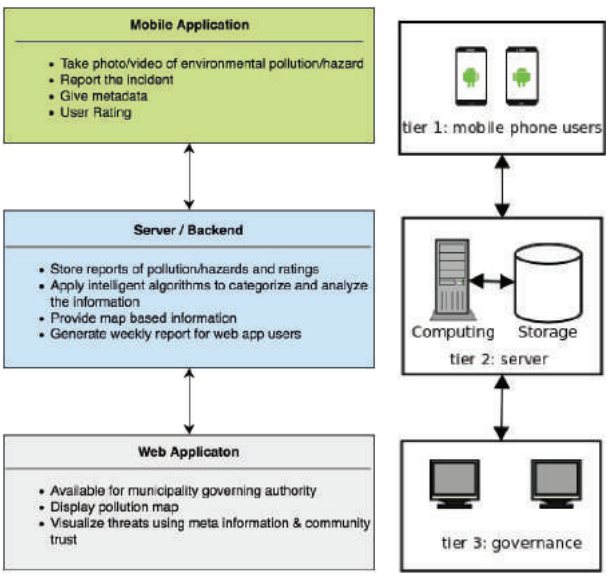


Figure 1: Illustration of the three tiers of the proposed framework.

Figure 2(a) shows how the home page may look like. This page contains a floating button on the bottom right corner which gives users with options to submit a report on environmental pollution.

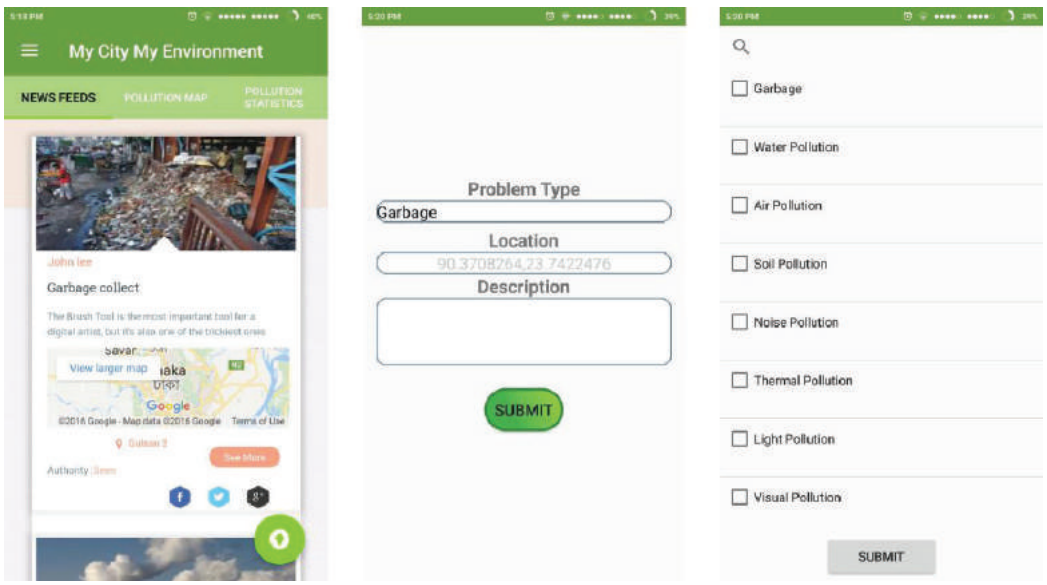
Apart from taking photos or videos from inside the application, users need to provide a *type* for categorizing the report for future usage (See Figure 2 (b)). A list of possible *types* will be presented as option for the users where they can select multiple *types* to address any incident of environmental pollution. The mobile application collects the location information from available wifi network, mobile network or GPS (See Figure 2 (c)). Recorded videos and images taken from within the application is stored in a different directory in the system storage.

Users can view the pollution map from the mobile application (See Figure 3(a)) which is eventually a map of geographic locations extracted from the reports submitted by the end users. Aside pollution map, users can also view statistics of environment pollutions of the city through the *Pollution Statistics* tab.

7. Server Application

Storage of data collected from the end users and the web application are hosted in the server side which is the middle tier of our proposed framework. The server provides an Application Program Interface (API) for the mobile application and the web application; thus it is a facilitator of information for the other tiers. A secured, fast and sustainable architecture is used to build the middle tier. Following is the list of technological stack used for developing the server side:

- Apache Web Server
- Laravel 5.3 Web framework for API and Web support (Language: PHP)



(a) (b) (c)

Figure 2: (a) News feed page shows the recent post on hazardous incidents of environment pollution

(b) submission and (c) selection of pollution type in the application.

- JSON based API support

8. Web Application

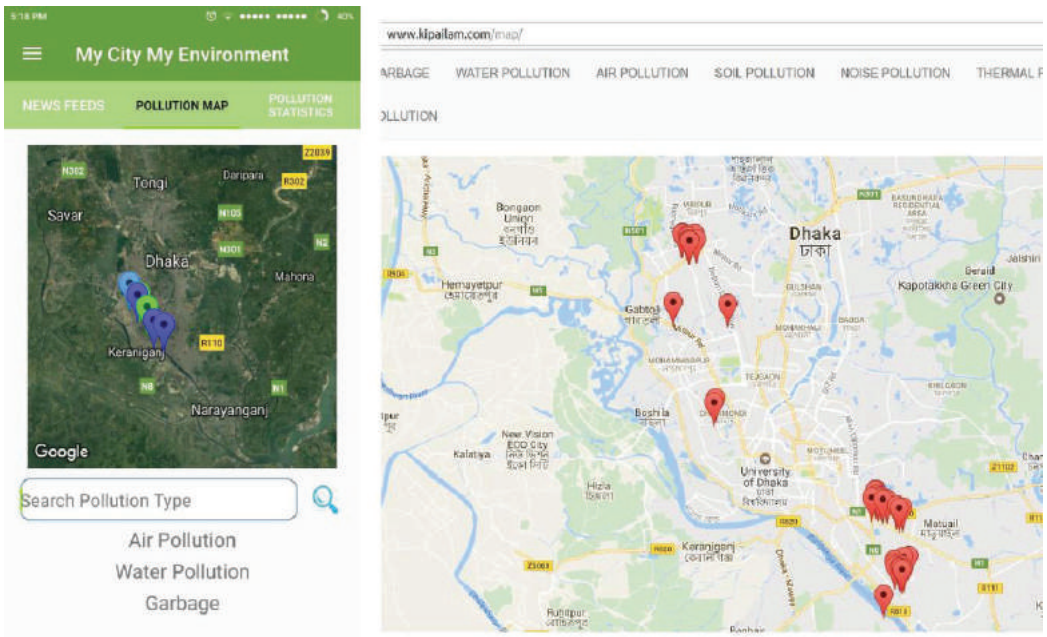
Users in the third tier of our framework are the municipality authorities who will be able to see the pollution map as shown in Figure 3(b) through the web application (www.kipailam. com/) . The map is updated in real time, thus as soon as an end user's report is validated by the system, the map gets updated. Along with that, users of this web application can get (print or email) both detailed or summarized reports.

9. Results

In this section, we delineate the results and findings that were gathered after the deployment of the framework in test basis.

10. Study Area

To test the effectiveness of our framework and application, we designed a study. In our study, we used Dhaka, the capital city of Bangladesh. A group of volunteers were selected randomly. Most of them were students studying in the tertiary level or university. They usually travel in various directions in the city around their educational institutes, home and other places of recreation. All of these students were in possession of a smart phone equipped with gps, camera, etc that is the minimum requirement supported by our system. For the systems without internet connection, we provided an off-line submission procedure to the server of their data locally saved in the storage of the smart phone. The users were told to report any incident of environment pollution like: waste, air, water, noise, light, etc.



(a) (b)

Figure 3: Pollution map for (a) the users in the mobile application and (b) in the web appli- cation for the users in the third tier of the application.

11. Deployment Period

We told the participants to use both the 'My City, My Environment' application and the web-server using a browser whenever they find any incident over a period of two weeks in December 2016. During this time, they reported 53 data points mostly in Dhanmondi, Mirpur and Jatrabari area. They shared several of these items in social media like twitter and Facebook.

12. Responses

Various incidents of pollution were reported. Figure 4 shows are distribution of different types of pollutions reported by the users through our application. Maximum was related to garbage management system (34%).

Many of the posts were supported by free text comments. A few examples are like '*the canal isblocked by garbage*', '*this canal is totally blocked which causes water logging in the area during the rainy season*', '*air pollutes because of these fish market*', '*too much dust*', '*road is covered by garbage*', '*due to water logging for a long period*', '*because of water logging, transportation is disturbed*', '*drainage system is blocked because of garbage*',etc.

13. User Feedbacks

After the deployment period, we engaged the users in a post-study feedback survey. This feedback also included a usability test for the UI of the application. The questionnaire con- trained five positive statements about the applications as following:

1. Learning to use the app was easy for me.
2. The app will be able to bring community awareness on environment pollution.

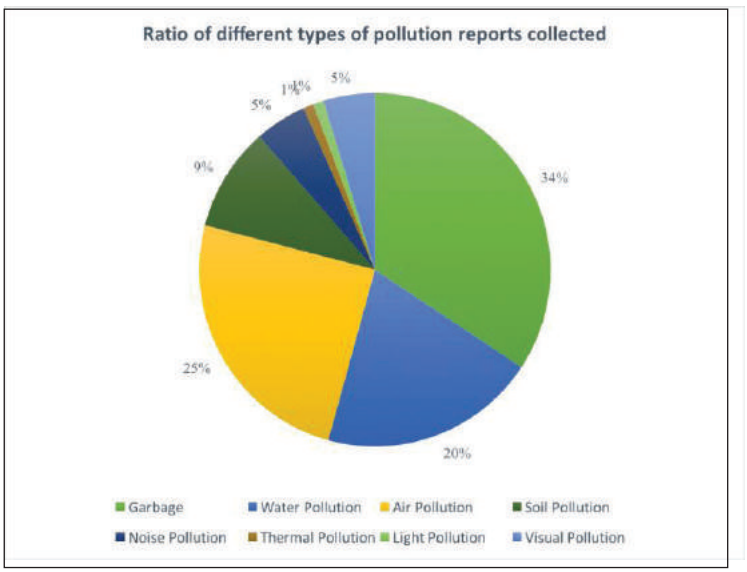


Figure 4: Distribution of data among various types of pollutions reported.

Table 1: Summarized results from user feedback survey

Question no	Strongly Agree	Agree	Disagree
1	52.4%	47.6%	–
2	61.9%	38.1%	–
3	66.7%	28.6%	4.8%
4	61.9%	23.8%	14.3%
5	52.4%	38.5%	9.5%

3. The app will be able to bring effective changes in decision making.
4. I will definitely try to use the app in future.
5. I will suggest it to my friends and colleagues.

The users were asked to rate this statements stating whether they 'Strongly Agree', 'Agree' or 'Disagree' with the statements. Also we asked them to comment on the most positive and negative thing they found in the application. Twenty one users provided us with feedback and Table 1 summarizes the user feedbacks from the questionnaire:

We could notice that mostly the users were in agreement with the statements except for a few disagreements. Among the positive things, the users told us about 'Community Awareness through social media', 'one can play a very important role in this respect as smart phones are available to people of all classes nowadays', 'get to show what is going on with the city by this android app'. Users emphasized about the requirement of 'clean city' and how he is able to 'voice my opinions about environment pollutions'. Among the negative feedbacks, they complained about the availability of internet, cost of bandwidth to upload images and lack of the third tier involvement in the application. There was feedback to include tackling sexual or any type of harassment through the same framework.

14. Challenges

In this sub-section, we describe a few challenges to this framework that we faced during implementation, might be posed in future and how we address them.

User Trust

One of the strength of our framework is the openness that allows any user to submit data. However, there is a hinge to data trust worthiness. In present, we have registration system by which a user can register in the server and submit the reports using registration credentials. The similar reported rated high/positive by the other users will increase the trustworthiness of the particular user and incident and will resolve the issue. However, in future we plan to introduce a new layer of users with admin capabilities or high reputation who will verify and rate the incidents reported by the normal users.

User Privacy

If not provided with privacy protection of the users, the application users sometimes might feel unsafe to report incidents. To address this issue within our framework, we also allow anonymous reports to be submitted and later supported and rated by the other users.

Cost Effectiveness

The number of mobile phone users in Bangladesh has increased in a large extent (BRTC 2016) and most of them are using android based very cheap smart phone sets. Thus our framework does not

incur any extra cost in terms of engaging the users. There has been direct concern from the users of the app towards the cost of the application due to the connectivity needed to upload images and geo-locations. We have already addressed this issue by making the image/video an optional feature and also added off-line reporting system, where they will submit the data stored locally once they are connected. However, governance might address the issue by adding this to available free internet (Facebook 2016) or other such publicly available WiFi networks.

User Incentives

The idea of collective governance (Ostrom 1990) would not come to reality unless we are successful in bringing a large number of regular active users in our community. To solve this issue, we have included the social media and network features. The users are motivated when their supported or reported cause or environmental issues get noticed, liked and shared by other users and addressed by the authority. In future, we wish to add gamification in smaller level to give them awards and thus incentives to use the application regularly.

15. Conclusion

In this paper, we described a participatory sensing framework for environment pollution monitoring and management. Our app 'My City, My Environment' successfully engaged users to report and spread awareness among the citizens by sharing them in social network. The active governance feature is absent and generates a report and a visual map to help in expert decision making. However, these are the few areas in which we wish to explore and develop further:

–Engage city governing bodies in the third tier of the application for a locality.

–Provide intelligent application and algorithms in the second tier to help the authority in solving problems more effectively. One such idea is to provide a vehicle routing solution to waste management (Benjamin & Beasley 2010).

–Add new features to improve the data trustworthiness and provide better incentives to the users through gamification of rewarding scheme.

We believe incorporating this features and active involvement of stakeholders in the framework is capable of producing effective results in monitoring and management of envi- ronment pollution in urban areas of Bangladesh.

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River Flow Regime in Coastal Erosion and Accretion at South-Eastern Coast of Bangladesh

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Abstract

This research presents the influences of the coastal erosion and accretion at south-eastern coast (Cox's Bazar) of Bangladesh by analyzing the natural flow regime of Matamuhuri and Bogkhali River. This research analyzes the changes of water level and discharge rate through statistical analysis by using Microsoft Office Excel and SPSS software. Erosion and accretion rate have been extracted through Geostatistical analysis from Landsat TM satellite imagaries of 1974, 1983, 1984, 1993, 1994, 2003, 2004, 2013 with the help of Geographical Information System (GIS) and Remote Sensing (RS) techniques. Primary data have been collected from field observation. Secondary data have been collected from Bangladesh Water Development Board and Center for Environmental and Geographic Information Services (CEGIS). The results revel that water level of Matamuhuri River is higher than Bogkhali River in every season. As a result, Matamuhuri River plays a significant role in the coastal erosion and accretion. This research is a synthesis of time series of historical data that is providing a more complete picture of the changes. The results of this study can play an important role in coastal landuse planning, management and implementation.

Keywords: Water level, Discharge, Flow regime, Erosion, Accretion.

1. Introduction

Humans have long been fascinated by the dynamism of free flowing waters (Poff *et al.,* 1997). The study of river regimes is an important, if somewhat neglected component of comparative hydrology which can be defined as the study of the character of hydrological processes as influenced by climate and the nature of the earth's surface and subsurface (Haines, 1988). The characteristics of a channel and surrounding landform can vary with flow, levels of water and discharge in a river. There is a correlation between water level & discharge rate of rirver with erosion and accretion. Erosion and accretion may vary with the variation of water level and discharge (Taguchi *et al.,* 2013). Within a river, different habitat features are created and maintained by a wide range of flows, for example, many channel and floodplain reatures, such as river bars and rifflepool sequences, are formed and maintained by dominant, or bankfull, discharge. These discharges are flows that can move significant quantities of bed or bank sediment and that occur frequently enough (e.g., every several years) to continually modify the channel (Wolman and Miller, 1960). Furthermore, five critical components of the flow regime regulate ecological processes in river ecosystem: the magnitude, frequency, duration, timing and rate of change of hydrologic condition (Poff and Ward 1989, Richter *et al.* 1996, Walker *et al*. 1995). Rivers in Bangladesh supply extremely high flow in

monsoon and low flow in dry season, because of its geographic setting. The natural flow of a river varies on time scales of hours, days, seasons, years and longer (Poff *et al.,* 1997). In the recent past, the flow regimes of rivers in Bangladesh have significantly been changed due to variation of discharge and regular water flow. It is imperative to analyze the variability of water flow to know the river hydraulics.

2. Aim and Objectives

The water level and discharge rate of Matamuhuri and Bogkhali River influences the coastal erosion and accretion at south-eastern coast (Cox's Bazar) of Bangladesh. The broad aim of this research is to analyze the natural flow regime of Matamuhuri and Bogkhali River that influences on coastal erosion and accretion.

To achieve the broad aim of this research specific objectives are identified and these are:

i. To analyze the water level and discharge rate of Matamuhuri and Bogkhali River;
ii. To illustrate the relationship between water level and discharge with erosion and accretion.

3. Study Area

The study is conducted on the south-eastern coast of Bangladesh which is situated in the Cox's Bazar district of Chittagong division. It is bounded by hilly area and Bogkhali River on the north and East, Bay of Bengal in the West, and Jhilwanja Union in the south. Study area is located in coastal region of Bangladesh and this wet coastal plain lying parallel to the shoreline. The region stands on the south-eastern extremity of Bangladesh and shares south-eastern border with Mayanmar. Geographically, the study area located between 20˚30' and 22˚ North latitude and 92˚45' and 92˚15' East longitude (Figure-1).

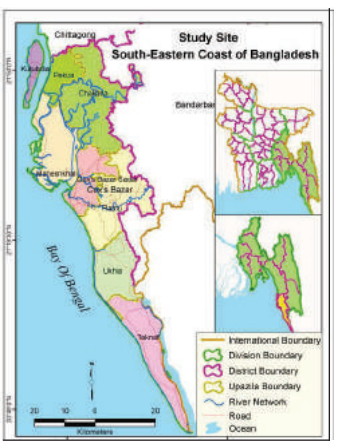


Fig. 1: Study area (source: sob and lged, 2015)

The climate in Cox's Bazar is determined by its location in the tropical monsoon region and is mostly similar to the rest of the country. The annual average high temperature in Cox's Bazar is 31.1° and average minimum of 23.9° C. The average rainfall is 285 mm which varies seasonally. Study area lies in Low Hill Ranges (Dupi Tila and Dihing Formations). There are five broken ranges of hills between Karnafuli River and the southern tip of Bangladesh. The main mass of hills goes down the Teknaf peninsula. There is a slight break in the west along the Rejukhal valley.

Naf, Matamuhuri and Bogkhali are major rivers in this region. Rivers are influenced by tide and the tidal water can reach about 50 km inland. The district occupies an area of 2491.85 square kilometers including 192.42 square kilometers forest area (BBS, 2011). The local people depend largely on the coastal natural resources for their livelihood.

4. Data and Methods

Research methodology is entirely responsible for the systematic arrangement and proceeding of the research work (Berg, 1995). Usually, a research outcome depends on the availability and consistency of the data set. This study has conducted based on the secondary data of the water level and observed discharge of the Matamuhuri and Bogkhali River. The daily water level and observed discharge data were collected from the Bangladesh Water Development Board (BWDB) for forty years (1974 to 2013) of the Lama and Ramu gauging stations of the Matamuhuri and Bogkhali River respectively (Table 1).

Tab. 1: Summary status of the collected data

Gauging Stations	Type of Data	Periods (Year)
River: Matamuhuri	Daily Water Level (mPWD)	1974 – 2013
Station: Lama		
Station ID: 203		
River: Bogkhali	Daily Water Level (mPWD)	1974 – 2013
Station: Ramu		
Station ID: 40		
River: Matamuhuri	Daily Discharge (m^3/s)	1974 – 2003
Station: Lama		
Station ID: 203		
River: Bogkhali	Daily Discharge (m^3/s)	1974 – 2003
Station: Ramu		

Station ID: 40

The set of time series data were analyzed by different techniques. Data insertion process was used for preparing data table. Consistency test has been done for reliability and correlations between different items. Missing data acquisition technique was used for interpolation of missing data between various data points automatically. All of these techniques were used for flow regime analysis. Data were analyzed by using Microsoft Office Excel program, SPSS. Average, auto-sum tool was used for data generation. Design, layout, format etc. tool was used for graphical representation. Average of all day, month and year data are gathered as decadal group and then

this data have been represented by various graphs (Figure 2). Historical change in hydrological datasets generally employ for statistical testing to detect trends.

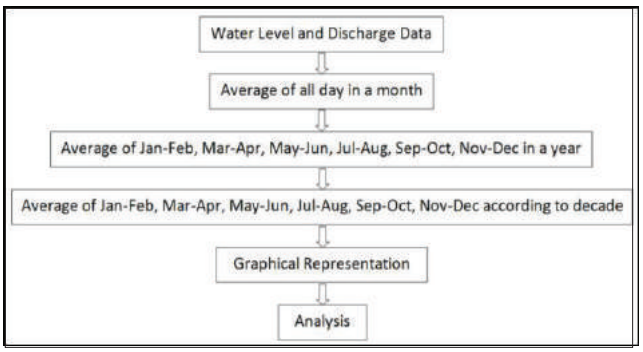


Fig. 2: Flowchart of water level and discharge data analysis

5. Result and Discussion

The natural flow of the river varies according to month, season, and year. Observations of gauging stations data for many years are generally needed to analyze the characteristic pattern of river's flow quantity and variability, natural flow regime of river. Extremely high or low flows or of the entire range of flows expressed as average daily discharge are the components of analysis (Dunne and Leopold, 1978).

There are lots of water level and discharge gauging stations in the south-eastern coast of Bangladesh. Among them water level gauging station and discharge gauging station at lama and Ramu have been analyzed. Adequate and length of records are essential for any long-term hydrologic statistical analyses and representation. Information about flow is required in determining the channel adjustment, analysis of river erosion and accretion. The subsequent sections present the outcome of the flow regime analysis.

5.1 Water Level

Water level is a significant function of river flow (Maheshwari, 1995). Water level or flow line of water is the height from where the surface of a mass of water rises or falls. Water level indicates a line that is consequent to the surface of a body of water. Generally, the high water level is the top elevation of water of the bank of the channel. In this study data have been analyzed and presented only two water level gauging stations. The measuring unit of water level is mPWD.

5.1.1 Lama gauging station at Matamuhuri River

The analysis of year 1974 to 2013 Water level data presented to show the decadal water level pattern of lama. Water level of 2004-2013 year was more in every month than the water level of 1994-2003, 1984-1993 and 1974-1983 year. On the contrary, water level of 1984-1993 year was

low in every month except July than the water level of 2004-2013, 1994-2003 and 1974-1983 year (Table 2).

Tab. 2: Decadal average water level at lama gauging station

Months	Decadal Water Level (mPWD)			
	1974-83	1984-93	1994-03	2004-13
Jan-Feb	6.16	6.1	6.51	6.66
Mar-Apr	6.19	6.05	6.5	6.56
May-Jun	6.91	6.81	7.29	8.27
Jul-Aug	7.77	7.82	8.24	8.41
Sep-Oct	7.12	6.91	7.3	7.73
Nov-Dec	6.43	6.35	6.7	6.81

Source: Bangladesh Water Development Board, 2015

Among the four decades the highest water level was 8.41 (mPWD) in July month of 2004-2013. On the other hand, the lowest water level was 6.1 (mPWD) in January month of 1984-1993. Frequent water level changes can be observed in every decade. Hydrograph analysis of decadal average at lama station exposes that variation of water level in every decade. From the figure 3, water levels increased gradually in every decade till July-August month and decreased gradually after that period. The plot of average water level hydrograph indicates that highest of peak water level occurs between June and mid-October. For 2004-2013 peak occurred at May-June. But in other decades' water level reached the top level at July-August month. Without 2004-2013 all other decades show similar pattern (Figure 3).

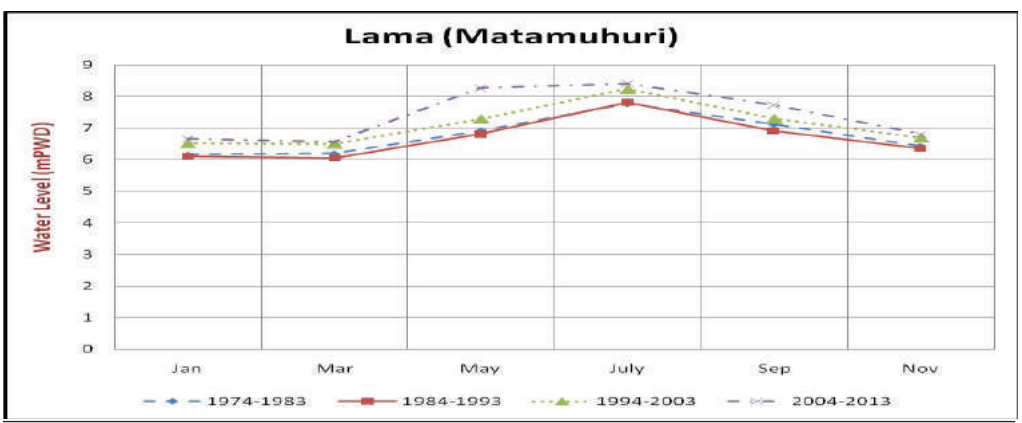


Fig. 3: Average Decadal water level hydrographs of the matamuhuri river at lama station

Again in March, 1995-2004 water level fall suddenly after that increase to the last of the year and peak was in September. So, from hydrograph it can assume that sudden rise of water level has been occurred in that particular decade. The hydrograph line for 1984-1993 shows the lowest water level in every month (Figure 3).

5.1.2 Ramu gauging station at Bogkhali River

From the analysis of 1974 to 2013 year it is visible that water level increased gradually in every decade till July month and decreased gradually after July month. Figure 3 shows that water level of in this station was closest in every decade. Among four decades (i.e. 1974-1983, 1984-1993, 1994-2003 and 2004-2013) the highest water level was 4.33 (mPWD) in July month of 2004-2013 period (Table 3). On the other hand, the lowest water level was 2.42 (mPWD) in January month of the same time period. But in 1994-2003 water was very low. In November, 1974-1983 water level was high than others (Table 3). Water level variation can easily understand from the decadal water level table (Table 3).

Tab. 3: Decadal average water level at ramu gauging station

Months	Decadal Water Level (mPWD)			
	1974-83	1984-93	1994-03	2004-13
Jan-Feb	2.64	2.61	2.59	2.42
Mar-Apr	2.59	2.58	2.71	2.45
May-Jun	3.23	3.48	3.41	2.92
Jul-Aug	4.19	4.04	3.9	4.33
Sep-Oct	3.61	3.39	3.17	3.32
Nov-Dec	3.09	2.79	2.68	2.58

Source: Bangladesh Water Development Board, 2015

The plot of average water level hydrograph of the Ramu station indicates that highest peak of water level occurs between July-August (Figure-4). Hydrograph analysis of decadal average at Ramu station exposes that variation of water level in every decade. From the figure 4 water levels increased gradually in every decade till July- August month and decreased gradually after that period. The highest water level was in July month 2004-2013. On the other hand, the lowest water level was in January of same decade (Figure-4).

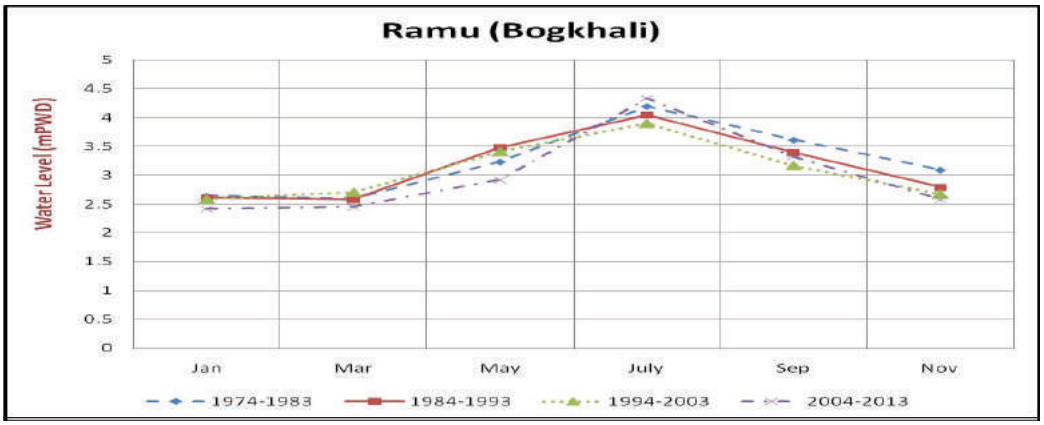


Fig. 4: Average decadal water level hydrographs of the bogkhali river at ramu station

All the decades show a similar pattern of water level. Again in for all year water level start to increase and after that increase reach at the peak and then go decrease (Figure 4). There was a regularity of season wise water level increase and decrease. But there was a high fluctuation in recent decade.

5.2 Discharge

River discharge is an important determinant of erosion-deposition aspect. Discharge is the amount of water flowing through a particular point of the river. Fluvial discharge Variation occurs typically from the upstream to the downstream of the lower coastal plain. River discharge increases in downstream because more water is flowing into the channel from many different tributaries. Discharges have great effect of channel characteristic changes.

5.2.1 Lama gauging station at Matamuhuri River

The average of every 10-year discharge data of lama station expose that discharge reached its highest peck in July month of 1974-1983 & 1984-1993 time periods but discharge reached its highest peck in May month of 1994-2003 time periods. The discharge rate increased gradually till July month of 1974-1983 time periods and gradually decreased after July (Table 4).

Tab. 4: Decadal average observed discharge at lama gauging station

Months	Decadal Discharge (m^3/s)		
	1974-83	1984-93	1994-03
Jan-Feb	7.37	33.17	44.68
Mar-Apr	12.04	15.24	83.04
May-Jun	97.11	48.42	148.28
Jul-Aug	183.14	184.13	94.31
Sep-Oct	95.55	145.81	93.18
Nov-Dec	26.29	63.64	90.32

Source: Bangladesh Water Development Board, 2015

Among the three decades (i.e. 1974-1983, 1984-1993 and 1994-2003) the highest discharge rate was 184.13 m^3/s in July month of 1984-1993 period. On the other hand, the lowest discharge rate was 7.37 m^3/s in January month of the 1974-1983 time periods. There was very irregularity of season wise discharge increase and decrease in 1984-1993 time periods (Table 4).

Hydrographs provide a good visual representation of the seasonal variation in the flow of the river. The plot of average discharge hydrograph of the Lama Station indicates that the highest of peak discharge occurs between June and mid-October (Figure 5). From the above statistics reveal that there is correlation between seasonal variation with discharge increase and decrease. Basically, Mid-may to end of the July is the rainy season in our country. Heavy rainfall occurs in this season. As a result, discharge rate increases in the Matamuhuri River which impacts on erosion and accretion.

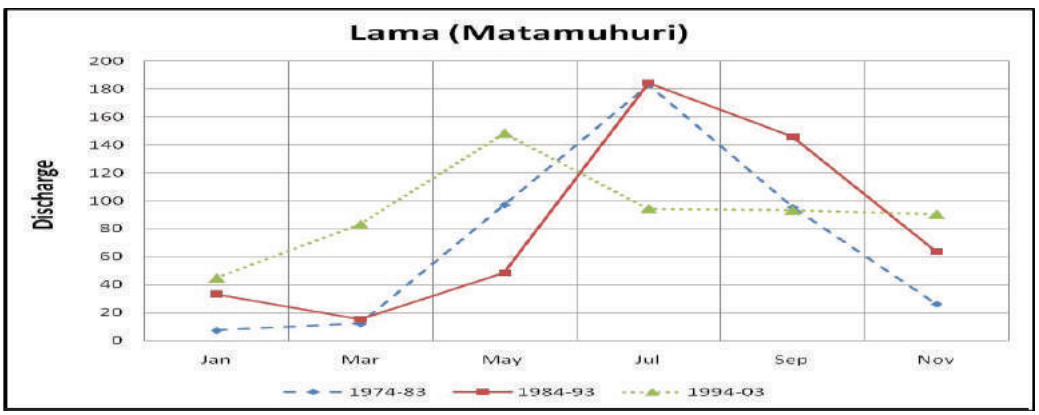


Fig. 5: Average discharge hydrographs of the matamuhuri river at lama station

5.2.2 Ramu gauging station at Bogkhali River

The average of every 10-year discharge data of ramu station expose that discharge gradually increased in every decade from May to September. But in the July discharge reach its highest peak for every decade. In 1974-1983 discharge was very low than other decades. 2.54 were the lowest and 178.87 was the highest discharge. Again in 1994-2003 discharge was high than previous records. From October, discharge start to fall (Table 5).

Tab. 5: Decadal average observed discharge at ramu gauging station

Months	Decadal Discharge (m3/s)		
	1974-83	1984-93	1994-03
Jan-Feb	2.54	2.76	40.93
Mar-Apr	5.01	3.98	33.71

May-Jun	27.94	53.87	84.35
Jul-Aug	91.23	105.62	178.87
Sep-Oct	38.02	43.38	87.55
Nov-Dec	9.15	11.1	47.03

Source: Bangladesh Water Development Board, 2015

Figure 6 shows that the discharge has increased a lot in recent decades. Hydrograph for 1994-2003 year shows the higher discharge than others. But hydrographs for 1974-1983 and 1984-1993 are nearly similar from the discharge level. In July, 1994-2003 discharge amount was 178.87 m^3/s which is higher than 105.62 m^3/s and 91.23 m^3/s. But after October decadal discharge hydrographs started to fall abruptly. From the graph it can be said that in January water discharge was very low than other months. But with the course of time discharge level has been increased for all months (Figure 6).

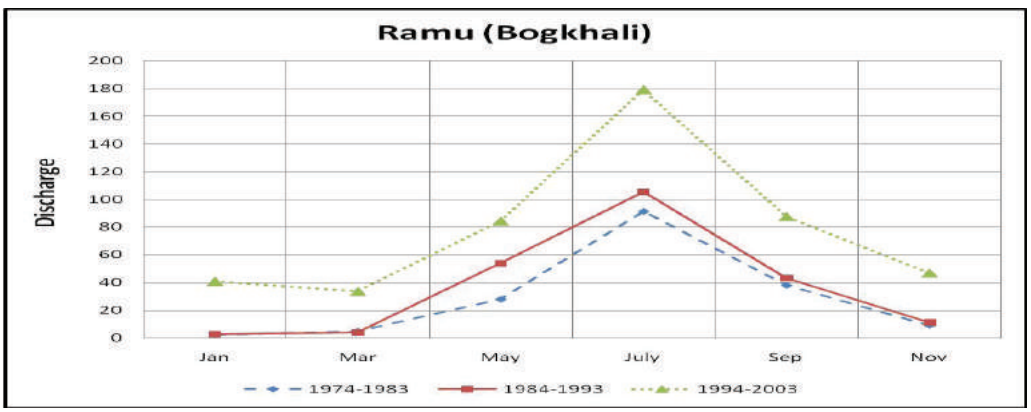


Fig. 6: Average discharge hydrographs of the bogkhali river at ramu station

The water level of Matamuhuri River is more than Bogkhali River in every season. It largely depends on the source of river and the surrounding physiographic condition. If the water level will increase, then the discharge rate will also be increased. As a result, the discharge rate of Matamuhuri River is high than Bogkhali River. Based on this result various aspects of river can be identified. River water levels or water discharge in a river can vary with flow and the characteristics of the channel. From the data analysis and visual representation, it is possible to say that seasonal variation is responsible for discharge and water level diversity. This diversity also effects the erosion and accretion on a river.

From the above statistics also reveal that there is connection between seasonal variation with water level increase and decrease. Season also a factor for the variation of water level and discharge rate in a river of a particular year. Basically, Mid-may to late July is the rainy season in our country. Heavy rainfall occurs at that time. As a result, water level increases in the river and discharge rate also increase in this period. Seasonal (one-year) discharge and water level fluctuations of the lama and Ramu station reflect the total water discharge and water level scenario. The peak flow period occurs in the July-August. Reductions in the flow can be observed in November-December and January-February (Figure 3, 4, 5 and 6).

5.3 Relationship between Erosion and Accretion with Water Level and Discharge

As flow is a function of river water level and discharge it is possible to get different erosion and accretion rate for the flow variation. The average water level and observed discharge rate of lama and ramu station of Matamuhuri and Bogkhali River respectively played vital role in coastal erosion and accretion at south-eastern coast (Cox's Bazar) of Bangladesh last four decades.

Water level and accretion is negatively correlated. The accretion rate increase with the decrease of water level. In 1974-1983 period, the water level was very low than other decade without 1984-1993 period. A devastating cyclone was happened within 1984-1993 period in the study area. The water level was 4.99 (mPWD) in this decade. The landmass accretion rate was very high than other decade which was 147 square kilometers (Figure 7).

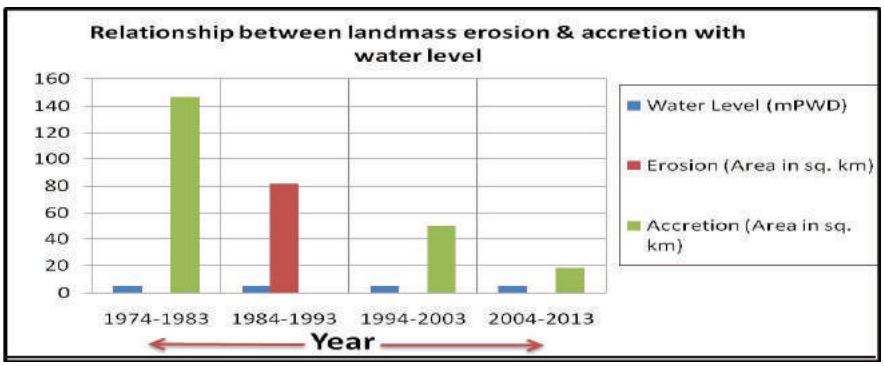


Fig. 7: Relationship between landmass erosion and accretion with water level

The accretion rate decrease with the increase of water level. Water level was very high in 2004-2003 periods than other decades which was 5.21 (mPWD). As a result, the accretion rate of landmass was very low in this decade which was only 18 square kilometers (Table 6).

Tab. 6: Decadal water level, landmass erosion and accretion rate

Period (Year)	Water Level (mPWD)	Erosion (Area in sq. km)	Accretion (Area in sq. km)
1974-1983	4.99		147
1984-1993	4.91	82	
1994-2003	5.08		50
2004-2013	5.21		18

Source: BWDB & CEGIS

Water level and erosion is positively correlated. The erosion rate increase with the increase of water level. The water level was very high in 2004-2013 periods. The water level was 5.21 (mPWD) in this decade. The beach erosion rate was very high than other decade which was 35.5 square kilometers (Figure 8).

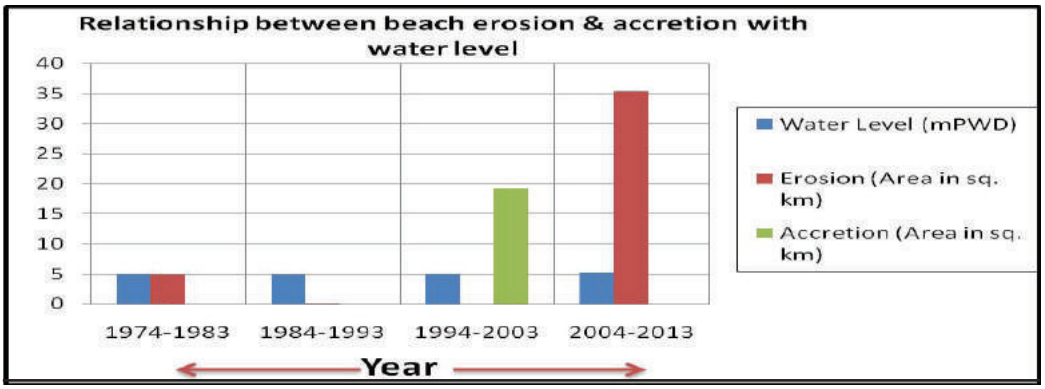


Fig. 8: Relationship between beach erosion and accretion with water level

The erosion rate decrease with the decrease of water level. Among the four studied decade, water level was very low in 1984-1993 period which was 4.91 (mPWD). As a result, the erosion rate of landmass was very low in this decade which was zero square kilometers (Table 7). The analysis proves that erosion is positively correlated with water level.

Tab. 7: Decadal water level, beach erosion and accretion rate

Period (Year)	Water Level (mPWD)	Erosion (Area in sq. km)	Accretion (Area in sq. km)
1974-1983	4.99	4.89	
1984-1993	4.91	0	
1994-2003	5.08		19
2004-2013	5.21	35.5	

Source: BWDB & CEGIS

Discharge and accretion is negatively correlated. The accretion rate increase with the decrease of discharge rate. In 1974-1983 period, the discharge rate was very low than other decade without 1984-1993 period. The discharge rate was 49.62 (m3/s) in this decade. The landmass accretion rate was very high than other decade which was 147 square kilometers (Figure 9).

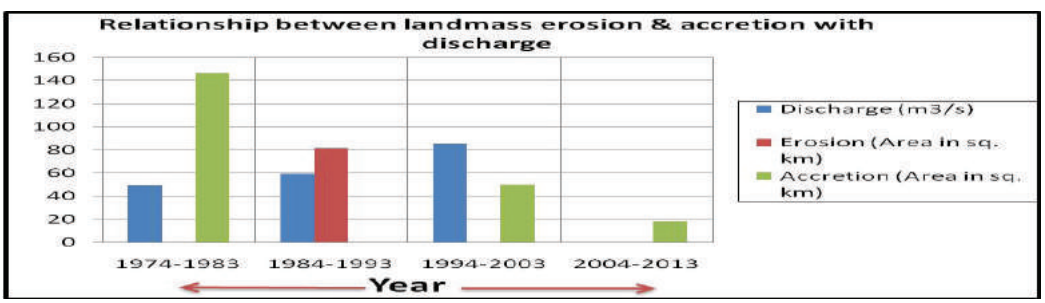


Fig. 9: Relationship between landmass erosion and accretion with discharge

The accretion rate decrease with the increase of discharge rate. Table 8 provides a picture of this statement.

Tab. 8: Decadal discharge rate, landmass erosion and accretion rate

Period (Year)	Discharge (m^3/s)	Erosion (Area in sq. km)	Accretion (Area in sq. km)
1974-1983	49.62		147
1984-1993	59.26	82	
1994-2003	85.52		50
2004-2013			18

Source: BWDB & CEGIS

It was not possible to collect discharge data of 2004-2013 periods because of the availability of the data. Erosion and discharge is positively correlated. Figure 10 shows a picture of this statement.

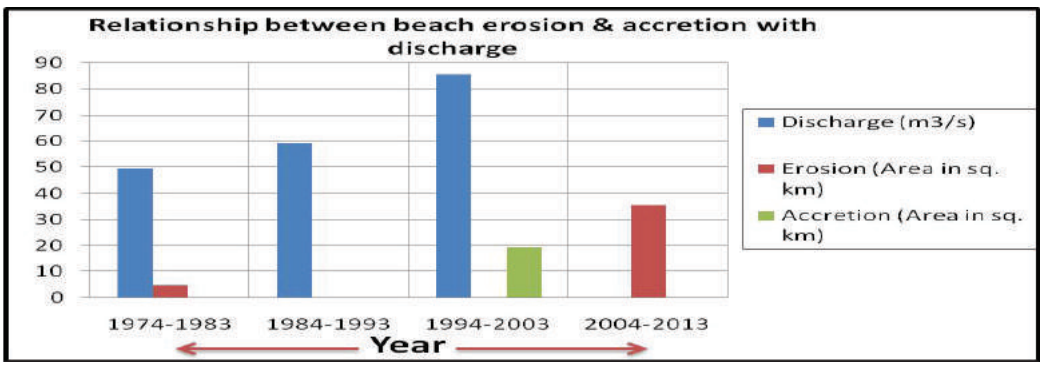


Fig. 10: Relationship Between Beach Erosion and Accretion With Discharge

As a result, decrease of water level and discharge in the river show positive impacts on accretion. So increases of water level and discharge in the river show negative effect on accretion. Accretion occurs when river lose its' energy. On the other side erosion occurs when river is full of energy (Figure 11).

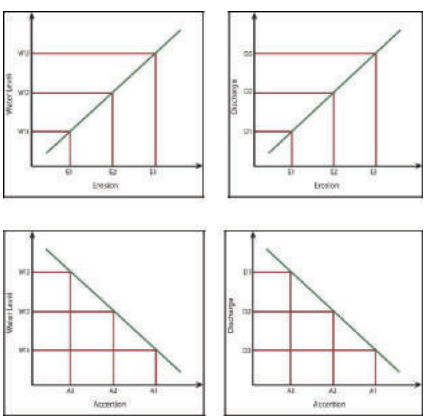


Fig. 11: Relationship between water level and discharge with erosion and accretion

6. Conclusion

The structure and form of the river and adjoining areas are continually changed due to erosion and deposition and that is the direct effect of hydrological parameters such as water level and discharge. There was an internal mechanism among erosion, accretion and water level, discharge. The rates of this change are variable. Coastal landforms in Bangladesh have been changed from water and sediment supply perspective. Particularly change of coastal landforms putting emphasis on river erosion and deposition. Channel dimensions are so adjusted over a period of time. From this point of view, the flow regime and behavior of river is invariably unstable.

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Urban Greening and Roof Top Gardening: Scope and Opportunities in Bangladesh

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Abstract

Urban Greening and Roof Top Gardening are two very important issues in regarding climate change mitigation in urban context. The green resources of most of the urban centers in Bangladesh including Dhaka are overwhelmed by a number of limitation inherent to the exceptional mode of urban development, rapid increase of urban population, transformation of green and other open spaces into other types of land use, lack of proper planning and implementation and management restrictions as well. A roof garden is any garden on the roof of a building. Besides the decorative benefit, roof plantings may provide food, temperature control, hydrological benefits, architectural enhancement, habitats or corridors for wildlife, and recreational opportunities. The practice of cultivating food on the rooftop of buildings is sometimes referred to as rooftop farming. Rooftop farming is usually done using green roof, hydroponics, aeroponics or air-dynaponics systems or container gardens (Wikipedia, 2013). Besides using the already present space at the roof itself, additional platforms could possibly be created between high-rise buildings called "aero-bridges". Garden is an embellished area with plants. The importance of gardening has been becoming popularized in every countries day by days. The gardens not only serve as a place of recreation, it also serves as a place for education by the way of establishing a home garden or botanical gardens. Urban agriculture currently feeds 700 million people, a fourth of the world's urban population.

In urban areas, due to escalating population, more land area is brought under the construction of houses; therefore the space for growing flowers, vegetables and fruits are diminishing by leaps and bounds. Even in multistoried buildings, roof gardening is possible to grow fruits and vegetables by using the pots and containers. This practice is known as container gardening. Psychiatrist recommends that working in garden refresh the body and mind by reliving harsh stresses. Gardens become the integral part of the family life benefited by the supply of toxic free fresh fruits and vegetables. In many countries RTG has become very popular as they habitually accepted it as a social and cultural practice and in some countries it have been imposed by promotional incentives presented later in this paper which can be replicated in Bangladesh. This paper will represent the scope and opportunities of urban greening and Roof Top Gardening (RTG) in Bangladesh.

1. Introduction

Roof gardens are the friends of urban environments those assist to reduce the overall heat absorption of the building as well as reducing energy consumption. The art of creating the greenery and maintaining the greenery is known as "Roof Gardening" (TNAU, 2013). This is

also known as Terrace gardening. The existing roof top can be effectively utilized for growing fruit plants, vegetables, spices, homestead medicinal plants, flower plants and ornamental plants. The population explosion occurs every day resulted in the migration of peoples from rural areas to urban areas for income generation. Due to migration of peoples most of the agriculture lands are converted into residential areas, resulted with decreased production of fruits and vegetables. This can be supplemented by by kitchen gardening and roof gardening.

Story of human settlement reveals that growing plants on the top of structures poses a historical background. In ancient Mesopotamian Civilization there were constructed (4th millennium BC–600 BC) ziggurats, a temple of Sumerian origin in the form of a pyramidal tower which had plantings of trees and shrubs on aboveground terraces. An example in Roman times was the Villa of the Mysteries in Pompeii, which had an elevated terrace where plants were grown (Wikkipedia, 2013). A roof garden has also been discovered around an audience hall in Roman-Byzantine Caesarea, an ancient seaport of Palestine south of present-day Haifa, Israel. It was founded (30 B.C.) by Herod the Great and later became the capital of Roman Judea. The medieval Egyptian city of Fustat had a number of high-rise buildings that Nasir Khusraw in the early 11th century described as rising up to 14 stories, with roof gardens on the top story complete with ox-drawn water wheels for irrigating them. This paper will represent the scope and opportunities of urban greening and Roof Top Gardening (RTG) in Bangladesh.

2. Environmental impact of Roof Top Gardening

The primary cause of heat build-up in cities is insulation, the absorption of solar radiation by roads and buildings in the city and the storage of this heat in the building material and its subsequent re-radiation. A study was performed by the University of Cardiff which shows that plant surfaces by transpiration process, do not rise more than 4–5 °C above the ambient and are sometimes cooler. This then translates into a cooling of the environment between 3.6 and 11.3 degrees Celsius (6.5 and 20.3 °F), depending on the area on earth (Wikkipedia, 2013). A study at the National Research Council of Canada showed the differences between roofs with gardens and roofs without gardens against temperature. The study shows temperature effects on different layers of each roof at different times of the day. Roof gardens are obviously very beneficial in reducing the effects of temperature against roofs without gardens. If widely adopted, rooftop gardens could reduce the urban heat island, which would decrease smog episodes, problems associated with heat stress and further lower energy consumption.

3. Social and community-based Benefit

Gardening favors contacts and exchanges and betters the quality of life. For seniors, gardens stimulate social encounters, physical activity (Hautecoeur, I 2013). It can mean getting back to the earth for some and participating in a lively project that comes with various therapeutic benefits. The community in contact with the garden will benefit from the feeling that comes from helping others, commitment to a project and socializing with one another. Roof top garden came up as a concept of relief to our urban lifestyle that taking place of our exhaustion to concreteness of our cities.

4. Food security

Gardening will favor the production of food for a meals-on- wheels program or a food bank, or for personal use. More or less not a matter it can contribute in producing fresh vegetables and fruits to the city dwellers contributing greatly to our built environment as a great friend.

5. Economic

A rooftop garden can improve a building's energy efficiency and increase its value for little cost by expanding the useable space. Food cultivation also diminishes expenses. It not only contributes in food security but also promotes service sectors as creating job opportunities for seed and sapling suppliers, labors, compost manufacturers. A study conducted on Khulna city shows that about 87% agro-forestry nurseries in Khulna city and its adjacent areas are using their self made compost (Roy, T. K. et al, 2013). The study also reveals that about 70% urban wastes in Khulna city is organic in nature and suitable for preparation of organic fertilizer.



6. Environmental

Here, we are referring of the improvement of air quality through the absorption of carbon dioxide and the production of oxygen by plants. The consequent increase in humidity and evaporation will bring down the ambient temperature, biodiversity will attract birds and insects; and plants will absorb ambient noise. Using rainwater to irrigate plants will reduce pressure on the municipal waterworks and can be integrated in a system that uses household wastewater. Eating organic and local will reduce the quantity of chemical products used to grow plants and to transport food.

7. Horticultural

Experimenting with new gardening techniques or developing a new model for urban gardening to spread urban agriculture could be on the menu; personal : Te simple pleasure of gardening and being able to benefit from a relaxing space at home will be the foremost motivation.

8. Urban agriculture

An urban garden can supplement the diets of the community it feeds with fresh produce and provide a tangible tie to food production. At Trent University, there is currently a working rooftop garden which provides food to the student café and local citizens. Available gardening areas in cities are often seriously lacking, which is likely the key impetus for many roof gardens. The garden may be on the roof of an autonomous building which takes care of its own water and waste. Hydroponics and other alternative methods can expand the possibilities of roof top gardening by reducing, for example, the need for soil or its tremendous weight. Plantings in containers are used extensively in roof top gardens. Planting in containers prevents added stress to the roof's waterproofing. One high-profile example of a building with a roof garden is Chicago City Hall.



Like all developing countries the urban Population in Bangladesh has grown much faster than the rural Population. As population growth has typically sprawled in the capital city of Bangladesh, the city has been facing tremendous urban problems. With the growing importance of the city and mounting up pressure of population, the problems are getting more and more precarious every year. Amid all the problems, unwanted sprawl originates not only due to ineffective development control but also due to failure of the equilibrium between demand and supply of build able and livable urban land. Dhaka Metropolitan Development Plan (DMDP) reveals that about 20% land of about 590 sq mile area is shown as urban agricultural zone and retention pond (DAP, 2010). But unfortunately most of those areas are at the threatened of encroachers, land and water pollution by untreated industrial wastes and not suitable for cultivation. Urban and peri-urban agriculture have not received adequate policy attention in Bangladesh. Policies, such as National Agricultural Policy 1999, National Food Policy 2006, National Food Policy Plan of Action (2008-2015) have not addressed the important aspect of urban agriculture and food security (Ananya et al, 2012). For those who live in small apartments with little space, square foot gardening, or living walls (vertical gardening) can be a solution. These use much less space than traditional gardening (square foot gardening uses 20% of the space of conventional rows; ten times more produce can be generated from vertical gardens). These also encourage environmentally responsible practices, reducing or eliminating pesticides, and weeding, and encouraging the recycling of wastes through composting.

There are three types of soil within DMDP area , which are Chy, Chy loam, Loam (Soil Research Development Institute, 2001). According to the Bangladesh Agricultural research Institute, Chy is the most suitable soil for the production of agricultural products and Chy loam is the medium suitable soil and Loam is not so suitable soil for agricultural production. In Gazipur Upazila, about 22% soil is Chy, 52 % is Chy loam and 24 % soil is loam. In RupganjUpazila, almost 70% soil is suitable for agricultural production. In KaliganjUpazila, 45% soil is Chy and Chy loam. So there is also a huge scope for agriculture practice (Ananya et al, 2012).

9. Potentials of roof Top Gardening in Urban Bangladesh

- Year round supply of fresh fruits and vegetables
- Reduces expenditure on purchase of fruits and vegetables
- Effective utilization of space available at the roof top
- Supply of toxic free fruits and vegetables
- To grow our own favourite vegetables
- Rare and unavailable vegetables can be grown in roof garden
- Apart from the above, working in a roof garden will relieve stress and strains.
- Maintaining the greenery through roof garden reduces the pollution
- Increases the monetary value of land / apartment
- Avoiding Toxicities of fruits and vegetables

10. Strength to Popularize RTG

Around 1,200 big and small nurseries are currently operating in Dhaka, its outskirts and neighboring areas (Ansari, 2008). About 500 of them are exclusively growers who sell the plants to others. This is a positive force to popularize RTG in Bangladesh.

11. Institutionalization of Urban Greening

The concept of urban agriculture has spreaded during 1990s with the pioneer works of Urban Agriculture Network supported by the UNDP. A number of direct or indirect stakeholder departments are responsible regarding the two issues of Urban Greening and Roof Top Gardening. These are the City Corporations (Dhaka North, Dhaka South, Gazipur, Narayangonj) and the Rajdhani Unnayan artripakkha (RAJUK). The jurisdiction of RAJUK includes the City of Dhaka and it's vicinity in the Districts of Dhaka, Narayanganj and Gazipur covering an area of 1528sq. kms. With DCC and RAJUK, a number of state bodies, autonomous bodies, private organizations, NGOs, different societies are involved with greening activities in and around Dhaka city. Of them, the key state and autonomous authorities are Department of Environment (DoE), Local Government and Engineering Department (LGED), Bangladesh Forest Department (BFD), Dhaka Urban Transport Project (DUTP), and Dhaka Transport Coordination Board (DTCB), Department of Archeology, etc. Apart from these, some NGOs like ASHA, PROSIKA, different financial organization, donor agencies such as ADB, World Bank are also taking part in greening activities in Dhaka city. Some social organizations like Society of Arboriculture, Bangladesh National Nursery Consortium (NNC) are also contributing their efforts for promoting greening activities (Ansari, 2008).

The lack of funds is a serious constraint for enhancing greening activities. Within the city area, DCC provides services to its residents. But Most of the cases DCC allocate maximum amount of money in its budget for utility services development. Green areas such as parks, play ground, graveyard development get very little attention in DCC's annual budget. The corporation allocated Tk 2.50 crore (25 Million Bangladeshi currency) in its budget for the fiscal year (2007-2008) for the development of city parks, open spaces and playgrounds which is only 0.8% of its total budget . Most of the time DCC's own funds is not able to keep pace with the incremental rate of urbanization, fast-growing population, and increasing demand for its services (Ansari, 2008).

12. Scope of RTG in Sylhet City

A study analyzes the rooftop gardening status, floristic composition and cost and return of the rooftop garden in Sylhet City Corporation. Data was collected from 450 rooftop gardeners randomly during July-September 2010. Study reveal that rooftop gardening is generally for mental satisfaction (95.3%) followed by leisure time activity (87.8%) in the study area and almost all the family members of gardeners' were involved; while collection of planting materials, sites preparation and marketing of products were reported to be carried out by males only (male 71.33%). Middle income classes were most interested in rooftop gardening (43.78%). The survey recorded 53 plant species (35 families) of which Cucurbitaceous family represented highest eight species. Shrubs (28%) were highest followed by herbs (26%) among agri-crops (36%) and flower species (30%). About 89% of the rooftop gardeners procured planting materials from nursery, market, fair, neighbor, relative and friends and they mostly prefer to use seedlings (48%) for roof gardening followed by direct seed sowing (21%). Gardeners sell products sporadically in different local markets, directly or through intermediaries, with no uniform pricing for system. Rooftop gardening improves the food security and meet nutritional deficiency to the gardeners. Survey revealed that generally very few people consider rooftop gardening commercially to get profit and from the cost-return analysis this gardening system can be economically viable if proper and scientifically managed.

13. Constraints of RTG to be implemented

In Dhaka three types of building constructions are noticed as development by Government, private entrepreneurs and private developer companies in the form of joint venture. In case of private land owners, it is easily possible for RTG if the owner of the building is intended to do it. In case of Public building, it can be facilitated by mandatory policy by the Government as some of the departments or autonomous organizations have the manpower of Gardener in the organogram who can take care of it. The most complex situation arises in the buildings developed by the developers where the flat owners have limited access to gardening as the roof is treated as common property. This situation can be overcome by anacting policy of necessary airmark on the roof top for gardening and imposition by the flat owners association as joint venture.

14. Best Practices to be replicated

- In some European countries such as Switzerland, bylaws have been approved that new buildings must be designed to relocate the green space covered by the building to their roofs.

- In Toronto, Canada Green Roof By-law imposed green roofs for all new development above 200 sq/m. Coverage requirement ranges from 20-60% of the available roof space and the law effects all new application made after January 31, 2010.

- The city of Portland, Oregon offers a Floor Area Ratio bonus in its building code. Developers may build an extra 3 sq/ft per foot of green roof they construct without additional permits. They also offer a grant reimbursement of up to $5 per sq/ft for reducing stormwater infrastructure with a green roof.

- Austin (TX) Green Roof Density Bonus has been introduced. Austin recently passed a Green Roof Density Bonus, which can give a density bonus of up to eight square feet for every square foot of green roof installed

- In a concerted effort to combat the ever rising urban heat island in Tokyo, the new "Tokyo Plan 2000" was implemented on April 1, 2001, requiring new buildings greater than 1,000 square meters (10,000 sf) or over one-quarter acre to green at least 20% of its useable roof space.

- City of New York passed legislation in 2008 to provide a one-year tax abatement, or tax relief, of $4.50 per square foot (up to $100,000 or the building's tax liability, whichever is less).

- It's now mandatory in the City of Copenhagen that all new flat roofs at or under a

  30 degree-pitch, both private and public, have to be vegetated. If old roofs have to be retrofitted, the building owner may be able to receive public financial support for a green roof.

- The Architectural Services Department of the Government of the Hong Kong Special Administrative Region has issued a Study document includes a Green Roofs Overview, Design & Technical Guidelines, and Recommendations for greenroof directions for Hong Kong and the way forward.

15. Recommendations

- Steps should be taken to formulate proper strategies for protection of existing urban green areas of all the cities, rehabilitate what have been destroyed, and plan for the judicious utilization of resources for sustainable development.

- In case of Public building, it can be facilitated by mandatory policy by the Government as some of the departments or autonomous organizations have the manpower of Gardener in the organogram who can take care of it.

- RTG may be promoted in the buildings constructed by developer companies enacting policy of necessary earmark on the roof top for gardening and imposition by the flat

owners association as joint venture. RTG induced roof design may be facilitated in cooperation with Real Estate and Housing Association of Bangladesh (REHAB), Institute of Engineers Bangladesh (IEB), Institute of Architects Bangladesh (IAB), Bangladesh Institute of Planners (BIP) with technical cooperation.

- Active government facilitation and NGOs could play vital role to increasing RTG by providing training and motivate people with technical aspects of rooftop gardening.

- There is needed for a legislative framework regarding the prevention of abuse of the urban green spaces that are a part of the soul of the city.

- The authority should develop a routine preventative maintenance program for the green areas under the jurisdiction of all City Corporations and Pourashavas of Bangladesh so that the improvements will provide a lasting benefit.

- Citizen involvement is necessary to bring awareness and social motivation for Green Roof Movement in every cities and towns of Bangladesh

- Legislative reform is needed to allow roof top gardening by the flat owners through a common platform or society on the roof top of buildings constructed on joint venture by the developer company. It should be resoved through a consultative workshop among REHAB, Flat owners and the legislative institutions

- Government should appreciate those initiatives and consider proper planning policy to motivate citizen of the urban areas for planting fruit plants and vegetable in their rooftops. It may be a rebate in their holding tax. A little subsidy can contribute significant economic contribution in promoting roof top gardening all over the Bangladeshi cities

- Appropriate technical support and cooperation between different organizations might be explored for promoting and popularize roof gardening

- Unutilized and incidental spaces within all the cities of Bangladesh should be brought under effective use by promoting urban and peri-urban agriculture.

- New urban peripherial areas as Gazipur, Tongi, Narayangonj, Savar, Karaniganj can be taken into consideration for establishing new small parks, play grounds, botanical garden by the concerned Local government agencies as concerned city Corporations, Pourashavas, zilla porishad or autonomous institutions (those who are the stakeholders) as Shilpokola academy, sports institutions as BKSP, NSC, BCB, BOA, BSF and other federations. They can purchase land in market price and can establish parks or play grounds which is inevitable for resilient city planning

16. Conclusion

Green roof may become a place of emotion for the amateurs; a green urban characteristic of our cities, aesthetic to our skyline if it becomes a habitual practice to us. Urban Sustainability aims at sustaining ability of a city. A city may be self sustained in terms of transportation, energy consumption, food security and livelihood pattern. Now a days days, two strongly promoted urban management strategies for developing countries are urban agriculture and reduction/reuse of solid wastes. Green roof can contribute both of those policies supporting a little to our food security but innumerable to our built environment for a healthy city if it is facilitated properly.

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SMART BIN: An IoT-Based Smart Garbage Bin for Making Greener Dhaka City

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Abstract

This concept paper we are proposing a smart garbage bin model named SMART BIN for Dhaka city which helps to improve the standard infrastructure of green city and human settlements in Bangladesh. One of the typical problem and the most potential barrier for making the Dhaka city Greener is the mounting waste problem, where Dhaka city is producing over 6000 tons of garbage each day (S M Alauddin 31 October, 2015)1 but authorized organization is collecting less than half of it because of insufficient garbage bins. Recent steps have already been taken by setting up 15 thousand garbage bin in the Dhaka city (Anon., 2016)2 but the challenge is in maintaining these bins properly. Ordinary bins which we already have in our roads are not technologically smart enough to solve the garbage problem and it has some issues itself. Our proposed model will overcome these issues and opens new opportunities for sustainable development of Dhaka city. This paper uses literature review about technological bins which has been being used in developed countries and helps to extend our model and adapt with Dhaka city. Finally, we describe our plans for future work. There are numerous opportunities for SMART BIN as we can easily overcome the problems we currently have with ordinary garbage bins and make our Dhaka city greener, a sustainable human settlement with the implementation of our proposed model.

Keyword: *Garbage Bin, Internet of Things, Smart Bin, Green City, Waste Management*

1. Introduction

Dhaka, the capital city of Bangladesh, is one of the mega cities of the world and houses around 20 million people. The population is growing so fast that it is causing many social problems. One of the typical problem is Waste management problem (S M Alauddin 31 October, 2015)[1]. A few years ago, Dhaka city was producing over 3000 tons of garbage each day (Tamzid Ahmed Chowdhury, 2006)[3] but with the increasing of the population, garbage production has grown proportionately with around 6000 tons of garbage being produced each day (S M Alauddin 31 October, 2015)[1]. The difficulty in managing waste was one of the reasons that led Bangladeshi government decided to divided the Dhaka city corporation in two parts, Dhaka city corporation

north and Dhaka city corporation south (Tusher, 2011)[4]. Dhaka South City Corporation (DSCC) is producing 3,300 tons of garbage each day and Dhaka North City Corporation (DNCC) is producing around 2,700 to 2,800 tons. Which causes air and environmental pollution and this is the main barrier for making the city greener (S M Alauddin 31 October, 2015)[1].

Despite dividing DCC into two parts, garbage related issues still remain unsolved. DSCC generates 3,300 tons of garbage each day but their collection capacity is only 2200 -2300 tons, while another 300-350 tons of garbage per day which are collected by Private Sector companies. Hence about 2000 tons of garbage are left/day by DSCC because of insufficient garbage bins and other utility apparatuses(S M Alauddin 31 October, 2015)[1]. Previously around 1200 garbage bins(Alam, 2016)[5] were used in DCC but after dividing DCC, the DSCC decided to has decided to set up 15,000 small bins in its area to collect the remaining 2000 tons of garbage(Anon., 2005)[6].

Further challenges continue to persist as ordinary garbage bins which we already have installed in our roads are not technologically smart enough to solve the garbage problem and it has some issues itself.

In this concept paper, we are proposing a smart garbage bin model named SMART BIN, an IoT-based smart garbage bin which helps not only to improve the standard infrastructure of green city but also human settlements in Bangladesh.

2. Motivation

Bangladesh government has taken on the application of digital technologies and committed to make Digital Bangladesh by 2021. Within this time another goal is to be a middle-income country with peace, prosperity and dignity by help of technologies. As a result, the government of Bangladesh proposed a large number of projects relating to smart and digital technologies such as Online transaction and payment infrastructure, promotion of e-Business and commerce, High-tech Park, Human resource development, building e-Learning infrastructure, ICT-based education, e-Administration infrastructure, e-Citizen services, m-Governance services, Healthcare services, Agriculture services, Effective and efficient social security, Environment services. Some of those initiative is already taken and some are in queue (Hasanuzzaman Zaman and Rokonuzzaman, n.d.) [7](Rahman, 2015)[8].

As a part of the sustainable environment development and making Dhaka city greener, DCC have been technologically developed for collecting waste such as improved waste container, van, trucks, bulldozer etc. Bangladesh Government even has a plan to establish a Waste to Energy Plant as soon as possible. The plant will use the waste as substitute of coal and it will use 2000 tons of domestic waste from City Corporations' every day collection(S M Alauddin 31 October, 2015)[1].

Hence to aid with such development initiatives, we proposed a model to improve the current status of garbage bins in Bangladesh. Our proposed model is feasible, sustainable and can improve with garbage collection significantly to tackle current challenges.

3. Problem Statement

Ordinary bins which we already have in our roads are cheap, light weight and easy to install. However, it isn't technologically smart enough. The whole structure is made by metal with a bin and a cover on top. Bin is flexible to collect the garbage while the cover on it is protecting the bin's garbage from rain water and birds. There are two types of garbage bins currently we have in our city one is bigger in size and another is little bit smaller. Garbage management workers collect the garbage from the bin after 7:00 PM every day (Alam, 2016)[5]. These ordinary bins have some issues. Conscious citizen faces problem when they can't find the nearest bin and the problem increases when if they found it may be broken or stolen (Rahman, 2016)[9] (Figure 1). It is also not possible to track the fullness of bin automatically and there is no easy way to notify its responsible worker to collect it and make it free again. If the citizen find the bin broken or stolen,then there is no easy way to notify responsible worker to fix it or rebuild it. If we consider developed country such as United States, Canada, Australia, Germany they are using more advanced bins (Anon., n.d.)[10] That are not only used for garbage collecting but also in multipurpose applications. So, our main challenge is to make our ordinary bins to technologically advance to overcome those problems and make it a multipurpose smart bin.



Fig. 1: Ordinary garbage bins in Dhaka city, Broken garbage bin, stolen garbage bin [left to right]

4. State of the art

Technology is growing fast and the Internet-of-Things (IoT) devices are part of this current technology trend. IoT is the first step to build a smart city and the market value of it will be around $14 trillion by 2022(Joseph Bradley, 2013)[11]. Waste management is also following the trend and hence garbage bins are also getting smart by IoT technologies in developed countries. New features includemeasuring the fullness of bin, Radio-Frequency Identification (RFID) technology is widely using because RFID tag can be read without seeing it and it can store more data than ordinary bar code system (Belal Chowdhury, 2007)[13], (Anon., 2016)[15]. After collecting containing status data, bins can send it to its authorize person automatically using internet. So, technologies are helping us for waste management services to reduce waste production, ensure that wastes are properly disposed, and promoting recycling where applicable (Anon., 2016)[14].

4.1 Bigbelly Solar Garbage bin

Bigbelly is a solar powered smart garbage bin, when it gets sunlight photovoltaic (PV) solar cells to convert the sun's energy into electricity and charge the battery inside it. When sunlight is not there it can operate by battery backup. It has a compaction or a hydraulic arm inside which can produce force of2,000 pounds and with that force it can hold four times more waste than traditional bins. Bigbelly can display and give its fullness information to its authorized person and they can easily identify in which place bins are filling up frequently and then they can setup more or larger bins there(Anon., 2016)[14](Belal Chowdhury, 2007)[12].

4.2 ReDBin: An Internet-of-Things based household-waste container for future smart cities

ReDBin is a IoT based smart bin which can automatically sort out different types of garbage and it have self- management capability that can show its fullness status and inform the appropriate authorities to make it empty and re-useable again. It has also ability to inform if it needs any repair. Garbage collector can easily find the bin because of its tracking system. It shows some environmental monitoring data, weather information, traffic flows etc. This bin also includes a user friendly Graphical User Interface (GUI). This bin is solar powered to avoid negative environmental impact(Belal Chowdhury, 2007) [12].

5. Proposed System

We are proposing a garbage bin model called SMART BIN, an IoT device connected with internet. It will also powered by solar energy which is an advantage for Dhaka city where sun shine is available for most of the session. As a result, SMART BIN doesn't need any extra external power to operate making it an eco-friendly garbage bin. It has a large touch supported Liquid Crystal Display (LCD), a speaker, camera and a WiFi router as a peripheral device. LCD display can have multipurpose use such as such as displaying bin containing status, current date, time and weather temperature. It can also show the current location of the bin so if any citizen wants to know about his/her current location information they can simply go to the nearest bin and get the information. If someone is lost and want to go to a specific location or someone want to go to a place without knowing the direction, they can easily navigate to that location from bins location by SMART BINs display. SMART BIN which can be installed nearby any heritage infrastructure and display the history of that infrastructure so That tourists can get a quick information about that heritage point. Similarly, in this way SMART BIN installed nearby government office can also give notice on the display of it, Other possible applications include, SMART BIN installed nearby train/bus station to display train/bus schedule. It can display police, ambulance and fire service's toll free numbers and if any emergency occurrence like road accident happens then citizen can easily notify police/ambulance/fire service by the SMART BIN quickly. SMART BIN can be connected with a smartphone application (App) and all citizen can install this app for free so that they can easily find the nearest bin, notify authorized people if it is broken or not working, if it is full but no one has collected its garbage yet etc. Big data analysis is also possible from the data of containing status. We can easily analysis the raw data and identify the place where SMART BIN is filling frequently. Users can use a quick internet access by WiFi router and authorized department like police can use the camera for any kind of investigation remotely. In off peak hour or even a peak

hour, commercial companies can display their quick digital advertisement for marketing their product therefore they can pay/ take responsibility to maintain the SMART BIN.

6. Conclusion

The proposal of making Digital Bangladesh is to use modern technology to bring a sustainable human settlement and improve the quality of life.We have presented our model SMART BIN which uses technology to provide a more eco-friendly approach to waste management. The studies have shown that there are numerous opportunities for SMART BIN as we can easily overcome the problems we currently have with ordinary garbage bins. The two main contributions of this concept paper were the state of the art of garbage bins which are already using in developed country and propose a model of smart bin which is needed for Dhaka city and with the implementation of our proposed model, we can make a greener Dhaka city and a sustainable human settlement.

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SHUBASTU: A Hope for the Ever Increasing Populace of Slums of Dhaka for a Solvent Life

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Abstract

Dhaka is an ever growing dynamic megacity that needs hundreds of thousands ofpeople to fuel its multi diverse industries. Each year around four hundred thousand new migrants flood into its already crumbled housing system,seeking the diverse job opportunities the city offers to improve their living standards [1]. However, due to the absence of a proper infrastructural system to supervise the migrant‟s needs, they often derail from their dreams and get lost within the city‟s miseries.Our paper addresses this issue of slum dwellers with special attention to connecting slums with employment opportunities through mobile technology.“Shubastu” is a multiplatform system that bridges the slum dwellers with their potential employers under the supervision of a proper authority, e.g. the city corporation.“Shubastu” offers a system to categorize the slum dwellers according to their expertise and make this data available to relevant employers. Our paper is a model of doing this without the need of training the semi-literate, tech incapable slum dweller while providing this information to tech capable employers through mobile technology. The paper argues that this research work will not only offer significant improvements for slum dweller‟s living standards. Moreover, it will facilitate a growing economic industry to flourish. In addition to that “Shubastu” also presents the opportunity to conduct necessary data analysis and research work on domains that has been neglected despite of having real economic and academic prospects.

Keywords: *Poverty Alleviation, Slum Dwellers, Jobs, Data Analysis, Demographic maps, Business Industry, NGO, Government Aid, Research work*

1. Introduction

The latest census conducted by the Bangladesh Bureau of Statistics (BBS), gives us an overwhelming number of 1.06 million people that lives in slums across Dhaka [2]. Most of these migrants crowd into Dhaka from all over the countryhoping to get into the workforce. It is these migrants who contribute significantly to build up the city‟s industry and in turn its economy by participating in its labor intensive manufacturing, building and service sectors. However, while rural migrants continue to flood into Dhaka, finding remunerative employment remains a major challenge for these poor and semi-literate people. Jobs often tend to be low paying and do not offer any measure of security.According to BBS, around 6.5 % of the slum dwellers work in

households as domestic helpers [2]. While, almost 18% of the slums are populated by housewives [2], having high probability of engaging in domestic services in near future. Around 7% [2] work as rickshaw pullers. These are the kinds of job that are never categorized and available on anyrecognized system, e.g. the newspapers. As a result, despite of being a sizable economic industry, the workers and the employers do not have any platform to interact with each other. This leads to unavailability and insecurity for both the employees and the employers. Moreover, the censuses conducted by various government organization categorize the populace mostly according to their age groups and gender. Figure 1 illustrates such a categorization of the populace in the form of a population pyramid [3]**.** Although it is very essential to conduct a census on the city‟s workforce to categorize the populace according to their expertise, censuses of such is scarce in our country. Similar work has been done in western countries to assist various organizations in their projects. Figure 2illustrates a pie chart showing the density of different work groups within BritishColumbia[4]. This gap in information leads to the mismanagement and poor distribution of government aids among the potential future workforce. In addition to that, the data acquired from such censuses can be used to construct a demographic map of the skilled labors distributed among the various locations they are situated in. Figure 3gives an illustration categorizing job loss concentration among various countries after the great recession [5]. This kind of demographic map can be of huge assistance to the employers seeking skilled workers of a particular expertise in a required location. Additionally, further categorization can be applied on the acquired data to categorize the skilled labors in various age groups. This can determine the proper number of under aged workers and number of elderlies or disables eligible for government aids. Shubastu offers a system to fill in these gaps in information which will facilitate various organizations and employers to seek and acquire their targeted group of people. We argue that this will lead to a more organized and reliable transaction of employment and aids to the proper people. Which resultantly will facilitate to construct and enrich a new economic industry to alleviate poverty and improve the living standard of the city. Moreover the data server along with the demographic map tool promises to fill the void in research work and promote a new course of data analysis and research programs in the employment sector of Dhaka. The paper argues this research project will be the pathfinder of a new technology based service system that is the necessity for this modern smart devices based era.

2. Creating employment opportunities for the slum dwellers to alleviate poverty

The major difficulty that most of the new migrants face while searching for employment opportunities, is that there is no reliable platform which offers employment for their expertise. For example a skilled motor mechanic will have to depend on friends and neighbors in his slum to seek a job in his domain. Or an expert household assistant may have to wait a long time before his/her expertise can be reached to the proper employer. This happens because of the absence of a proper infrastructure or a system that categorizes these skilled workers and make this data available to the proper authority. One of the main reason behind this absence of a proper platform is the tech illiteracy of the workers. One study conducted by Chipchase et al about the problems that illiteracy has on mobile phone use demonstrated the different ways illiterate people used mobile phones[6]. The studyshows that some functions could be easily carried out such asturning the phone on or off, accepting incoming calls while other functions like sending text messages and finding contacts from the contact list were more difficult. Responding to other basic information such as remaining

battery power, network connectivity, incoming text messages was often challenging. First of all, it is very probable that a slum dweller may not have access to proper devices such as a smartphone or a computer. Even if the price of the smartphones is decreasing rapidly, it may not still be quite usable by the slum dwellers today. Another study explored mobile phone uses among blue collar workers in Mumbai [7]. The study shows the usability difficulties among these workers. "Awareness and perception of mobile phones:Participants were aware of, and desired mobile phones. However, they did not feel clever enough to use them, and would like to be „taught"" [7]. The study implies "...You need to be educated to use these phones"[7]. However the study indicates the business prosperity if a workers contact was available to his/her potential employers. A worker says in the interview „„„... My neighbor, a door to door vendor got an inexpensive mobile phone and gave his number to customers. Now he has a cart in the market and additional help for home deliveries"[7]. The time and resources required to train the targeted populace to use software technology makes the whole system unsustainable. Therefor it is essential to construct a system which can categorize and enlist these skilled workers without having to train the hundreds of thousands of them [1]. "Shubastu" offers exactly a system of that kind. A system where thousands of slum dwellers will be registered according to their work expertise without the need of training them. However, we have acknowledged that the employers of these potential workforce do have access and user capability of basic technological infrastructure for example websites and mobile phone applications (apps). "Shubastu" offers a multiplatform system constructed of an online website and mobile phone app to facilitate these employers to acquire their required workforce. For example a garage owner may find the motor mechanic mentioned earlier through the system. Or a family seeking a household worker can find the right person without having to depend on unreliable and unsafe sources. In addition, jobs that actually reach some of the slum dwellers often tend to be less paying and insecure. This problem occurs due to the lack of number of jobs available, which is the result of the absence of a proper platform. This implies if a proper platform was there to facilitate both the employees and the employers in these particular domains, the number of jobs available will increase rapidly. Along with that payment and security will be established as well, as worker will now have more options to choose from. While the employers will also have a reliable and plentiful platform to acquire their workers.

2.1. Registering the tech illiterate skilled workers according to expertise

As the slum dwellers do not possess efficient capability of using technology. "Shubastu" proposes a simple system to do it on behalf of them. We have acknowledged through our research that employees of skilled workers commonly have three major criteria by which they employ their workers. These are, first of all, the workers expertise. Secondly the workers experience. And finally, his/her expected salary. We have also come to know of numerous government and non-government organizations which has various operations among many of the slums in Dhaka. Habitat for Humanity, Zakat foundation of America Bangladesh Office, Action for Social Development, BRAC, Muslim Aid-UK Bangladesh Field Office and Save the Children are some of the many. "Shubastu" proposes to collaborate with these organizations in their work. By doing this we can reach most of the slums and their inhabitants. Along the process, we will communicate with both the authority of the organizations and the slum dwellers to acquire relevant information. This information will not only be used in "Shubastu" but also be useful to the related organization. The data to be gathered is namely, the workers name, address, phone number, expertise, experience

and expected salary. This data will then be updated on the system server. In addition to that, a worker can also upload his data in the system if he has the means accessible to him. This is illustrated in figure 4from the existing android application.

2.2. Making the data available to tech capable employers

"Shubastu" is consisted of multiplatform software applications to provide the workers data to relevant employers. The platform is constructed with an online website and an android application. Both of these are very easily accessible for the tech savvy employers as they have access to either a smartphone or a computer. According to a recent report published by Counterpoint Technology Market Research,the number of Smartphone users in Bangladesh has increased by 3.1 million to 8.2 million in 2015[8].The mobile subscriber base grew strongly by 11% during the 12 months of 2015 to reach 131 million subscribers[9]. The rise in smartphone uses is illustrated in figure 5. These tech capable users will be able to select different categories of expertise and different locations to choose workers from. They will also be able to view a workers experience and expected salary, which will enable them to choose the right person for their requirement. This is illustrated in figure 6 from the existing android application. As there will be a wide range of workers available in the system, an employer will have the benefit to shuffle through and negotiate to avail and employ the proper one. This will eliminate the need of unreliable and unsafe third party affiliation.

2.3. Bridging the slum dwellers with potential employers

The main scope of "Shubastu" is to bridge the skilled workers with their potential employers without the need of any third party. As employers will be able to select workers from desired locations and expertise, this can be achieved through the system offered by "Shubastu". As a particular worker may be contacted by a number of employers, the chances of getting the right job will also increase greatly for the worker. This process will eventually but surely establish a strong and reliable network of employers and employee. Which in turn will create more jobs and facilitate to alleviate poverty.

3. Facilitating numerous non-government and government organizations and businss industries through knowledgesharing by various demographic maps

"Shubastu" is also capable of constructing demographic maps on different characteristics using the data on the server. These maps will be able to facilitate business industries as well as non-government and government aid workers in their various programs. The data will not only guide them to choose favorable locations of action but also will assist them in finding the right procedure and invest the right resources. Research work and similar tools are not present currently in our country‟s system. "Shubastu" presents an opportunity to stimulate research and analysis work in this regard. Moreover, it offers assistance to cultivate new business industries and to guide various non profitable government organizations in the right course.

3.1. Facilitating business industries to grow

"Shubastu" offers a demographic map showing the density of a particular group of workers in different locations of Dhaka. For example the density of garment workers or rickshaw pullers

living in different areas in the city. Such tool can assist various industries including market, housing and other utilities facilities to target their location of projects.This tool can also provide data about the probability of business opportunities around these locations. This data can be of great assistance in measuring the scope and criteria of investments. Figure 3 shows an illustration of a possible demographic map.

3.2. Assisting Non-government and government organizations

In addition these demographic maps can also assist and guide non-government and government aid programs to target their resources around certain locations. They can also have the knowledge of the kind of aid which is most required in these areas. For example a map characterizing age group of the workers will show the density of under aged workers in different areas. These data will certainly assist organization like "Save the Children" to focus their resources in appropriate areas and in the right criteria. It has been stated in their website - "To ensure quality education to all children, Save the Children works with the government and all other communities through introducing unique education delivery system to the working and hard-to-reach children, training teachers, digitalizing education materials etc. In order to protect children from AIDS, Save the Children works for building social awareness, provide necessary health and psychological support to the affected, synthesizing society and communities in Bangladesh"[10].Figure 3 shows an illustration of a possible demographic map.

3.3. Filling in the void in research and data analysis work in this regard

Moreover these assortment of data will fill in the gap of information and absence of proper research work in the above mentioned domain. It will provoke and guide many other research and analysis programs towards successful working stage as well. As implicated evidently on previous two sub-sections, "Shubastu" holds real possibility of becoming a tool of massive usefulness to numerous industries and organizations. However, proper research and data analysis work in this regard is very scarce in our country‟s system. We argue that "Shubastu" is sufficiently capable of giving a jumpstart in research work in this regard and also can provide efficient data support to initiate this much needed research work.

4. Economic sustainability and scope of business model

Similar to any other research work and data service system, the success of "Shubastu" will largely depend on the sustainability of the program.We have explored and demonstrated the necessity and usefulness of "Shubastu" in previous sections. It can be stated that the services offered by the system will create the demand from both the business industries and the various non profitable government and non-government organizations. This will enable "Shubastu" to attain necessary demand forits services to become a sustainable system. That leaves the program to one of the most important requirements, which is monetary resources. In that regard "Shubastu" offers a model to become a self-sufficient and economically sustainable system. The system will require several resources to run its services. Such as manpower, data servers and other software tools. The major domain of the research project is to collect reliable data regarding skilled workers situated in various locations of the city. The next step is to analyze the data and make the result of the

analysis available online through various platform e.g. websites and smartphone applications. We are presenting a system model to acquire these requirements while maintaining self-sufficient economic sustainability.

4.1. Data acquisition through knowledge sharing with various organizations

"Shubastu" will collaborate with various NGOs and other government organizations to collect the necessary data. There are hundreds of such organizations which run different programs in many areas of the city. The system will analyze and process all the data acquired from various organizations to yield the useful results mentioned in section 3 of the paper. This result will be provided to the relative organizations in turn. Therefore both sides of the system will enrich and assist each other in the sequential process. We have already proposed "Zakat Foundation of America –Bangladesh" to collaborate in the data acquisition process and hoping to relate with more and more organizations over time. Similarly government can provide necessary requirements and in return can ask for information services from the system. We argue this process will make the data acquisition a self-sustainable one and also enable the system to enrich smoothly over time.

4.2. Economic independency through social business model

"Shubastu" will also need monetary resources to run its data server system and other technological support systems. We present a social business model which will enable "Shubastu" to run independently and achieve economic sustainability. The system will extend online through websites and smartphone applications. These platforms will provide the opportunity of a business prospect. The system can earn revenue from these platforms through advertisements. This will make the system able to attain economic sustainability. Furthermore, the yielded result from the data analysis can be of great monetary value to related organizations and industries which will also facilitate the systems sustainability.

4.3. Government and Non-Government support and fund

Although "Shubastu" is capable of maintaining and sustaining itself. The project will get sufficient stimulation to reach its fullest potential by the aid of government or non-government funding and support. We argue that this aid will be returned to a magnified proportion to the relative organizations. "Shubastu" inherits a social business model. We believe the system is eligible to receive fund from various government and non-government organizations for the services it offers for the city"s radical improvements.

5. Conclusion

Dhaka is a vibrant city full of life and diversity. This is the country"s economic and business center as well. Millions of people living and working here makes it one of the most diverse and attractive employment destinations in our country. Dhaka is also the largest in the country according to the population. In the year 2016 the population of greater Dhaka area was estimated as an astonishing

18.237 million [11]. Making it one of the most populated cities in the world [12]. The reason behind this enormous population is the unplanned migration from rural areas into the city. Every year around four hundred thousand in number is added to this already overwhelming proportion of the populace [1]**.** These people continue to push into the city‟s massively overcrowded housing system for one purpose only. The purpose is to avail a job in the country‟s most attractive employment sectors offered by the city‟s numerous industries. As a multi mega city Dhaka includes hundreds of industries and business opportunities. These industries and other business sectors requires hundreds of thousands of skilled workers to fuel the city‟s ever thirsty demands. The prosperity and development of the city also depends vastly on these workers. However, to allocate and maintain these huge workforce seems to be almost out of control today. Often the migrants seeking employment opportunities find themselves completely vulnerable and useless in the city‟s employment system. Which occurs for the lack of a proper platform to enlist and allocate these migratory workers in the city‟s job sector. Resultantly these workers despite of having sufficient skills get deflected from their path to a better life. Although the city still has the demand for new workers and also the skilled workers are available, this lack of a proper platform prevents them from engaging with each other towards the betterment of the city‟s living standards. We argue that "Shubastu" has the capability to bridge this gap between the skilled workers and their potential employers. We have demonstrated that the various aspects of the system can facilitate these skilled workers in guiding them to their dream of having a solvent life in the country‟s capital. The paper also implicates the tremendous scope in research and analysis work offered by the proposed model. We strongly believe "Shubastu" holds real possibility to turn the city‟s mess into its most valued treasure.

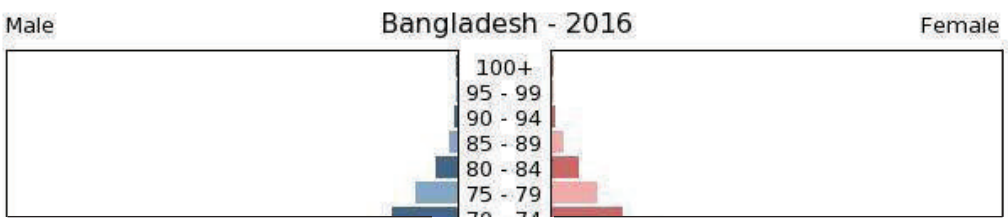


Figure 1: Population pyramid of male and female categorized in age group

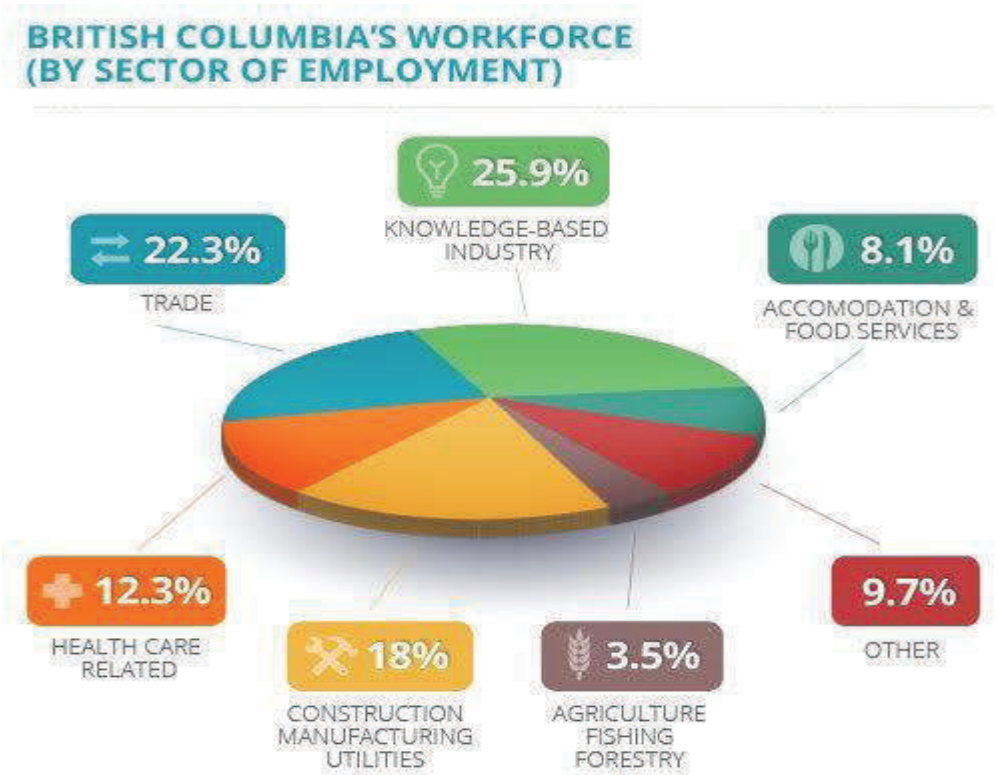


Figure 2: Pie chart of sectors of employment of British Columbia

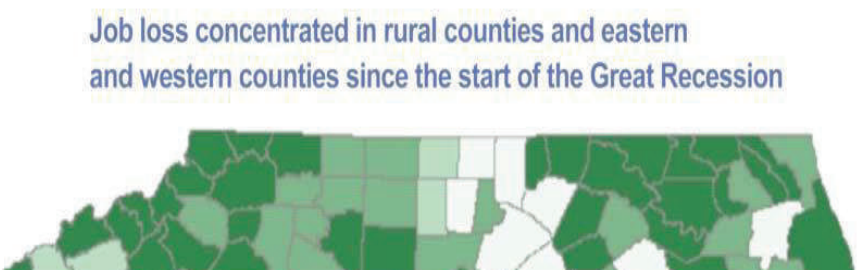


Figure 3: Demographic map illustrating job loss concentration

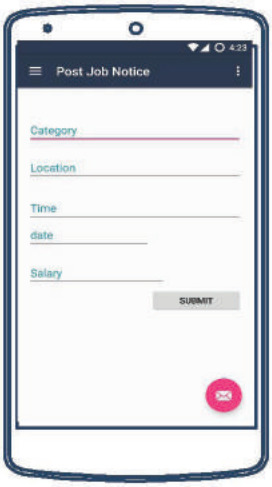


Figure 4: Updating skilled workers information in the android application

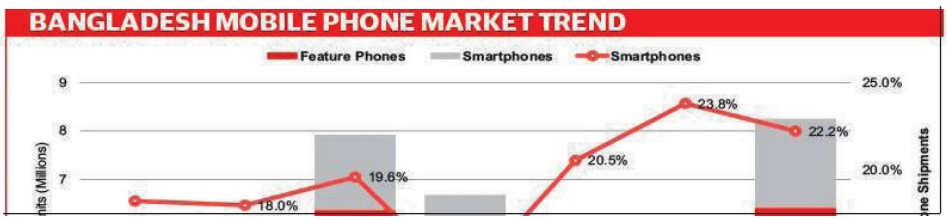


Figure 5: A bar graph illustrating the rise in smartphone use in Bangladesh

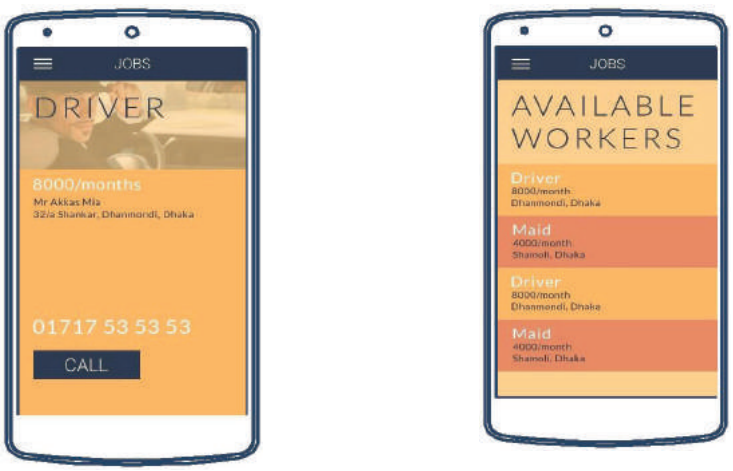


Figure 6: Skilled workers information available on the android application

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Good Governance of Wetland Resources in Bangladesh An Analysis of the Co-Management Model in Tanguar Haor

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Abstract

Bangladesh is a land of fertile soil in alluvial plains, water and wetlands that drain into a vast and complex network of river basins. During the monsoon, almost half of the country turns into wetland consisting of rivers, streams, creeks, floodplains, marshes, *haors, beels* and *baors*. These diverse and highly productive wetland ecosystems support millions of poor people in rural communities of the country.

Over the last two centuries, the management of wetlands has focused principally on revenue earning. Prior to British rule in India, fishermen of Bangladesh enjoyed customary rights to fish in rivers, *haors, baors* and *beels*; the local communities had access to fish, swamp forest, reeds, wildlife, and other aquatic resources to support their livelihood. The post-colonial management regime has been basically structured by top-down and centralized, approaches, which is based only on the economic return of natural resources, and ignores the significance of other dimensions, such as social, ecological and cultural aspects of resource management, and has no or only a limited role for local resource users in resource management. Thus, the purposive exploitation of wetland resources becomes a serious governance issue in the resource management system of Bangladesh, as local communities are being marginalized from access to and control over resources to ensure their well-being. Therefore, sustainable development based on the maintenance of the functional diversity provided by wetland ecosystems requires careful management and evaluation of the different functions in terms of the welfare benefits they provide.

The purpose of my research was to understand how community based management system helps local community establishing their rights over the wetland resources within a participatory institutional structure. With the help of main objective, I explored the efficacy of community organization involved in the sustainability of co-management system introduced by CBSMTH project in Tanguar Haor area.

The research was conducted in Tanguar Haor, which is situated in the district Sunamganj of Bangladesh. The reason behind this selection is that it is the second Ramsar site of Bangladesh and also the only one wetland area where an initiative has been taken under CBSMTH project by the Government of Bangladesh to establish a co-management system for sustainable management of the wetland's resources. A qualitative research approach was followed in this case and the study was supplemented by quantitative data where possible.

The research findings have revealed that establishing a co-management governance system as an institutional structure and process is necessary to sustain community-based organizations' (CBOs) operations in decision-making regarding wetland resource management. The outcomes of examining the participation of local resource users, as an alternative to a centralized, command-

and-control, and hierarchical approach to resource management, have called for a fundamental shift in wetland resource management to facilitate the participation of CBOs in decision-making.

This alternative approach to natural resource management would require appropriate degree of **integration of the "bottom-up" and "top-down" approaches to include all relevant stakeholders in the** decision-making processes at multiple levels of social organizations.

Chapter One

Introduction: Research Problems and Issues

1.1 Introduction

Human well-being depends on the many benefits provided by ecosystems, some of which come from wetlands. The association of man and wetlands is ancient, with the first signs of civilization originating in wetland habitats such as the flood plains of the Indus, the Nile Delta and the Fertile Crescent of the Tigris and Euphrates rivers.

Wetlands cover about 6% of the earth's land surface. They are home to some of the

richest, most diverse and fragile of natural resources. As they support a variety of plant and animal life, biologically they are one of the most productive ecosystems.

Wetlands are unique features in the environment that play an essential role in the stability and biodiversity of ecosystems as well as the functioning of the hydrological cycle. These natural ecosystems are therefore of national importance due to the varied functions they perform. Many rural communities depend on the wetland resources for their daily livelihood. The potential of wetlands to contribute to livelihoods is closely related to their ability to maintain ecosystem functions. This underscores the need to strike a balance between conservation and productive use of wetlands (Edward 2008).

Unfortunately, people have long been unknown of the importance of wetlands, and as a result, wetlands become prime examples of ecosystems that, despite their provision of beneficial services, functions and products, have not escaped the impacts of human activities. The increasing growth of population coupled with the advancement of modern technology has necessitated human intervention on these natural ecosystems, and thus, has resulted into the gradual loss of wetland resources. Such damage can specifically be attributed to some uncontrolled developments including extensive drainage and conversion of wetlands for agriculture, dams, mining, infrastructure and urban development. Poor management of resources has also caused infestation with alien plants and the occurrence of erosion. Therefore, environmental and social scientists have attuned to caution that the rapid loss of wetlands may lead to environmental and ecological problems with a direct impact on the socio-economic benefits of the associated populace. Consequently, a clear challenge has emerged with respect to the link between sustainable development and wetland protection.

1.2 Purpose and objectives of the research

The purpose of my research was to understand how community based management system helps local community establishing their rights over the wetland (*haor*) resources within a participatory institutional structure. With the help of main objective, I explored the efficacy of community organization involved in the sustainability of co-management system introduced by CBSMTH project in Tanguar Haor area. In assessing the roles of different co-management committees under the community organization in Tanguar Haor, I examined the evidence of benefits incurred upon the *haor* people (mainly poor fishers) in the event of their participation in sustainableharvesting during CBSMTH project intervention in the study area.

The specific objectives of this research were to:

- Examine the relationship between different co-management committees (at different tiers) concerned with access and control over Tanguar Haor resources such as, wildlife, fisheries, reeds, swamp forests, etc.

- **Analyze the processes and structures of stakeholders' participation and** deliberations in sustainable harvesting of resources.

- Examine the potential for multi-stakeholder governance in establishing *haor* inhabitants' (mainly poor fishers) rights on Tanguar Haor resources.

Considering the purpose and objectives of the study, the following major questions were addressed in this research:

Institutional arrangement in wetland resource management

1. *What are the local and national institutional arrangements that govern the access, use and control over wetland resources?*

2. *How are the issues of equity and distribution addressed by formal and informal institutions?*

3. *What are the historical changes in resource access of local resource users?*

4. *What are the changes in livelihood options of local resource users?*

5. *How do wetland policies facilitate marginalization of local resource users from their traditional usufruct rights to resources?*

6. *Do you think any local institution (community organization) is capable of taking responsibility of Tanguar Haor management/ If yes/no, why?*

Stakeholders in wetland resource management

1. *Who are the major stakeholders involved in resource use and management?*

2. *What are key factors that organize stakeholders to participate in the decision-making in wetland resource management?*

3. *Who possesses the maximum power in the decision-making process?*

4. *What is the nature of conflicts among stakeholders?*

5. *What are the conflict resolution mechanisms practiced by the community?*

6. *What is perception of the local community regarding projects/initiatives for conservation and sustainable development in Tanguar Haor?*

Deliberations and Participation

1. *What are the processes and structures of deliberations in decision-making?*

2. *Who are the participants in decision-making processes? And what is the level of participation at multiple scales?*

3. *What are the factors facilitating or hindering participation of local communities in decision-making?*

4. *How are the local communities supporting community-based natural resource management initiatives?*

5. *Has there been any major transfer of power and authority to the local institution?*

6. *Are there any effects of community-based natural resource management on access to resources by the local communities?*

7. *What are the effective ways to include local voices in decision-making?*

8. *What are the ways in which stakeholders' knowledge can contribute to policy making?*

Governance in wetland resource management

1. *How do resource users perceive their entitlements and the impact of institutions on their entitlements?*

2. *How are the different institutions making decisions on resource improvement, development initiatives, resource allocation and management?*

3. *What are the mechanisms that exist in informal and formal institutions to maintain wetland resource governance (accountability, transparency, participation, equity and fairness, and networking)?*

4. *How do various government institutions share power, responsibility and authority with relevant stakeholders?*

5. *How can the capacity of local community be enhanced for participatory governance in wetland resource management?*

1.3 Research Methods

The research was conducted in Tanguar Haor, which is situated in the district Sunamganj of Bangladesh. The reason behind this selection is that it is the second Ramsar site of Bangladesh and also the only one wetland area where an initiative has been taken under CBSMTH project by the Government of Bangladesh to establish a co-management system for sustainable management of the wetland's resources. Aqualitative research approach was followed in this case and the study was supplemented by quantitative data where possible. Keeping the overall objectives as well as research question of the study in mind, primary data both qualitative and quantitative was collected to lead the research in the right direction. Several Participatory Rural Appraisal (PRA) tools, such as interviews by administering semi-structured questionnaires, key informant interviews, focus group discussions and in-depth case studies were used. The study also reviewed all available secondary reports/documents regarding the CBSMTH project produced since its inception to get a better understanding about the project intervention. Support and assistance was obtained from local community, government and non-government organizations including MoEF, IUCN, CNRS and ERA. MoEF is the implementing agency of CBSMTH project whereas IUCN is the technical partner. .

1.4 Research Significance

Wetland ecosystems are of great importance to Bangladesh due to their extent and of the critical economic and ecological role that they play in sustaining life and livelihoods in the country. The Northeast region of Bangladesh is known as the Haor Basin (HB) which is considered as a unique ecosystem of national and international importance. Each of the HB wetlands is a key element of a complex hydrological, biological and ecological system, supporting a significant assemblage of rare and vulnerable species of plants and animals, including endemic species. But the purposive exploitation of wetland resources becomes a serious governance issue in the resource management system of Bangladesh, as local communities are being marginalized from access to and control over resources to ensure their well-being.

Therefore, sustainable development based on the maintenance of the functional diversity provided by wetland ecosystems requires careful management and evaluation of the different functions in terms of the welfare benefits they provide. In view of their complex, dynamic and co-evolving multifunctionality, a management approach is needed that addresses the pressures exerted on wetland ecosystems in Bangladesh. Establishing a co-management governance system as an

institutional structure and process is thus, necessary to sustain wetland resources. Tanguar Haor is such a wetland which holds a unique example of learning co-management governance in Bangladesh. It is also important to document the lessons learned from this co-management system of Tanguar Haor in order to conserve the natural resources in the northern part of Bangladesh. This in turn would help to identify strengths, weaknesses, opportunities and threats of the establishing co-management structure in Tanguar haor, and consequently, will also contribute to replicate the co-management governance model in other wetlands of Bangladesh.

Chapter Two: Literature Review

2.1 Wetland and Natural Resource Management

The concept of governance has evolved to dominate the discourse on wetland management while considering the need to balance sustainable resources use with livelihood needs of people using the wetlands. The traditional hierarchical mode of governance has, in many locations, been replaced by other modes of governance in which the market, network, or community are dominant (without substituting the role of the state). However, it is critical to understand what type of institutional framework would be required to establish wetland resource governance which aims at sharing power between the state and stakeholders for long term sustainability in resource management.

Wetlands governance is therefore essentially about

• **Who has the power to make decisions that affect wetlands and wetland users and how** those decisions are made.

• **Who has the power and responsibility to implement those decisions, and how those** decisions are implemented.

• **Who is held accountable, and how, for implementation.**

Policy-making, planning, decision-making, and management actions by a wide range of sectors at all levels - from international to the local - contribute to effective wetland governance. Recognizing the key role of wetlands in supporting human populations and biodiversity as well as the need to maintain resilience and productivity of wetlands through wetland conservation has received increasingly greater attention over the last two decades. Efforts at global, national and local levels have included activities ranging from awareness-raising, developing guidelines, policy and legislation, co-management and governance arrangements. Learning from these experiences across regions is important, and will help sustain such efforts.

Wetlands, as a distinct and identifiable form of water body, have been incorporated into the legal structures underpinning its resources management. The international arrangements that have impact on wetlands reflect the broad principles indicating how nature should be conserved, informing potentially enforceable legal arrangements. The multilateral international agreements have somewhat focused on one or more of the relevant and interdependent values of wetlands. However, the Ramsar Convention 1971 appears to be the only international agreement which focuses directly upon

wetlands. Actually, the Convention is the first of the modern global nature conservationeffort with the mission that **"the conservation and wise use of all wetlands through local**

and national actions and international cooperation, as a contribution towards achieving **sustainable development throughout the world".**

The evolution of later international arrangements under this convention has eventually helped to address several issues by incorporating an ecosystem approach and an integrated approach to the management of wetlands more generally. The Convention on Biological Diversity of 1992 is a more recent and vitally important instrument that in particular, significantly extends what was included in the Ramsar Convention, and strengthens international legislation relating to wetland protection. In addition to the direct mechanism of wetlands management provided by the Conventions already mentioned, other legal instruments at national, regional and international levels, such as 'World Cultural and Natural Heritage 1972', 'ASEAN Agreement on the Conservation of Nature and Natural Resources 1985' have also continued to govern the management of wetlands (Sullivan and Fisher 2011). More importantly, wetlands governance allying the theme of 'Sustainable Development' in recent years has found practical expression inthe form of Millenium Development Goals (MDGs).

2.2 Community-Based Resource Management

Natural resource management, in general, and fisheries resources management in particular, are currently undergoing a major paradigm shift. In recent years, the notion of government as the only decision-making authority has been replaced by multi-scale, polycentric governance, which recognizes that a large number of stakeholders in different institutional settings contribute to overall management of resources. Improving the management of natural or common pool resources and empowering local communities, community-based management has become a common strategy in the last two decades. Local knowledge, local institutions, and common property regimes are taken into consideration in this co-management approach (Khan 2011). The multi-faceted nature of socio natural systems has drawn attention for wider use of experiential learning to address the complexity of sustainable natural resource management and to promote desirable behavioral change (Muro and Jeffrey 2008). Although the design principles for community management institutions (Ostrom 1994) and factors linked with sustainable common property regimes, and institutions (Agrawal 2001) have been studied questions arise on how to best initiate such regimes, what the role of participatory planning methods should be (Sultana and Thompson 2004), and also, how to keep the CBOs functional on a long-term basis, thereby reducing the problems related with resource management and its sustainability

2.3 Governance in Community-Based Management Approach

The sharing of power and management responsibility with local communities for wetland resource management was promoted for many practical reasons. These include: i) formal institutions in many ways were ineffective in managing natural resources at the local level, ii) local level institutions are capable of framing bylaws to manage natural resources effectively, iii) sharing of management responsibility greatly decreases the transaction costs of the management, iv)

local knowledge that is specific to local resources is easily available and time-tested, v) it is very effective to resolve conflicts through meditation, and vi) recognition of multiple social actors and diverse interests in the decision making process.

As a recapitulate from the previous chapters, the EEF wetland management approach generated mistrust, chaos, conflicts, and injustice among the local level resource users. The leasing system of *jalmohals* was favouring non-fishers, politically and financially powerful groups or individuals. Such a highest bidding leasing system excluded genuine fishers from their traditional user rights to resources and created scope for outsider investors to capture *jalmohals.* However, the higher lease fee means excessive exploitation of resources because the investors tend not only to procure the paid lease-fee but also make a substantial amount of profit. This also, in turn, implies more restrictions on the access to resources by the local communities. Inherent in this spiritual belief of the local communities is a strong message of sustainability and a conservation philosophy that should be recognized in the natural resource management approach. However, generally, local beliefs remain neglected in the expert-driven, technology-based natural resource management approach. The community-based management approach, in contrast, promotes the incorporation of spiritual aspects of resource management to strengthen the sustainability context (Khan 2011).

2.4 Co-management and Wetland Resource Governance in Bangladesh

Rural poor communities, particularly in the developing world, gain their livelihoods from wetland and floodplain resources such as fish, swamp forest, reeds, aquatic fruits and wildlife. Both wetland and floodplain thus play a vital role in the lives of millions of poor people worldwide by providing subsistence livelihoods. Local communities in tropical Asia, have a long tradition of managing wetlands. They have been managing wetland resources for centuries to secure their livelihoods, with local institutions playing a central role in resource management practices (Walker *et al.* 2002).

Bangladesh is a land of fertile soil in alluvial plains, water and wetlands that drain into a vast and complex network of river basins (Nishat *et al.* 1993). During the monsoon, almost half of the country turns into wetland consisting of rivers, streams, creeks, floodplains, marshes, *haors, beels s* and *baors*. These diverse and highly productive wetland ecosystems support millions of poor people in rural communities of the country (Khan 2011).

Over the last two centuries, the management of wetlands has focused principally on revenue earning. Prior to British rule in India, fishermen of Bangladesh enjoyed customary rights to fish in rivers, *haors, baors* and *beels s*; the local communities had access to fish, swamp forest, reeds, wildlife, and other aquatic resources to support their livelihood. The post-colonial management regime has been basically structured by scientific and technology-based, top-down, centralized, production and efficiency-oriented approaches. In the formal management system, the poor local communities have been regarded as a threat to natural resources and accused of being polluters and/or degraders of commons. Access to resources and the customary rights of the resource users have thus been gradually eroded by the policy changes. The top-down, command-and-control, and centralized management system, which is based only on the economic return of natural resources, ignores the significance of other dimensions, such as social, ecological and cultural aspects of resource management, and has no or only a limited role for local resource users in resource management.

Bearing the legacy of British colonial period, the formal management system of natural resources in Bangladesh is based on the Economic Efficiency Focused (EEF) approaches for the immediate exploitation of resources for economic purpose. Though this EEF approach is ideally based on the objective of providing wellbeing (such as, education, health, security, etc.) to the society, the intensity for maximization of revenue collection from the natural resources enhances the rate of exploitation while also deviating the well-being of society. However, from the British period up till now, there has been very limited indication of improved well-being of the population in the *haor* areas of the country, though the underlying intention of the EEF approach was to do so (Hardin 1968). Rather in practice, the science and technology-based, EEF policy regime has created conditions that facilitate exploitation, conflicts and chaos in the wetlands resource management (Toufique 1998).

Table 1.1: Laws, policies and legislation on sustainable haor resource management in Bangladesh

Year	Sectoral Laws, Policies and Legislations	Specification of the Laws
1977	The Haor Development Board Ordinance	It requires the Board to prepare projects and schemes to develop the haors and other depressed low lying areas.
1982	Protection and Conservation of Fish (Amendment) Ordinance	Prohibits unsustainable fishing techniques, and calls for conservation of fish resources.
1985	Land Management Manual	Guidelines for leaseholders, for sustainable exploitation of fisheries resources.
1992	National Conservation Strategy	Recommendations for achieving sustainable development in all sectors. NCSIP -1 is implementation mechanism.
1995	National Environmental Management Action Plan	Halt degradation: promote sustainable use, conservation of biodiversity.
1997	TanguarHaor Management Plan	Sustainable Management (wise use) of the haor dealing with community based haor management.
1999	Notification of Ecologically Critical Areas	Enactment of the ECA clause in the Environmental Conservation Act (1995) and Rules (1997)
2000	TanguarHaor Management Plan (revised)	Emphasis on implementation of wise use principle prescribed in Ramsar guidelines and community based haor management.
2015	TanguarHaor Management Plan Framework and Guidelines	Provides a broad-based overview of the resource management and planning context of TanguarHaor and also serves as a guiding point of reference for further context-specific, locally grounded planning

Source: Huq (1993); Giesen and Rashid (1997); Kabir and Amin (2007); IUCN Bangladesh (2015)

Co-management issues in Bangladesh have emerged in development sector in the Eighties. However co-management in wetlands started from the mid Nineties. It has evolved mainly from the experience of fisheries management in common property resources through different programs and projects initiated by the government, NGOs and community. Some of the significant projects are Forth Fisheries (from 2000 to 2006), Community Based Fisheries Management (CBFM-1) from 1994-1999 and CBFM-2 from 2001 to 2007, Management of Aquatic Resources through Community Husbandry (MACH) from 1998 to 2007 etc. In all cases, NGOs, communities and the Government of Bangladesh (GoB) attempted to try out different mechanisms to develop co-management to utilise government properties for example, natural resources through introducing some rules, regulations and norms. These projects got immense popularity that encouraged community people to integrate also private flood plains into the project area. The department of fisheries has played a key role on behalf of the GoB in these projects. Nature conservation, bio-diversity and sustainability of nature though considered as major focuses, but establishing access rights of the fishers and poor has also been prioritised in these projects (Karim 2007).

Table 1.2: Significant projects on sustainable wetland management in Bangladesh

Project Name	**Duration**	**Responsible Agency**	**Implementation Area**
Management of Aquatic Resources through Community Husbandry (MACH)	1998-2007	DoF-USAID	Hail Haor, Turag-Bangshi floodplain, Kangsha-Malijhee basin,
Community Based Haor and Floodplain Resource Management (SEMP Programme)	1998-2005	MoEF-IUCN-UNDP	Pagnar and 'Sanuar-Dakuar' haors, Hakalukihaor, The Jamuna-Padma floodplain, The Madhumati floodplain, Brahmaputra floodplain
Community Based Fisheries Management (CBFM-1 & II)	1994-1999 2001-2007	DOF-Ford Foundation DOF-DFID-World Fish Center	116 water bodies including HakalukiHaor in 22 districts
Coastal and Wetland Biodiversity Management Project (CWBMP)	2011-2013	DoE	**Cox's Bazar, HakalukiHaor,** Sonadia Island and St. **Martin's Island**
Wetland Biodiversity Rehabilitation	2009-2015	BWDB/GIZ	3 districts (Pabna, Nator,Sirajganj)
Community-Based Adaptation in the	2011-2015	DoE-UNDP-EKN-IUCN	**HakalukiHaor, Cox's** Bazaar-Teknaf Peninsula,

Ecologically Critical Areas through Biodiversity Conservation and Social Protection (CBA-ECA)			and Sonadia Island
Community Based Sustainbale Management of TanguarHaor	2009-	MoEF-IUCN-SDC	Tanguar Haor

Source: IUCN, 2016

2.5 Evolution of Community Based Wetland Management in Tanguar Hoar

Tanguar Haor is a unique wetland eco-system covering 9,727 hectares of area located at the north-eastern district of Sunamganj close to the Indian border in Meghalaya hill region. This complex ecosystem, known for its many species of fish and as a staging area for at least half a million of migratory birds, supports lives of about 60,000 inhabitants in 88 villages around its periphery.

The environmental importance of TanguarHaor was first promoted by International Union for Conservation of Nature (IUCN), Bangladesh Country office in the 1990s. The Government took keen interest in taking initiative for protecting Tangaur Haor. The first ever conservation project undertaken by Government in Tangaur Haor was National Conservation Strategy Implementation Project (NCSIP) in the early 90s where IUCNB worked as the technical partner. Later on IUCNB kept on policy advocacy for

conservation of Tangaur Haor. Considering the national significance of Tanguar Haor **and threats of depletion of its' natural resources, it ha**s been declared as one of the

Ecologically Critical Areas (ECA) of Bangladesh in 1999. Subsequently; on July 10, 2000 it became the second RAMSAR site of Bangladesh highlighting its global importance, especially for migratory birds.

A historic milestone has been achieved in the management and conservation of Tanguar Haor and its' rich biodiversity after the traditional leasing of TanguarHaor had been stopped and its' management was transferred to the Ministry of Environment and Forest from the Ministry of Land in the year 2001. Under the National Conservation Strategy Implementation Project -1 (NCSIP-1), MoEF initiated a pilot project in Tanguar Haor. And a management plan was developed with technical assistance from IUCN Bangladesh in 2000, introducing the **concept of "wise-use" of wetland resources based** on the wise-use principles of the RAMSAR convention. On this backdrop, a project titled **'Community Based Sustainable Management of Tanguar Hoar' (CBSMTH) was** formulated, and it is being implemented by IUCN-Bangladesh on behalf of the Ministry of Environment and Forests (MoEF) with the financial assistance of Swiss Agency for Development and Cooperation (SDC). The Project has already gone through a preparatory phase (2007-2009), a development phase (2009-2012) and a consolidation phase (2012-2016).

The preparatory phase (December 2006 to April 2009) was geared towards confirming the interest of government and communities to collaborate in managing the biodiversity of Tanguar Haor, while ensuring well-being of communities. During this phase, a co-management system was developed in order to fetch benefits for the poor.

Based on the experiences of the preparatory phase, the development phase (May 2009 to June 2012) includes 88 villages within a single management unit. This phase focuses capacity building for promoting alternative livelihoods amongst the extreme/ultra poor, especially women. After successfully implementing the development phase; the consolidated phase of the project has been instigated in July 2012 to June 2015 for next three years considering the concluded findings of the independent reviewer in June 2011. With 1-year extension of the consolidation phase following two months (July-August) no-cost extension, the current phase of CBSMTH project is scheduled to end on August 2016.

The SDC-funded CBSMTH project is the first ever intervention of the Government of Bangladesh towards wetland management through establishing a co-management model that allows the sustainable use of natural resources. A paradigm shift in collaborative management with community leadership is being strengthened in Tanguar Haor through this flagship project of IUCN Bangladesh.

During the project period, the three-phase cycle has had a significant role in setting a co-management governance arrangement in Tanguar Haor. A three-tire co-management organization has already been established covering 76 (out of 88) villages and 7,089 members (28% women headed HH) in the project area. The co-management system is in practice now and also has been conceptualized by the key actors particularly, the Government of Bangladesh and the community people of Tanguar Haor.

One of the notable progresses under the CBSMTH project has been made in the event of ensuring right of poor fishers' fishing access (sustainably) in Tanguar Haor. Most importantly, the introduction of fishing modality (permit-based) has successfully alternated the tendering process which previously benefited the influential groups at large.

During the project intervention, ecological protection and habitat restoration process of Tanguar Haor also gained a serious momentum. The ecosystem of TanguarHaor has been restored and biodiversity has been improved through community participation in the resources management and protection. The improvement of bio-physical conditions has been mainly caused by a number of project interventions, i.e. afforestation, homestead seedlings/spalings distribution, habitat restoration, sanctuary establishment, fingerlings releasing, regular joint patrolling of law enforcing agencies and community guards, awareness meeting on nature conservation, etc.

Besides, initiative for alternative livelihoods under the CBSMTH project has greatly helped to enhance income of TanguarHaor people as well as encouraged them to involve in sustainable natural resource management. By dint of Social Capital Management, the poor community of TanguarHaor now have own savings, get access to financial support from their accumulated fund and also enjoy benefit as accrued from fish harvesting programmes.

Chapter Three: Research Area And Environmental Setting

3.1 Natural Resource Settings of Tanguar Haor

TH is one of the largest wetland systems in the north-east region with relative natural resources. Approximately one-thirds lies in the Tahirpur Upazila and two-thirds lies in the Dharmapasha Upazila, both of which are located in Sunamgonj District of Sylhet Division. The *haor* consists of 46-50 *beels* of various sizes (Akondo, 1989; BFD, 2012). The area of TH including 88 villages within the *haor* is about 100 square kilometers, of which 2802.36 ha is wetland (Banglapedia, 2006).The *haor* is located at an altitude of only 2.5-5.5 meters above mean sea level.

3.1.1 Geographical Location

TH is located in the northeastern part of Bangladesh, between 25°12'10.572" and 25°5'47.989" North Latitude and 90°58'49.426" and 91° 10' 0.018" East Longitude. The total area of TH is approximately 160 square kilometers including all Geographic features and Landuse [Please confirm terminology].

TH is located in North-western part of Sunamganj district of Sylhet division. It shares a border of approximately 17 kilometers with Nongstoin, India in its North. The *Haor* is almost 2.5 kilometers away from Neighboring Netrokona district in the West.

Within the total area of TH there are two Thanas of the Sunamganj district e.g. Tahirpur and Dharmapasha and four unions e.g. Uttar Bangshikunda, Dakshin Bangshikunada, Uttar Sreepur, Dakshin Sreepur.

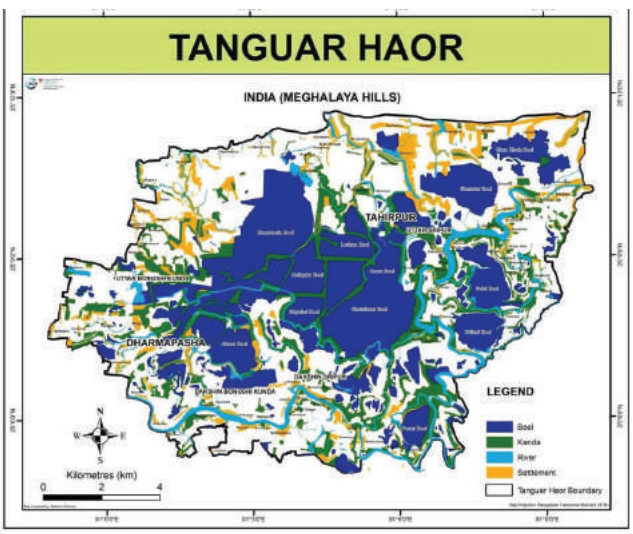


Figure 3.1: Map of Tanguar Haor

3.1.2 Habitation

TH is a unique habitat for wetland plants, freshwater fish and wetland associated wildlife. It is made up of about 50 small, medium and large interconnecting *beels* s, some of which are perennial and others seasonal. The higher grounds located in between *beels* s are locally known as *Kanda.* In the rainy season, all the *beels* s are united as one large lake or *haor*, making TH the larger freshwater wetland in Bangladesh. Deeper *beels* s are connected with rivers in some places but these *beels* s are also interlinked with each other which makes it a unique character of these *beels* than elsewhere in the country.

3.1.3 Climatic Features

The climatic condition of TH is sub tropical-monsoon with three dominating seasons, summer, monsoon and winter. Average annual rainfall is about 8000 mm in the northern part of Sunamganj with 65-69 % of the total rainfall occurring in the summer. Evaporation enhances rainfall during the spring causing flash floods in TH. Summer starts from the month of April to June with temperatures ranging from 30.9 ~ 33.4^{o}C, while monsoon from May to September and winter from October to February where the temperature ranges from 8.5 ~ 16.6^{o}C. Humidity is about 83% in the wet season and 64% in the dry season.

3.1.4 Diversity of Flora

Principal wetland habitats of TH include open water (with submerged and floating aquatic vegetation), seasonally inundated, mixed herbaceous vegetation, reed beds and rice fields. Formerly *Pongamia,* Hijol *Barringtonia racemosa*/ and Koroch *Milletia pinnata* (old name *Pongamia pinnata)* were dominant species in swamp forests, but these have now disappeared except for an occasional isolated tree and a pure formation in **the Rongchi 'forest', which is an 8**-hectare stand of 800^{+}severely-lopped and old trees (Giesen and Rashid, 1997). During the last couple of years, *Barringtonia racemosa* species were replanted on different *Kandas*. Different types of habitat and vegetationfound in Tanguar Haor which mainly include submerged vegetation, free floatingvegetation, rooted floating vegetations, sedges and meadows vegetations, reedvegetations, fresh water swamp forest vegetations, crop field vegetations and homestead vegetations.

Fresh water swamp forest

Fresh water swamp forests cover significant portions of lowland in Bangladesh and have suffered significant depletion through logging, sand mining and reclamation for other commercial uses. In Tanguar Haor this type of vegetation can be seen in the Chattania khal *beels* , Rupaboi *beels* and Tenkunna *beels* in the Tangaor *Haor* area. Some birds and mammals use this forest type as a resting and nesting place. However, there is a great concern for this swamp forest habitat due to over logging and suspected seepage from upstream reservoirs resulting in significantly changed circumstances for many swamp forest species. This swamp forest is all that remains of this habitat reside conservation, status of which is vulnerable even though some may be considered common within the swamp forest habitat

3.1.5 Diversity of Phytoplankton

In any aquatic ecosystem the phytoplankton works as the backbone of all zoo planktons that in turn keep the predatory animals alive in wetlands and other aquatic environments. The phytoplankton communities of the TH wetlands are very much linked with zooplankton and fish productivity. Several studies have highlighted these issues. One among these, Muzaffar and Ahmed (2006) so far found 107 genera of phytoplankton representing five classes.

3.1.6 Diversity of Fauna

Based on Nishat (1993), Karim (1993), NERP (1993a) and BNH (1997), it is estimated that a total of 200 wetland plant species, 141 fish species, 11 amphibians, 34 reptiles (6 turtles, 7 lizards and 21 snakes), 206 birds and 31 mammals occur in this *haor* (Gieson and Rashid, 1997).

Wetland International (WI) conducts waterfowl census every year in different wetlands in Bangladesh with the help of Bangladesh Bird Club (Bbc). On an average, fifty thousand individuals of around 70-80 species are found every year from the TH. Every winter about 60 species of migratory birds come to this TH as this *haor* is an ideal place for their food and habitat.

Fisheries Resources

Tanguar Haor is considered one of the important wetlands for its rich fish resources along with diversified flora and fauna. **. It is one of the 'Mother Fisheries' of a total of six** of the country. According to NCS Fisheries Report (2001), Tanguar Haor supports nearly 141 fish species which represent more than half (out of total 260 freshwater fish species available) of freshwater fish species in Bangladesh. Most importantly, a large number of nationally declared threatened species is interestingly available here. Out of 55 threatened fish taxa, 23 are found endangered in Tanguar Haor. Of these 23 endangered fish species, 17 are found only in Tanguar Haor. . In the 1999-2000 fiscal year, the government earned Tk 70,73,184 as revenue just from fisheries of the *haor* (Talukder, 2006). It gives this region a different dimension to think about the conservation strategy and develop action plan in local and global contexts. Moreover, this unique feature, accommodating many Red Listed species, indicates the importance of this *haor* for protecting its fish biodiversity and ecosystem.

Wildlife

Tanguar Haor resources especially reeds and swamps support birds and wildlife. Based on Nishat (1993), Karim (1993), and NERP (1993a), it is estimated that a total of 141 fish species, 11 amphibians, 34 reptiles (6 turtles, 7 lizards and 21 snakes), 206 birds and 31 mammals occur in Tanguar Haor (Gieson and Rashid, 1997). A total of 12 butterfly species have also been identified (DoZ, 1997) from Tanguar Haor. However, the most recent survey (2011) of IUCN has recorded 19 species of mammals, 24 species of reptiles and 8 species of amphibians in this wetland (Alam *et al.*, 2012). Birds of the TH are harmoniously linked and adapted with the seasonal hydrological cycle. These linkages and adaptations are closely interlinked with the birds feeding, breeding and migratory behaviours. According to a survey conducted by IUCN in 2011, there were 167 bird

species (total individuals-65,010) in Tanguar Haor. Among them 50.08% are aquatic and 49.10% are terrestrial. The survey team found 50.29% migratory and 49.70% resident birds. Of all the birds 12.57% were ducks, 6.58% were raptorial and 18.56% were waders.

3.2 Community Development Settings of Tanguar Haor

With an estimated area of 10000 ha, the TH has been classified as a wetland of international importance under the Ramsar Convention since 2000. About 50% of the area (5,682 ha) of TH is water bodies, followed by 31% crop land (Phase I Completion Report, IUCN 2010). Being located in the north-eastern district of Sunamgonj and at the foothill of the Khasi hills, the complex ecological system of the TH provides livelihood to some 77,000 population living in 88 island-like villages with as low as 5 households in a village to as big as 571 households (Census Data, TH, 2007) which administratively falls under two Thana (police station) and 4 unions. Recent estimate (BBS, 2011) shows that about 350,000 people live in these four unions. Having dominance by Benglai people, a small quantity of 10% belongs to the Garo and Hajong ethnic minority groups and live in 11 villages on the northern side of the *haor*. Depending on religion, majority of the population is Muslim (about 78%) and rest others are Hindu (BCAS, 1997). These peoples are totally dependent on the *haor* for their income, employment and livelihood. Paddy cultivation and fishing are the two major income source with many other minor sources such as duck rearing and cattle/buffalo fattening. The socio-economic structure of the *haor* villages is influenced by its length, breadth, remoteness and low level of education. Having an average household size of nearly 6, annual average income is about BDT 7306 per month (IUCN, 2012). Compared to national average income condition, the statistics show a good position but Haque and Kazal (2008) argued that the income distribution is highly unequal and followed a skewness, with few large farmers and a majority of rather small farmers.

3.2.1 Human Habitation and Settlement

The known history of human habitation in TH is of recent time. During the period 1780-1900 there was a considerable outward migration from the *haor* due to successive natural calamities that result in decreased population number (Nishat, 1993). But the situation started changing by the second half of the 19th century, the *haor* basin ecosystem recovered from this environmental stress regained its productivity. From the first quarter of the 20th century, the area began to attract settlers again from surrounding densely populated regions (Nishat, 1993), which is still ongoing (Talukdar, 1993). However, outward seasonal migration is still rampant in the area, particularly in the dry season. BCAS (1997) found that 17.8 % of adult males and 5.2 % of adult females had engaged in such seasonal migration. In addition, a large number of fisherfolk (1200-2000) and their families annually established temporary fishing camps at TH in the fishing season (4-5 months), who afterwards returned to their home.

3.2.2 Land Tenure

The land tenure system of TH is complex and often found in competing claims between public and private entities. Historical chronology is important to understand and tenure the system in TH. So far known, the area was under the control of the Zamindars of Bangshikunda until 1920 and later

on, it was transferred to the Zamindars of Gouripur. With the abolition of the Zamindar system (State Acquisition & Tenancy Act 1950), the area came under the control of the government as *khas* (= government) land. However, land administration was mostly informal until 1960.

In independent Bangladesh (after 1971), the status of TH continues as *khas land* and is controlled by two local government agencies, the Department of Land Revenue

(Ministry of Land) and the District Commissioner's Office (Ministry of Establishment). A

major shift in control over TH has been observed in the year 2000 when the Ministry of Environment and Forest (MoEF) took management charge of it as part of the enactment of the Environmental Conservation Act (1995) and Rules (1997) concerning Ecologically Critical Areas. The MoEF exercises its responsibilities through the District Administration in Sunamganj, under the direction of the Deputy Commissioner, Sunamganj.

Under the auspices of Sunamgonj district administration, two-third (about 7500 hectares) of TH is leased out as a commercial fishery (*jalmahal*), although accurate figures are lacking. Before MoEF intervention in 2000, the leaseholders controlled the area through buying concession from government. Interestingly, the leasehold area would vary according to the season. Even though in the dry season the leasehold was confined to the concerned *beels* s, while in the wet season this jurisdiction extended to the entire water body. To impose their control over all the resources throughout the year, the leaseholders maintain their surveillance team who are often found in violent situations with other competing groups and villagers.

Since the TH is a government land, the local community at TH generally does not possess legal documentation, proving ownership of land such as land rights or deeds. Rather, they practice ancestral or historic rights to land in and around the village, usually based on the traditional *likhon* system. Ownership of certain resources is sometimes unclear. In addition to managing the TH, the Forestry Department leases a small area (23 ha) of *chonmahal (*grassland) and reed land.

Surrounding land areas of TH are mostly privately owned. These holdings are generally small. BCAS (1997) has found that 45 % land holdings were smaller than 0.5 acres, 25.9 % in the range of 0.5-2.0 acres, 20.0 % in the range 2.01-5.0 acres and 8.9 % larger than 5.0 acres.

3.2.3 Land Use

Land (and water bodies) use in TH is diverse and it changes with the seasons. Even though agriculture and fishing are the dominant land use for this region, other practices such as forests and pastures and reed-beds are also common and provide a considerable amount of livelihood depending on season. A combination of topography and the annual cycle of flooding and receding of waters dictate the land use patterns. Generally, elevated ground (*Kandas)* is cultivated with a variety of *rabi*(winter) crops, trees (e.g. fruit trees) and is used for habitation. In the north of TH, near the border to India, wheat is extensively cultivated in the winter months. Low-lying areas are generally used for rice cropping, and deeply flooded areas (*beels* s) are used for fishing activities.

Even though some areas have been designated as 'forestry land', they consist of reed

land and grassland and the only remaining forest area is a small patch of 8 ha near Rangchi, which is not managed by the Forestry Department. BCAS (1997) carried a survey and found that in between 1947 and 1996 the forest area has decreased from 18% to 5 %, while agricultural land has increased from 58 % to 67 %. During the period, settlement area doubled in TH.

Chapter Four: Assesing Community-Based Resource Management in Tanguar Haor: The Impact of Cbsmthp Intervention

4.1 State of Co-Management System in Tanguar Haor

4.1.1 Institutional Development of Co-management

Community-based resource management in Tanguar Haor emerged as a way to involve resource users and to utilize the local institutional arrangements and knowledge in this wetland's management. A co-management structure, emanating from a series of discussions and deliberations, was proposed to the Government of Bangladesh. As a result of concerted efforts, culminating with a formalized arrangement acceptable to the local people, district administration and authorized ministry, a co-management model within the structure has been developed. The structure has involved different levels of functions starting from village to district level, and engaged the local community of Tanguar Haor to participate as well as the community organization to negotiate and interact with the government machinery and vice-**versa, aiming to manage wetland's** resources while ensuring welfare of the local communities. The existing co-management governance under the CBSMTH project is apparently well thought-out with a foundation at the grassroots resource user level and linking up **to the GOB's highest, policymaking level. The Village Co**-management Committee (VCC) is at the bottom of the governance structure. As its name suggests, VCCs were formed at the village level. The CBSMTHP has so far facilitated the formation of 74 VCCs covering 76 out of 88 villages around Tanguar Haor, and brought 7,089 members from 4,943 out of 10,205 households into the co-management process. The VCCs are the bases for establishing four Union Co-management Committees (UCCs). The Central Co-management Committee (CCC) is the apex body at the ecosystem level that serves as the voice for the TH community. The CCC has already been registered as Tanguar Haor Somaj Bhittik Soho-

Beyabostapona Society (THSBSS) from the "Registrar of Joint Stock Companies and Firms" whose registration no. is S11534. However, co-management system in Tanguar Haor remains functional mainly by the Tanguar Haor Management Committee (THMC) that has connected community organization with the government. The THMC has been formed with the district administration of Sunamganj, respective stakeholders and community leaders, and is headed by the Deputy Commissioner (DC) of Sumanganj. All the decisions towards the management of Tanguar Haor are taken in the THMC meeting, as chaired by DC. During the project period, the THMC has provided stewardship with policy support in project implementation, and has made appropriate recommendations to MoEF which has been playing a vital and very positive role towards success of the project. Besides, a Project Steering Committee (PSC) headed by the secretary of MoEF has also been functioning at the national level. The PSC has been mandated for monitoring and guidance on strategic project interventions with necessary policy initiatives in the field of Tanguar Haor wetland's resource management. Strong commitment of the Government, as a whole, has been emanating in the meetings of the PSC) and THMC.

Other than the GoB participation, organizations like CNRS, GUS, BELA, Helvetas and ERA have been included in the list of the concerned stakeholders (as partners of IUCN) with the responsibilities for a specific component (natural resources and biodiversity aspect, social capital management, capacity building, monitoring) of CBSMTH project at different phases.

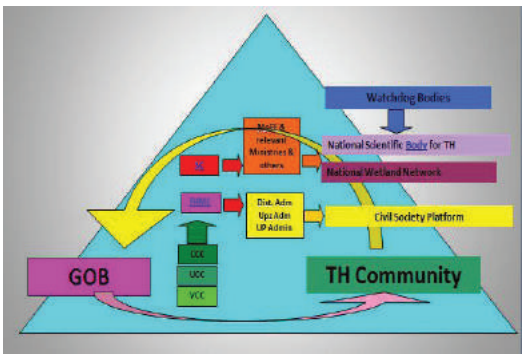


Fig. 4.1: Institutional structure of Tanguar Haor community organization
Source: Mazumder, A (2014)

The 3-tier community organization of Tanguar Haor since its formation has been functioning through a democratic process. Nine General Body members of the VCC, five professional secretaries and four other office bearers; President, General Secretary, Office Secretary and Treasurer, are elected to the VCC for two years and form the VCC Executive Committee (EC). The VCC-EC members are aggregated at the concerned UCC as UCC General Body (GB) members, and they vote for formation of UCC-EC members. The UCC-EC members are aggregated into the CCC as CCC-GB members. At VCC level each voter of GB has the right to choose four office bearers, and one professional secretary from his/her own professional group in the EC. At the UCC level each voter of the GB has the right to choose only one member for the EC from his/her own group. On the other hand, at the CCC level each voter of the GB has the right to choose all members of the CCC-EC body. That means that the VCC is practicing five votes, UCC a single one and CCC nine. Three representatives from the CCC represent the community at the THMC.

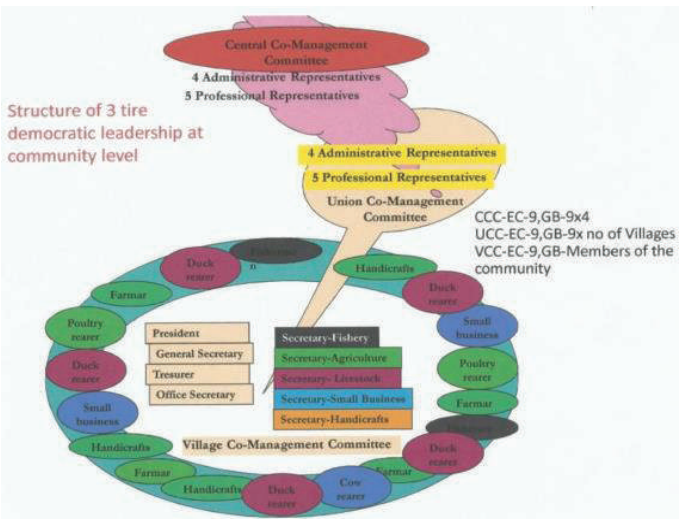


Fig. 4.2: Structure of three tire democratic leadership at community level

Source: Mazumder, A (2014)

Portfolio based election system is introduced under the project, i.e., an elected President of the VCC is only legible to compete for the UCC presidential candidature, and the same way an elected President of UCC is only legible to compete for the CCC presidential candidature. Three representatives from the CCC represent the community at the THMC.

Different types of meetings such as weekly meeting, preparatory meeting and monthly meeting of VCC, weekly UCC-EC meeting, quarterly UCC-GB meeting, CCC- GB meeting and CCC-EC meeting held in the community organization regularly . All the challenges, effort to strengthen community organizations, community actions for resources protection and necessary day to day issues are discussed and decisions are taken in different meetings. Women are participating actively in decision making process under a democratic organizational platform.

4.1.2 Legal Arrangement of Co-management Organizations

Community-based resource management systems cannot be revital-ized in isolation. The planning and implementation of these systems require the development of new legal, administrative and institutional arrangements to complement contemporary political, economic, social and cultural structures.

The legal recognition of the CBOs as institutions by the appropriate authority is always a requisite for the continuation of the activities and implementation of the code of conduct

in wetland resource management. The legitimacy of the CBOs thus, need to be **confirmed to avoid any negation towards the CBOs‘ role from outside entities. Actually,**

legal recognition helps the CBOs in various ways to claim their rights to the resources and protects their interests through negotiation with formal institutions. Experience has shown that the sustainability of co-management organizations depends to a great extent on how solid is the legal footing.

In the context of increasing pressure on natural resources of Tanguar Haor, the need to formally codify the existing co-management practices through greater government involvement and legislative support continues to gain importance. However, the

CBSMTH project through its “learning by doing” process over years has put in place some crucial safeguard measures mostly under the Government authorizations.

The THMC and PSC was established through a GOB Gazette Notification including a TOR for each committee. The two committees, although formed at district and national level for the period of each phase of CBSMTHP, have immensely contributed to the smooth implementation of project activities at field with a strong legal support. In case of TanguarHaor community, the CCC (and its Constitution) wa**s registered as a “Co-management Society” under the 1860 Societies’ Registration Act.** To execute function of the existing community organization proactively and

independently, the CCC constitution has also been placed for amendment as well as ratification **from the 'JointStock Companies'** Though VCCs and UCCs do not have any separate legal standing, they have been included in the CCC Constitution as supporting units.

One of the remarkable progresses for bringing legal status to the TanguarHaor community was made through obtaining a government gazette notification on fish profit distribution. The modalities for benefit sharing among community fishermen, community organization and government allowed the community to harvest fish sustainably in TanguarHaor by establishing their rights to access fish resources there. Under this circular of the Government of Bangladesh (13 March, 2008), the concerned Ministry of Environment and Forests determined the ratio of share of fishery for the three stakeholders, namely, fishermen (harvester) 40%; Community 36% and the Government 24%. The above ratio of share was determined through community level consultation, discussion at the THMC, National Steering Committee and the Ministry.

Later on, several modalities have been designed for commercial and non-commercial fish harvesting and got legality with approval from the government. Among those, endorsement of the buffer zone fishing modality by the government is a great achievement for the CBSMTH project. The modality has brought all the remote *beels* of Tanguar Haor into a single management while establishing rights of the poor fishers. The benefit of this modality is that it drives community people towards understanding the value of biodiversity conservation and thus, makes less pressure on the core zone of Tanguar Haor. Also huge no. of fishermen engaged in the buffer zone have been deviated from the illegal fishing which was happening before.

Apart from fish harvesting modalities, the CBSMTH project has significantly contributed to produce a number of policy documents which directly or indirectly provide legal entitlements to the co-management organizations in Tangua Haor. The publication of 'Tanguar Haor Management Plan Framework and Guidelines' (THMPF) has been a great success of the implementing project in Tanguar Haor. The framework book is not only considered a reference book for Tanguar Haor, but also carries a strong commitment of the Government of Bangladesh towards sustainable management of this wetland. Based on this framework, the project has also developed the draft of a new 'Tanguar Haor Management Plan' aiming to accommodate the experience of previous phases with particular focus on social, economic and political issues of Tanguar Haor in the near future.

Besides the planning documents, the draft of 'Tanguar Haor Managment Rules'

(THMR) which has already been accepted by the implementing ministry in principle, has encompassed a re-designed co-management structure for Tanguar Haor. Thus, the THMR, other than playing an authoritative role for this wetland, is expected to strengthen the governance system of Tanguar Haor. In addition, the CBSMTH project has produced some other policy documents such as community guard policy and benefit-sharing agreement of forest resources. These policy and legal instruments will certainly contribute to ensuring sustainability of the Tanguar Haor resources beyond project interventions.

4.1.3 Institutional Capacity of Co-management Organizations and Community Leaders

Building capacities and abilities of community leadership is always a requisite to ensure long-term durability of the community based institutions as well as the partnership with government agencies. The CBSMTH project has made a continued and focused effort to identify and build the capacity of community leaders, with a view to having emergence of a new generation. During the project period, a total number of 6,066 community leaders including 2080 (34.28%) female at village level have been trained for leadership development in organisation and co-management system.

Capacitating Tanguar Haor community through leadership training and mentoring now appears to bear fruits in terms of their ability to lead and mobilise community people within the community structure already established there. The scope of issues discussed by community leaders has expanded to include resource management and protection (law enforcement) issues, poverty and income generation schemes, and market access questions. Capacity development of local leaders has been ensured for smooth functioning of SCM operation so that the community members can use this fund for income generation activities successfully. In addition, the community leaders have grown skills for organizing meetings at different levels of the existing co-management structure in Tanguar Haor.

During the 3rd phase of CBSMTH project, the community leaders of CCC have organized thirty nine (39) Executive Committee body meetings and twenty three (23) general body meetings with the technical support of project staff resulting 349 and 240 decisions respectively with the active support of project staff. In most cases, the community has taken decisions related to SCM fund operation, commercial and non-**commercial fish harvesting in TH, community guard's deployment for actions against** fish and others resource poachers, and awareness building within community against illegal resources extraction. The participation of female members in both categories of meetings have been much appreciated with an average of 30% overall.

On the other hand, The UCC leaders have organized a good number of EC-meeting (688)and GB meeting (60) quarterly with the support of project during this time. The subjects of decisions were more or less similar to CCC meeting except few ones like approval of financial support to individual community members. At the bottom tier, the VCC leaders have organized weekly meetings and monthly meetings for SCM operation and others social and resources conservation issues. Apart from meetings at the community level, the leaders of TanguarHaor have participated in the THMC meetings (13) at district level during 3rd phase, where the community leaders directly contributed in sharing the resources and in the maintenance of ecosystem services through implementing 75 decisions taken in favour of them.

However, the emergence of community leadership able to articulate community interests, especially in the domain of resource management and livelihood development remains a key condition for the sustainability of community organization in Tanguar Haor. Efforts also need to be ensured to continue building robust community structures with the aim to work towards the generation levels of income that would allow the communities to move beyond subsistence benefits to envisage common investments to address some of the many more substantial investments needed in this wetland.

4.1.4 Community Patrolling and Resource Protection

The presence of community guards and other law enforcement for ecological restoration and protection of TanguarHaor becomes another important achievement of CBSMTH project. There has been enhanced control of the community organizations together with law enforcing agencies comprising 24 Ansars, 12 police and 29 community guards. Some local devotees of Tangua have undertaken the challenging task of community guarding at their wills. The guards patrol the haor resources roster wise in groups (3-4) all around the year. The project has facilitated to set up camp for community guards with providing necessary logistics. On the other hand, community organization in TanguarHaor has been sharing the sheer responsibility of community guards by giving salary (monthly basis) from their own community fund.

Besides, the Project has demonstrated success in establishing and subsequently strengthening the community guards to work in coordination with the police and the Ansar in protecting the TH resource bases. The Ansars have been deployed in the haor for about one decade with the government's financial support and under the supervision of district administration, Sunamganj.

Different initiatives and attitudes of the district administration have encouraged community guards to take an active role to protest against fish poachers in TH. In particular, the district administration has been kind enough to support community guards by deploying a learned magistrate who is staying in Tanguar haor on rotation all round the year. Such cooperation has been largely contributing to minimize the rate of illegal harvesting of resources including fishes, birds and reeds. the reduction illegal fishing in TH. It is reported that (Bi-annual Operational Report 2015-2016, IUCN) in consolidation phase, a total of 500 joint actions have been taken against fish poaching in Tanguar Haor by ANSAR, Police, project staff and community guard under the lead of learned Magistrate. It is estimated that these Joint efforts captured and destroyed illegal equipments (boats, fishing nets, birds haunting nets, etc.) with approximate market value of BDT 26,394,290.

4.2 Role of Governance in Tanguar Haor Co-management

The component 'Governance' is an important transversal theme which is being adequately addressed in the CBSMTHP interventions to achieve the main goal of the project. During project implementation, governance issues particularly transparency, accountability and participation are considered with the utmost priority. The leaders of the co-management bodies (VCC, UCC and CCC) are elected through a transparent democratic process, and the elected committees are accountable to its members which has been practiced and monitored during the project period.

4.2.1 Governance interventions into the content and context of CBSMTHP

Accountability (and Supervision)

The CBOs in Tanguar Haor has been found accountable to its beneficiaries regarding outcomes and expenditures. As for instance, VCC is the bottom level committee which is responsible to UCC. In the same way, UCC is accountable to CCC for any activities or expenditures. The frequent level of meeting at all levels help to communities for decision making, therefore, to supervise other tiers activities. Although the CBSMTH project has identified some mechanisms of check and balances in the system, but due to limited promotion, these are partially applied in the co-management and SCM (Social Capital Management) system. There is a potential negative impact of the intervention including such practice would be burden for women and unduly considered. Sometimes, the influential leaders of Tanguar Haor provoke the poorest people to extract resources from Tanguar Haor in illegal way through providing capital support to purchase illegal fishing gears. Many poor community people also become pursued by the vested groups and often, get inactive when they hardly find the immediate financial benefit / interests.

However, the CBSMTH project has greatly succeeded to eradicate the culture of practicing tender process and to root out the tendency of nepotism from receiving all kind of supports. After that, a permit based participatory new fish harvesting modality has developed under the umbrella of co-management system. Besides, the project has also set mechanisms to make community people liable for any unlawful activities. But, in some cases, such attempts are not working properly when few demotivated people stop paying the installment of loan and undermine different supports received from project. In that case, continuous supervision has taken under the different activities of co-management bodies with legal steps initiated by the concerned authority.

Transparency (and Access to Information)

The communities of Tanguar Haor in most of the cases, successfully bargain to acquire support of local administration for managing and conserving resources. The local administration represented by UNOs of Tahirpur and Dharmapasha Upazilas always play an important role in conducting various community-led development activities along with beneficiaries. Many government departments including Livestock, Agriculture, BWDB, DRRO, Fishery and Forestry at district levels are the member of THMC which is the apex management body of THSSBS. These service providers, through their Upazila offices extend support to the community people as per need of the project. Thus, they influence the decision making process and help to monitor the project activities. Community leaders also play a vital role in monitoring TH resources (community-led monitoring) and their role is restricted to monitoring own fund (CCC) only. However, all the involved stakeholders promote project interventions through consultation, discussion as well as awareness building. Decisions of the community meeting at any level are well documented by making resolutions. Although the project provide only the required amount of incentives to the local stakeholders following budget constraint, but all kinds of transactions are made absolutely transparent.

Participation

The co-management system in Tanguar Haor has been designed for multiple stakeholders such as advisory, implementation and beneficiary stages. Despite facing the natural adversity, community members tend to ensure their participations in the at any level of meeting and discussion. The participation is also organized taking into **account the legitimate role division between various actors where men's needs are** largely reflected in the objectives of CBOs. The existing co-management structure is still in the process of incorporating local elites, tribal minorities, youth group and most importantly, local governments both at Upazila and Union levels. It allows Union Parishad Chairman to represent at the district level meeting (THMC) in where CCC leaders also attend and take part in decision making. However, all the stakeholders are engaged in collaborative and participatory resource management system. Diversified motivational campaigns and training/ consultation meetings for capacity/ awareness building are arranged in the light of conservation issues of Tanguar Haor resources. The newly formed committees at village, union and central level through the recently held election have obviously set a good example of democratic practice within the co-management governance.

Non Discrimination (Equity)

The existing co-management structure in Tanguar Haor has been truly gender sensitive. In three tiers of the co-management structure, three positions (Office Secretary, Handicraft Secretary and Small Business Secretary) are reserved for only women to make them more responsible as well as to improve their leadership skills. Through these positions, women participation and empowerment could be possible under the governance process. Besides, out of 20 Eco-guides 25% female inclusion has been made possible under the Eco-tourism activity. Under the re-designed (proposed to MoEF) co-**management structure, a separate 'Female Community Guard Group'** formation is under consideration beside the male group. The CBSMTH project has also included the disadvantaged group and provided supports in different categories. Likely, these are skill development training, leadership training, loan disbursement from SCM **fund, etc. The project has also taken an output indicator 'Coverage of women headed** and underprivileged HHs reaches 80% as membe**r of the VCC' and planned** accordingly. Under this project, women and disadvantaged group are benefitted in the co-management system through receiving AIGA training to improve their household livelihood income.

Efficiency: (Access to Resources)

The co-management system has brought formal provisions for the local communities by establishing their rights to use the Tanguar Haor resources including fishes. While abolishing the traditional leasing system, the Government has terminated the allocation of fishing rights to the highest bidding leaseholder, and suspended all fishing except for small-scale fishing in the immediate vicinity of haor villages for subsistence purposes. After the project intervention, for the first time, a fish harvesting modality r has been developed with the support of the THMC and community consultation. Conforming to a set of conditions, the fishermen community of Tanguar Haor area has been permitted for fishing there both on commercial and non-commercial basis which earn 76% income for the poor *haor* dwellers. The newly introduced buffer zone

fish harvesting modality even at such a nascent stage seems revolutionary in terms of bearing fruits among the poor fishers of Tanguar Haor. Such excellent way of controlling indiscriminate extraction also ensures the maintenance of ecological integrity of Tanguar Haor, and makes the co-management system more effective.

Chapter Five: Sustainability Potentials of Co-Management and Conclusions

5.1 Best Lessons Learned from Co-management Practice in Tanguar Haor

As stated earlier, hierarchical government bureaucracy, the predominant organizational structure of the 20th century, favours a top-down, command-and-control management system of natural resources management, which generally undermines the need of sharing power and authority with other stakeholders. In contrast, the multi-stakeholder co-management governance system facilitates the interaction of stakeholders across the scale to perform according to their authority and responsibility in natural resource management. The main element of co-management governance is the sharing of power from the central formal government agencies to the local level institutions, which encourages flexibility and adaptability in the management approach. To engage diverse stakeholders in NRM, it is essential to share power and transfer responsibilities to accountable and representative local institutions to ensure an effective local level management system (Bene and Neiland 2006; Kupcu 2005). My study documented the following lessons learned from establishing co-management practice in Tanguar Haor:

1. Establishing effective community based co-management takes time – enough time needs to be allowed for start up (when building local trust and awareness, dealing with government and reserving access to water bodies all take time), main implementation (building community organizations , and a gradual phase out that places emphasis on the sustainability of institutions and processes set up under a project.

2. Any Co-management system that tends to ensure inclusion of all possible direct and indirect stakeholders stands better chance or possibility to be more effective, efficient and successful in achieving its goals and objectives.

3. Continuity of the Government policy is essential for the Co-management system to be institutionalized. But the frequent transformation in the setting of government structure either at district or national level, often requires the project authority (like in Tanguar haor) to bring a new approach somewhat in the management of wetland, particularly at the policy level issues.

4. Program approach is a more viable option than project approach as it provides longer time span to change the mindset of the different stakeholders and institutionalize the practices within the Co-management system and structure.

5. Partnership approach in Co-management has the higher possibility to bring in diverse expertise especially for the management of the critically vulnerable

environmental resource like the Tanguar Haor.

6. Co-management bodies at the district level (i.e. Tanguar Haor Management Committee) play a significant role in coordination and management decisions a. To play an effective role in these committees, the capacity and confidence of the community organizations has also to be developed.

7. Involving the Union Parishads from an early stage is essential as they lead much of local opinion and are able to legitimize or threaten the initiative depending on their understanding and interests. In the long term they are also important for co-management.

8. It is best not to make rigid identification of participants. For resource management in large wetlands the community organizations, i.e. Tanguar Haor Somaj Bhittik Soho Beyabostaona Society (THSBSS) should be flexible so that membership can be changed once it is clear who uses the resources and who is motivated. But sufficient quotas should be set to ensure that the poor, fishers, and women are represented.

9. The emphasis of support for institutions should be on ensuring their sustainability and that good governance practices become routine.

10. Networking with media and creating champions to advocate for Co-management provide opportunity for wider acceptability of the concepts and practices.

11. Dependence on own resources reduces the threats of discontinuity of the Co-management initiative with the withdrawal of the development partners supports.

12. **Critical management body's close location/ proximity to the place of operation** (site) make it more effective and efficient.

13. The ground reality of illegal resource harvesting in Tanguar Haor, an instinctive practice of the demotivated locals, is proving to be countered hardly as an emergency means, and thus necessitate the dedicated and responsible role of the law-enforcing agencies for tackling the situation in haor area, if deteriorates even for a day.

14. Wetlands management perhaps is never excluded from the influence of muscle power. In case of Tanguar haor, the opportunist and interest groups are always eyeing to capture beels /s under leasing system for making maximum profit through extracting the fish resources. Such ill motives against the goal of sustainable resource management are good enough to create conflicting situation involving land dispute, and court-case game ultimately.

15. The CBSMTH project has demonstrated that it is possible to restore the productivity and functioning of large wetland ecosystems in Bangladesh, and thereby enhance livelihoods of poorer wetland users and biodiversity.

5.2 Steps to Sustainability

The communities were of Tanguar Haor were found motivated towards conservation, which is applauding. As evidenced from the field survey, the Upazila and District level administrations need to be more cooperating in the community-based management of Tanguar Haor. In a co-management mechanism, the government offices, community, and the development organization should integrate their efforts to ascertain the objectives of any conservation work. The following recommendations could be supportive for ensuring an effective co-management system in Tanguar Haor :

(1) The UCCs should be registered with the upazila cooperative office so that they UCCs get organizational prescription from that office. This will help the community organization to survive.

(2) Since Tanguar Haor is a big area owned by the government, the district level government offices (specifically the DC) cannot avoid responsibility to conserve the ecosystem of the haor. The DC office can use the local community forces to step up the conservation efforts.

(3) Since Tanguar Haor is a RAMSAR site, there is no scope for the Haor to be managed under leasing system (which was previously proved destructive for the ecosystem of the haor). What is needed is to have a comprehensive plan of the management the ecological resources so that the ecosystem services do reproduce. Selling ecosystem services, promoting ecotourism for example, could be an excellent option for the government to sustainably manage the haor while earning significant revenue from here.

(4) Institutionalizing the community-patrolling group is an obvious for saving the ecosystem health of Tanguar Haor. Either the Ansars should be strictly administered to render their services to the conservation of the ecological resources of the haor, or they should be withdrawn from the haor. Otherwise, the clash between Ansars and CPG is on the rise, which is detrimental and will be more so in the future.

(5) The government should extensively (not fully) support the CPG with financial assistance so that they can save the haor from miscreants. However, community should also play their parts in supporting CPG. Thus, CPG will run with the joint-support of both the government and the community. Only government supported CPG will be more reluctant and corrupted and like the Ansars are. The CPG should be accountable to both the entity.

(6) Political commitment to environmental conservation is very important for sustainable management of the ecological resources of TanguarHaor.

(7) Since the haor dwellers have no alternative income sources other than fishing during monsoon, the existing VGF programs should be expanded and strengthened during the fishing ban period.

(8) Above all, the community motivation towards biodiversity conservation is necessary. Motivational programs for the local community for the sustenance of Tanguar Haor with all its ecological resources should be continued process.

5.3 Conclusions

The cumulative effects of policy changes in *jalmohals* management have resulted in the total exclusion of local fishers and other poor communities from wetland resource use, which has severely impacted their livelihoods. Thus, the very fundamental issues of the sustainability of collective actions that have been organized (and experimented) through different development initiatives of the government need to be addressed appropriately. More specifically, CBSMTHP facilitated institutional structures and processes for sharing of power with local resource users in the decision-making process of the project implementation. In fact, major changes in the management approach of Tanguar Haor wetland resources, i.e. a shift from a centralized, top-down, command-and-control system to a participatory co-management system has provided an opportunity for the engagement of local resource users to protect access rights and address unsustainable practices as well. How to sustain this engagement process of marginalized local resource users in resource management decision-making courses of action, as raised by the representative of local communities, remains a major challenge in the wetland**'s** resource management. The above recommendations are some gross initiatives that need to be continued to ensure sustainable management of Tanguar Haor. However, this list of initiative is not exhaustive. There are more problem oriented steps or solutions, which also will require sufficient attention of the government and community. To the end, only a coordinated effort of the community, development organizations, and the government could be a comprehensive solution to the degradation of Tanguar Haor.

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Economic Valuation of Harpan Khola Sub-watershed at Panchase Mountain Ecosystem, Nepal – A Willingness to Pay mode of Payment

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Abstract

A dynamic complex formed by the interaction of plants, animals, microorganism communities and environment is an ecosystem and the benefits people obtain from the ecosystem and referred as ecosystem services. The data were analyzed using the Logit Regression model for the economic valuation of Panchase Forest Area. The study shows that though the forest conservation has been the government priority, it is forest management which is the dire need. Willingness to Pay (WTP) mode of Payment was considered for the research. Age of people, number of visits made by households' members, cost of loss incurred due to unmanaged forest expansion and distance from the nearest market are positively related to the WTP. Number of dependent family members, expenditure of households and assistance by NGOs and INGOS are negatively related to the WTP. The forest is a good with a negatively sloped demand curve.

Keywords: WTP (Willingness to Pay), ES (Ecosystem Services), CVM (Contingent ValuationMethod), CB (Cost Benefit)

Background and Review

An ecosystem is a dynamic complex formed by the interaction of living components, such as plant, animal, and microorganism communities, and their nonliving environment (Millennium Ecosystem Assessment, 2003). The benefits people obtain from the ecosystem are defined as ecosystem services (ES) (Millennium Ecosystem Assessment, 2003). The idea of ecosystem services has been refined in the past to include not only those services that humans get opportunistically from nature, but also services from ecological systems that humans manage directly (Antle et. al, 2001).

Human beings are supposed to be the most intelligent beings on earth and unfortunately, they have been the most destructive agents living on the earth too. The examples can be from the development of atom bombs, which were supposed to be created for the human security and used in the World Wars, to the exploitation of nature and ecosystem for the personal use. Human beings are an important dimension for the overall ecosystem balance and though the negative impacts of human interventions might be seen in the nature only by now, it is the human beings only who will be affected in the long run. Human beings have been dependent on natural ecosystem for several reasons- ranging from the agricultural lands for the food production to the recreational services for the livelihood.

Forests produce benefits to society such as timber, recreational opportunities, open space, wildlife habitat, and air and water purification. Non-use and non-market services provided by forests including the cycling of clean air and water supplies and provisions of habitat for flora, fish, and fauna do not come with a price, are essentially free and are seldom accounted. The fundamental

environmental-economic problem with forestland conversion is that the loss in ecosystem services is not paid for by those who benefit from the conversion because those benefits are external to the market factors of supply and demand.

The value of ecosystem services depends on the role of ecological properties in attaining human goals in a given certain socio-economic context (Barbier, et al., 2009). Human incentives for utilizing and manipulating ecosystem services are driven by ES values in the form of market price, private nonmarket benefits and social institutions (Robertson & Swinton, 2005). For the ecosystem services that are derived in the form of agricultural services, the valuation can be easy as different level of incentives can be identified and total value can be calculated but in case of non real-market based ecosystem services, the non-market valuation of ecosystem services benefits is needed to calculate the total value. The explanation of nonmarket valuation methods for ecosystem services and preferred methods for different ES can be found in Barbier et al. (2009).

A positive relationship between WTP for non-market forest benefits and income of respondents (Lehtonen et al., 2003; Wang et al., 2007), indicates income poor households have a relatively lower WTP or prefer to free ride in their use of forest services. However, the success stories of community based natural resource management programs signify their contribution to and benefits received from forest management (Ostrom, 1990). In addition, it is widely observed that respondents, particularly forest users and rural inhabitants, have higher WTP for forest ecosystem services compared to non-users and urban residents (Hanley et al., 1998; Brey et al., 2007; Christie et al., 2007). The challenge is determining how to incorporate the potential contribution and concerns of members of subsistence communities into a non-market valuation framework.

Valuation studies using the contingent valuation method have occasionally used non-monetary numéraires including time and in-kind goods such as rice and beehives to estimate the value of non-market benefits to address the cash constraint problem in developing countries (Shyamsundar and Kramer, 1996; Mekonnen, 2000; Alam, 2006; Asquith et al., 2008; Saxena et al., 2008; Shiappacasse et al., 2010; Tilahun et al., 2011). This study uses labour contribution as an alternate cost attribute as it is more appropriate for the forest-dependent communities which are the focus of the study. Usually, in an agrarian community, labour contributions have a social acceptance and farm-households allocate labour for different purposes such as forestry, farming, work for wages and self-employment to optimize their benefits (Jacoby, 1993; Abdulai and Delgado, 1999; Alam, 2006). The elicited willingness-to-contribute (WTC) in labour terms can be monetized to estimate the dollar value of non-market services (Hung et al., 2007; O'Garra, 2009).

Theoretically, when choices are constrained by both time and money, WTP can be elicited using either numéraire (Eom and Larson, 2006). Instead, using time as a numéraire contributes to making CE accessible to income poor populations and allows them to participate in environmental decision-making (Farley and Brown, 2007). Previous studies on the ecosystem services has been focused on the environmental perspective due to which the required attention of the government has not been achieved as the valuation of the possible loss occurring from the loss of ecosystem services has not been done yet.

In order to understand the scope of Willingness to Pay in the forest of Panchase, the following specific objectives will be fulfilled:

- To estimate the relationship between WTP and other socioeconomic variables.
- To derive a demand curve of the forest as a whole.

Methodology

A systemic research study needs to follow a proper methodology to achieve the predetermined objectives. The following method was carried out to fulfill the objectives of the study.

Theoretical Framework

According to Shogren et al., (2006) and McIntosh et al., (2007), a person's life time utility can be written as

‾= ∫‾0 − + ∫‾1 [( ) − [( ) + ˜( )], 1] − … … … … (1)

0

Where,

U = Fixed level of utility
‾0 = Constant Utility at good state
‾1 = Utility in the bad state
= Rate of time preference c = Consumption in period t D = Damage Function

τ = Invasion Time

T = Time of Death

α = Proportion of damage faced by the person

˜ = All contributions to invasion control by other parties= Monetary contributions to invasion control

1 = Environmental quality in bad state

Let us assume that person is endowed with wealth (W). Therefore, simplified budget constraint is expressed as

= [(0)] ∗ (1 − −) + ∫ [( ) + ( )] − … … … … … … … … … … . (2)

Where,

r = Interest Rate
( ) = Consumption choices
( ) = Contribution towards lowering market damage

τ = Invasion time

The Lagrangian expression for a person's problem of maximizing utility over good and bad states subject to a budget constraint is:

= ∫ [( ) − (( ) + ˜ ( ), 1) − 0] −

+ [− [(0)] ∗ (1 − −)

− [∫ [( ) + ( )] −]] … … … … … … … … … (3)

Differentiating equation (3) with respect to consumption and control expenditures and letting

1 ˜

= ( ) − (( ) + ˜ ( )) and = + ˜ lead to following first order condition:

1 − −

( ): 1 [( ) − (( ) + ˜ ( )),] + (−) = 0
≤ ≤ … (4)

( ): − 1 [( ) − (( ) + ˜ ( )), 1] − − − = 0, ˆ≤ 0
≤ ≤ … (5)

Solving equation 4 and 5, we get λ and is written as

1 1 (1− − ˆ)
= … (6)
2 −

The WTP is obtained when value of a change in the time of transition from good to bad state . Here indirect utility is f(,) and other parameter held at their original position and slope of indifference curve (MRS) is

… …

− = ⁄ … … … … … … … (7)

Using envelope theorem in equation 3 to determine the WTP value, V:

$$= -[\ ^{1}((\ )-\ ((\ )+\ \tilde{}(\ ),\ ^{1})-\bar{}^{0}]^{-}\ +\ [(-(0)+\ (\ )+\ (\ ))^{-}\ ]$$

Allowing c(0) = c(τ), keeping c and x at their optimum level (provided by equations 4 and 5) and employing dual optimality condition in 6 to simplify allows value at t = τ to be determined as follows:

$$= \frac{\frac{[\ \bar{0}\ -\ \bar{1}\ \ (\ )-\ ((\ )+\ \tilde{}(\ )),\ ^{1}\ ]}{\ }\ \ -}{\frac{1}{[\ _{1}((\ )-\ ((\ )+\ \tilde{}(\ )),\ \ \frac{1}{\ }\ *(1-\ \hat{}\ )]/2}} + (\ )^{-}\ \ldots\ldots\ldots\ldots (8)$$

We assume that $\bar{}^{0} > \bar{}^{1}$ and $\hat{} < 0$, V is always positive and equal to difference in utility from bad state to good state.

Willingness to Pay Theory

Environmental goods and services provide benefits to human in a similar manner as the market goods and services do. However, because of the public goods nature of environmental goods, many do not have markets and thus prices do not exist. By the nature of public goods, the major features discussed are the rivalry and excludability. That is why; the exact value of the environmental goods and services is difficult to measure. Theoretical concepts of economic welfare used to evaluate the value of environmental goods include consumer surplus, compensating and equivalent variation, and compensating and equivalent surplus. Compensating surplus, which is a special case of compensating variation, is more appropriate for stated preference methods, as used in the present study because the response elicited in the present survey is one in which utility is assumed held constant given a change in income and the good being valued is a case of "restricted demand" (Kolstad, 2011).

Economic Specification of the Model

Generally, Contingent Valuation Method (CVM) studies include often an estimation of the WTP function or valuation function that function depends on income and other socio-economic characteristics of the respondents to the CVM. Therefore,

$$= (\ )\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

Where,

WTP = Willingness to Pay

r = Vector of explanatory variables (scenarios, income, and socio-economic characteristics)

For this particular project assume WTP function is

= (1, 2, 3) … (2)

Where,

WTP = Willingness to Pay per year

Z1 = Scenarios

Z2 = Income

Z3 = Other remaining variable

As the f ′ Z1 > 0 then WTP/year > 0

f ′ Z2 > 0 then WTP/ year >0

f ′ Z3 > 0 then WTP/year > 0 or f ′ Z3 < 0 then WTP/ year < 0 Writing equation (2) in the econometric model form

$= _0 + _{1\,1} + _{2\,2} + _{3\,3} + \cdots$ … … … … … … … … + … … … … … … … (3)

Where,

WTP = Willingness to Pay per year

$_0$ = Intercept of the model

$_1$ = Coefficient of scenarios

$_2$ = Coefficient of income

$_3$ = Coefficient of other variables

= Error Term

$_1$ = scenarios that run from 1, 2, 3…i, 1 indicates zero to low level of invasion for one year, 2 reveals low to high level of impact for one year and 3 indicates low to high level of invasion for 10 years.

$_2$ = income that runs from 1, 2, 3 …j, 1 indicates income during zero to low level of invasion for one year, 2 reveals income during low to high level of impact for one year and 3 indicates income during low to high level of invasion for 10 years.

$_3$ = other remaining variables that run from 1, 2, 3 …k, according to the seen scenarios

Empirical Econometric Model

The Logit regression model has employed been employed for this study. The econometric model is as follows:

$$(\quad) = {}_0 + {}_1 + {}_2 __ + {}_3 __ + {}_4 + {}_5 + {}_6 __ + {}_7 + {}_8 + _ {}_9 + \ldots\ldots\ldots\ldots\ldots \quad (4)$$

Where**,**

= Willingness to Pay
$_0$ = Intercept of the model
$_1$ = Coefficient of age of respondent
$_2$ = Coefficient of number of dependent family members
$_3$ = Coefficient of number of times the members of households visit in the forest
$_4$ = Coefficient of Expenditure
$_5$ = Coefficient of Assistance
$_6$ = Coefficient of Cost Loss

$_7$ = Coefficient of difference of WTP from low impact to minimal of forest impact to households for one year
$_8$ = Coefficient of difference of WTP from low impact for 10 years to low impact for one year
$_9$ = Coefficient of distance from the nearest market

And,

Age = Age of the respondent

Dep_Family_Members = Number of dependent family members

No_of_Visits = Number of times the members of households visit the forest

Expenditure = Expenditure made by the household
Assistance = Money received by households, if any
Cost_Loss_in_Rs = Cost loss by the households
Diff X = Difference of WTP from low impact to minimal of forest impact to households for one year
Diff Y = Difference of WTP from low impact for 10 years to low impact for one year Travel_ distance = Distance from the nearest market e = Error term

Study Area

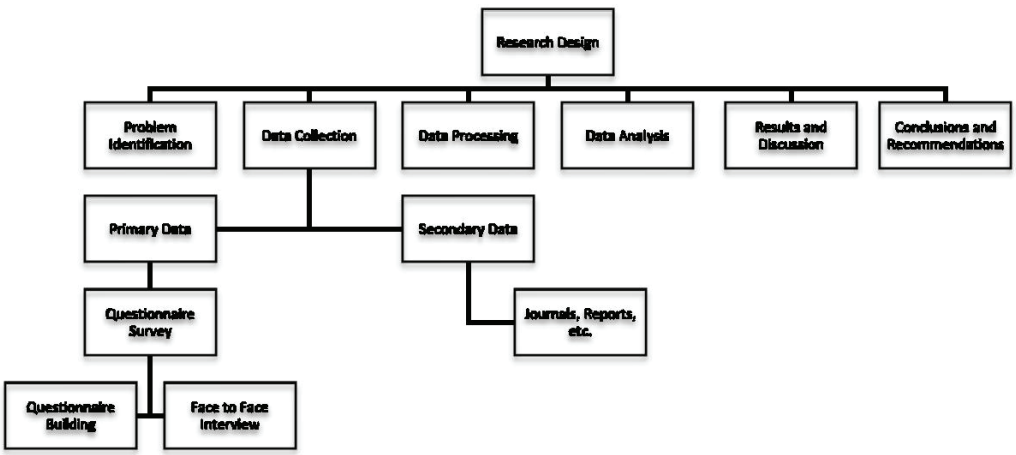
Panchase VDC, situated between (latitude: 28°10'55" to 28°15'56" North) and (longitude 83°48'03" to 83°49'53" East) is my study site. The Panchase region is very rich in plants diversity. There are five major forest types; Alder Forest, Chir Pine Broad Leaved Forest, East Himalayan Oak-Laurel Forest, Lower Temperate Oak Forest, and Schima-Castanopsis Forest. Kharsu (*Quereus semecarpefolia)*, Phalat (*Quercus species)* and Lali Gurans (*Rhododendronarboretum*) are major species at the upper part of the area whereas Chilaune (*Schima walichii*),Katus (*Castanopsis indica*), Rakchan (*Daphniphyllum himalayense*) and Sal (*Shoerea robusta*) found at the lower belt. There are more than 589 flowering plant species recorded in Panchase Forest. 107 species

of medicinal plants, 8 species of fiber yielding plants, 23 species of natural dye yielding plants; 18 wild species potential for floriculture (except Orchids), 56 species of wild Mushroom, and 98 species of ferns are found in the area. This region is commonly known as Kingdom of wild Orchids.

Research Design

The following flowchart will portray all the steps and procedures that has been carried out from the inception of the research to its completion.

Figure: Research Design



Source: Constructed by the author

Every primary research was conducted using survey study. For the same, survey design was created. Generally, survey design showed which questionnaire elicited to gather main information making different appropriate questions to fulfill the objectives. The survey was designed to elicit a subject's willingness to pay to control the impact due to the unmanaged forest conservation. The survey instrument had three sections: introduction, ecosystem services related questions and valuation questions. The introductory section asked respondents several demographic questions. Respondents were then informed about the ecosystem and the ecosystem services. After they were told about the same, they were asked how they use the ecosystem and its services for their livelihood and advancement. Such questions were included in the questionnaire to make them understand that the management of forests is of their use and importance only. And the concept of effective forest management could add up magnitude to their lives and values.

The knowledge of the researcher and the team was used to test the respondents' prior knowledge of effective forest management, the ecosystem services that can be derived of it and that the harms that it can make them, if not managed. The impacts could be on their surroundings, health or their overall economy.

The introductory section asked respondents several demographic questions. The second section asked respondents about the ecosystem services they obtained from the forest and their recreational activities supported by the forest area. The section also tried to take in their opinions regarding

the management of the forest conservation. Finally, the last section consisted of the questions regarding the willingness to pay scenarios of the local people. Primary as well as secondary data was collected applying the following tools and techniques. Primary data was collected using the questionnaire survey. For this purpose, open ended questionnaire was made for the valuation. Three questionnaires were pre-tested in the area in 3 sample points. Then, the tested questionnaires were performed as face-to-face interviews to identify the WTP of the household and other information telling different impact scenarios. Literature review and required secondary data were collected from different books, journals, newspaper, research reports and internet.

For the sample size determination, there are mathematical formula and for the sampling process, there are probability and non-probability sampling techniques that are available in both the cases when the total population is known and when the total population is not known. For this study, total population of the study site was determined. For this study, the sampling technique as of Garcia-Llorente et al. (2011), was followed. 7 sample points were determined to capture the heterogeneity in this study according to the impact faced by the respondent. Sample was selected randomly from sample points and total number of sample was further broken down as per the requirement. The sample points with the sample break down is shown in the following table.

Table: Sample with Sample Breakdowns

S. No.	Sample Points	Total No. of Sample	Sample Break Down
1	Tourist Home Stays	14	Tourists – 9 Operators – 5
2	School	9	Teachers – 6 Students – 3
3	Farm Lands	17	Farmers
4	Fodder Collecting Groups	7	Group
5	Residents	24	
6	Vendors	8	Grocery Stores – 8
7	Lake Side Shops	5	Forest Products Shops – 3

Source: Created by author

This research had set some expected sign which played major role for the research finding. The table below shows the independent variables used in the model, its description and expected sign for the WTP to control the impacts of the unmanaged forest conservation. The dependent variable takes the value 1 if the people have willingness to pay for the control of impacts otherwise it is zero.

Table 3.5 Independent Variables with Expected Sign

S. No.	Variables	Description	Expected Sign
1	Age	Age of the respondent	+
2	Dependent Member	Number of dependent family members in the households	-
3	Number of Visits	Number of times household member visit the forest	+
4	Expenditure	Expenditure made by the household annually in Rs.	-
5	Assistance	Money received by households from NGOs, INGOs, help, if any	+
6	Economic Loss	Loss due to the damage created by the animals of the forest, have to travel long for recreation, etc.	+
7	Diff X	Difference of WTP from low impact to minimal of forest impact to households for one year	+/-
8	Diff Y	Difference of WTP from low impact for 10 years to low impact for one year	+/-
9	Travel Distance	Distance from the nearest market	-

Source: Created by author

Collected data was processed with the help of Microsoft Excel 2013 and STATA 16 was used for the analysis and estimation purpose.

Results

Descriptive Statistics of Sample Characteristics

This section describes the variables used in the study and their obtained mean, median, minimum value, maximum value and standard deviation.

Table 4.1 Summary Statistics, Using the Observations 1-84

Variables	**Mean**	**Median**	**Maximum**	**Minimum**	**Std. Dev.**
Age	45.86	46.00	94.00	24.00	12.13
Language	1.23	1.00	3.00	1.00	0.43
Gender	1.16	1.00	2.00	1.00	0.37

Schooling	11.86	12.00	15.00	0.00	2.23
Occupation	2.26	2.00	4.00	1.00	0.39
Income	2.18	2.00	4.00	1.00	1.12
Dep_Family_Member	1.42	1.00	5.00	0.00	1.26
Indep_Family_Member	2.69	2.00	6.00	1.00	1.01
Enjoy_Nature	4.63	4.00	5.00	1.00	1.08
Env_Science	1.89	2.00	3.00	1.00	0.58
Env_System_Change	1.23	1.00	2.00	1.00	0.23
Env_Degradation	1.23	1.00	2.00	1.00	0.26
Benefit	1.09	1.00	2.00	1.00	0.24
Cost_Loss	1.78	2.00	2.00	1.00	0.58
Cost_Loss_in_Rs.	7856.23	2500.00	305000.00	0.00	36589.23
Fishing	2.36	2.00	3.00	1.00	1.59
Swimming	3.04	3.00	4.00	1.00	1.36
Recreation	2.97	3.00	3.00	1.00	1.56
Harm_to Economy	3.88	4.00	6.00	1.00	1.52
Harm_to_Health	3.08	3.00	6.00	1.00	1.69
Harm_to_Forest	4.23	5.00	6.00	1.00	1.22
Harm_to_Watershed	4.55	5.00	6.00	1.00	0.95
WTP	0.96	1.00	1.00	0.00	0.23
Picnic	1.82	2.00	3.00	1.00	0.67
Praying	3.02	3.00	4.00	1.00	1.05
No_of_Visits	4.56	5.00	6.00	1.00	1.21
WTP1	1021.32	1000.00	5000.00	0.00	956.36

WTP2	856.36	500.00	5000.00	0.00	823.26
WTP3	1759.68	1000.00	12000.00	0.00	2658.96
Caste	1.58	1.00	3.00	1.00	0.74
Property	1.82	2.00	2.00	1.00	0.39
TV	1.17	1.00	3.00	1.00	0.38
Env_Group	1.83	2.00	3.00	1.00	0.46
Tourists_Duration_Stay	2.65	2.00	4.00	1.00	1.24
Satisfaction_Level	2.96	2.00	4.00	1.00	0.37
Expense_Locality	7256.39	7500.00	10000	0.00	5623.65

Source: Field Survey, 2014

From the above table, the overall summary of the data collection can be observed. There are several variables that are seen in the table which can elaborate on different issues. But, I would like to focus on the prime aspect of my research study, i.e. to find the willingness to pay of the people regarding the forest management. According to the table, for the scenario one which is to manage the forest to completely pacify all its impacts on households for one year, mean WTP is Rs. 1021.32. Likewise, mean WTP for the second scenario which is to manage the forest targeting to keep its impact low for one year is Rs. 856.36. Finally, mean WTP for the final scenario that is to keep the forest impact low for ten years in the sample point only is Rs. 1759.68. Therefore, the conclusion we derive from the above table is that people are ready to pay more for the first scenario in comparison to the second and third created scenarios.

Econometric Model with Empirical Values

As we know that WTP depends on socioeconomic factors, income and other variables. For this particular study, WTP acts as the binary dependent variable which takes value 1 if people are ready to pay and 0 otherwise. On the other side, socioeconomic factors, expenditure the proxy of income and other variables are used as independent variable. Logit regression model has been run, then analysis and interpretation is done accordingly.

Table 4.4 Results of Logit Regression Model

Dependent Variable WTP	**Coefficient**
Independent Variables	
Age	0.0272 (0.0365)
Dep_Family_Members	-0.0852 (0.265)
No_of_Visits	0.836** (0.0321)
Expenditure	-0.00125* (0.000369)
Assistance	-0.000235* (0.0000120)
Cost_Loss_Rs	0.000562 (0.000221)
Diff X	3.56e-06 (0.000563)
Diff Y	-0.000147 (0.000138)
Travel_Distance	0.000387
	(0.000237)
Constant	0.524 (1.599)
Observations	51
Pseudo R2	29.86 Percent

Source: Field Survey, 2014

Standard errors in parentheses; ***p<0.01, **p<0.05, *p<0.1

The result from the logit analysis indicates that among the various determinants of WTP only number of visit of household member to the lake, expenditure, assistance and cost of loss are significant at 10 percent and 5 percent where number of visit and cost of loss is positively related to WTP and expenditure for household and assistance is negatively related to the WTP. For the variable age, as age of the respondent increases by one year, the odds ratio in favor of WTP for the forest management is increased by Rs. 0.0272 and if dependent family member increases by one, the odds ratio in favor of WTP for the forest management decreases by Rs. 0.0852, keeping other variables constant. *Ceteris Paribus*, as cost of loss increases by one rupee the odds ratio in favor of WTP for the forest management increases by Rs. 0.000562. The difference of WTP from low impact to minimize the forest impact to least for one year in Rs. is positively related to the WTP. Similarly, difference of WTP from low impact for 10 year to low impact for one year in Rs. is negatively related to the WTP. Also, the travel distance from the nearest market is positively related to WTP for the forest management increases by Rs. 0.000387. And, besides that, the overall model is fit at 29.86 percent.

Demand Curve of the Forest

To derive the demand curve of the forest as a product, we need to find the trend of WTP and the elasticity of the curve which is also the slope of the demand curve.

Table 4.6 Different Elasticity of Econometrics Model

Dependent Variable WTP	**Elasticities (Ey/Ex)**
Independent Variables	
Age	.0325896
Dep_Family_Members	-.0056417
No_of_Visits	.2896547
Expenditure	-.0426741
Assistance	-.0002751
Cost_Loss_Rs	.0129573
Diff X	.0006521
Diff Y	.0239571
Travel_Distance	0.568941

Source: Field Study, 2014

According to the above table which portrays the elasticity section, the first elasticity of WTP (Ep1) is 0.0652178 and the second elasticity of WTP (Ep2) is 0.0239571 as estimated from the software. Both the elasticity points are less than unity. Therefore, it concludes that relatively inelastic demand curve can be deduced. Furthermore, this demand curve is negatively sloped demand curve. The reason of being relatively inelastic demand curve might be that the intervention of the tourists is high in the area, the luring dominance shown by the NGO and INGO for the forest conservation in the region and the concept that the government should take care of the forest and not them residing locally.

Conclusions and Recommendations

It is no wonder that Economics is the study of allocating limited resources, for which it has to rely on valuation; which generates information about the obvious resource scarcity. The value of ecosystem services refers to what we, as a society, are willing to trade off to conserve these natural resources. One always has to remember that both biodiversity and ecosystem services are scarce and that is why the society is highly indebted by their degradation.

In pure economics or environment economics, an asset is scarce if its use owes opportunity costs. That is, in order to obtain one additional unit of the good one must give up a certain amount of something else. The quantifying and valuing ecosystem services are no different from quantifying and valuing goods or services produced by humans. However, valuing ecosystem services is problematic. Free riding is a bigger problem and to comply with the most ecosystem services, they tend to be over-consumed by society.

Biodiversity (and ecosystems) is a part of our natural capital, and the flow of ecosystem services is the additional benefit on that capital which society earns. Like private investors choose a portfolio of securities to diversify and maximize risky returns, we also need to choose a level of biodiversity and natural capital that ensures future flows of ecosystem services in order to guarantee persistent environmental quality and human well-being, including poverty alleviation.

Society can allot values to ecosystem services only to the extent that these fulfill needs or confer satisfaction to humans either directly or indirectly. This approach to valuing ecosystem services is based on the intensity of changes in people's preferences under small or marginal changes in the quantity or quality of goods or services. The economic conception of value is thus anthropocentric and for the most part instrumental in nature, in the sense that these values provide information that can guide policy making. Rather than being an inherent property of an asset such as a natural resource, value is attributed by economic agents through their willingness to pay for the services that flow from the asset. WTP is positively related to Age of people, negatively related to the number of dependent family members, positively related to the number of visits that household members make to the forest area, negatively related to the expenditure of households in the forest area, negatively related to the assistance that the area receives from NGOs, INGOs, etc., positively related to the cost of loss occurred due to the unmanaged forest expansion and positively related to the distance from the nearest market. The forest is a normal good for the region because of the decreasing willingness to pay of the people for its conservation and thus, is a negatively sloped demand curve.

As the conclusion says that the WTP is negatively related to the assistance provided by NGOs and INGOs that flows to the region, the implication is that the locals do not feel the ownership of the resources and ecosystem services there. The lack of ownership of the locals on their ecosystem services will ultimately lead to the failure of huge funds that are flown in by the bilateral and multilateral donors, therefore the locals mandatorily need to be given a share of investment for the assurance of their own ecosystem services. Another thing that comes along with taking initiation to establish their share of investment in the sustainability plan of the ecosystem services is the dire need of forest management. Since, the forest area has been declared as the National Forest, people perceive that conservation is the duty of government and not theirs. The secondary impact of the forest conservation has been the intervention of wild animals in the residential areas which can lead to the tertiary impact of conflict between wild animals and the residential. Therefore, the prime need now is the forest management rather than just conservation of the same.

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Travel Cost Valuation of the Sundarbans Reserved Forest of Bangladesh

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Abstract

Sundarbans Reserved Forest hosts the largest single block of tidal, salt-water mangrove forest on Earth with a diverse collection of flora and fauna, including many endangered ones. It is thus, (and also generally) necessary to find an appropriate estimation of the recreational benefits of this world-renowned region as a tool for the conservation of biodiversity, as well as the development of ecotourism, there. I have designed this report to do just that (estimate the recreational value) and to exhibit a relationship between the Sundarbans Reserved Forest (SRF) in Bangladesh and travel cost, using the responses of the visitors to this region from all over Bangladesh. A zonal approach of the travel cost technique has been used here and the sample was 300* visitors of SRF over a period of seven days. My analysis yielded that the total value of the environmental resources of SRF is around 197 million Tk./year. I have also made the suggestion of initiating an entrance fee of 50 Tk./person/visit which could generate proceeds of approximately 5,000,000 Tk./year, to successfully fulfill the duties of the mangrove area management and biodiversity conservation.

Keywords: Travel Cost, Valuation, Sundarbans

*The filled-in questionnaires are with the author and are available on request

1. Introduction and Background of Research

Sundarbans is one of the biggest examples of human exploitation on forests and its flora and fauna in the world. This amazingly diverse and resource-rich eco-region was declared a reserved forest in 1926 and later a World Heritage Site by UNESCO in 1987. Unfortunately, by then almost 60% of the forest land and natural habitats of this reserve were gone along with the animals and plants residing there (Guha and Ghosh, 2009). Sundarbans is also home to the largest mangrove forest on Earth and the Royal Bengal Tigers, which are a highly endangered species roaming around in this 1990s-declared Tiger Reserve. Unfortunately, there are only about 200 tigers left from among the 1000s that once roamed the land and even though there are awareness campaigns and strict laws against both the poaching of tigers and harming their natural habitats, their numbers keep dwindling due to a number of reasons, including issues between the locals and management, low levels of monitoring, inefficient and poor management facilities, corruption amongst law officials, lack of information on the importance of these land areas among the general public, etc. (Mukul, 2007).

Forest reserves, national parks and animal sanctuaries are established by environmental organizations to conserve the rich biodiversity of a particular eco-region and also prevent its flora and fauna from facing further depletion from human activities (Reeves, 2000). However, that is not enough. It is also important to put a value on these natural resources and, if possible, the reserve as a whole to develop the sector of ecotourism (Farnham, 2007), which in turn produces

revenues to better manage the reserves (Khan, 2004), and also, to establish both physical and official infrastructure to better protect these important parts from further destruction (Rana et al., 2010). Unfortunately, for our generation, not much research has been done in this area and definitely not in the context of Bangladesh which actually holds around 20% more of this forest area than our neighbors with whom we share the Sundarbans, India. Keeping this gap in the literature in mind and with the desire of producing a proper value for the Sundarbans Reserved Forest (SRF) from the viewpoint of the Bangladeshi people, this research aims to use travel cost valuation technique to put an economic value on SFR. The responses of national visitors to this area have been used to establish the value after much analysis. In addition, their willingness to pay to protect the SFR played the dominant role in providing a value for a proposed entry-fee.

Furthermore, an economic valuation of SRF is not only important, but necessary, because it is evident that only through revenue generation and spread of such information about the benefits it provides to our economy can we better manage this irreplaceable reserved area. This study will also help the respective authorities to develop national policies in correspondence to ecotourism in thecountry and specifically for the better conservation of SRF so that it can be prolonged and even expanded with time for us and our future generations. In addition, the surplus from the revenues can be used to appoint more skilled and honest officials who will take it to their hearts to truly protect the land from human exploitation and also, improve the infrastructure (without harming the wildlife there) to better accommodate and attract more tourists and cause a positive chain reaction in tourism revenue.

2. Methodology and Data Collection

Travel Cost Valuation (TVC) is a popular method when it comes to the question of valuing recreational sites since its inception by Hotelling in 1947. Generally, his method uses the premise that the costs faced by a tourist for a trip to a recreational place (like Sundarbans) can be used as a substitute for the recreational value placed by him/her for that place. Islam and Islam (2011) puts it perfectly when they say, "It is his *minimum* demand price for the recreational service the site is seen to possess." The rate of visitation decreases as the travel cost increase in line with the law of demand. Both a theoretical and a practical analysis of the valuation process of this demand are necessary for estimating the price of the recreational services provided by the site. Also, data on different travel costs and other related social and economic descriptive variables are included in the analysis to approximate a „recreational demand function."

To summarize the methodology of this research in a few words we can say that the study depended dominantly on the primary analysis of the survey questionnaires filled up by tourists who visited the SRF from 14 to 20 August 2015 (7 days). Using the TCV method the recreational demand for SRF was estimated. Secondary research for a comprehensive literature review and background check used relevant websites, articles, papers from famous authors and/or journals and environmental textbooks. In-depth interviews to understand the topic and some short talks with SRF officials were also conducted to get an idea of the prevalent political, social, management and tourist situations. In addition, this research emphasizes on the fact that apart from travel costs, the social and economic conditions of the tourists play significant roles in the determination of such a valuation. Using both primary and secondary sources the research extracts such determinants

and mathematically approximates their effect on the recreation demand. As an attempt for a better future for the management and restoration of SRF services it also estimates a revenue-maximizing entry fee.

This particular research applies TCVM to examine the advantages related with recreation in SRF. The TCVM is, in reality, an expansion of the idea used in a traditional approximation technique used for the formulation of zonal household production function (HPF) models; here the households are assumed to be utility maximizing dependent on many production and consumption commitments. Clawson and Knestch (1966) has stated that TCVM (also called the zonal model) is approximated as a „trip generating function," and the visit rate is dependent on several variables including travel cost to the site from place of origin, travel costs to alternate sites and social and economic characteristics of the sample individuals. Here, we have separated the areas around SRF into various zones and the costs of travel from each zone to the site are calculated. The analysis is done by regressing the number of visits (dependent variable) from each zone against the travel costs (independent variable). The cost per visitor per visit used the visitors" willingness to pay for the particular site.

The function we have used is that of Hanley and Spash (1993) and says that the total cost of each visitor „i" to visit the particular site „j" can be written as –

$$Cij = C\ (DCij, TCij, Ej), \text{ where } i = 1\ldots.n,$$

Where, Cij is the total cost for visitor „i" to visit the site „j"; DCij is the distance cost for individual „i" which is again a function of the distance from origin of visitor to site and the cost per mile of travelling; TCij is the time cost (includes the value of the visitor"s time and the time spent inside the place); Ej is the entry fee to the place (if it does not exist then = 0).

In addition to this, the recreational use value (V) for each of the designated zones can be estimated using this equation –

$$V = [(T \times w) + (D \times v) + Ca] \times Va$$

Where, T is the travel time (expressed in hours); w is the mean wage rate (expressed as Tk/hour); D is the distance between zone and site (expressed in km); v is the marginal vehicle maintenance costs; Ca is the cost of admission to an asset (may be = 0); Va is the mean number of visits per year from each zone.

A partially structured questionnaire has been used to collect data (primary source) we need, to establish the functional relationship, then find the site value and suggest an entrance fee, over a period of 7 days (including the weekends Friday and Saturday). The sample has been made as random as possible; of the 4,268 (data obtained from Forest Department office) visitors over the 7 day period, we selected 400 visitors keeping in mind to make them as diverse as possible as per age (only above 18 as children are usually dependents and are not seen to be able to make proper decisions), sex, marital, social and economic statuses, etc. A few of those filled-up questionnaires

3. Data Analysis and Results

Among the sampled respondents, most (25%) came from Khulna city which is the closest urban area, being only 61 km away. They had to spend the least (only 502.5 Tk. on average) for their travel. An unnatural trend can be observed next with Dhaka visitors being almost 18% of the total visitors, even though the city is over 240 km from the site, further away than other places like Potuakhali and Jessore (123 and 127 km away, respectively) from which 24 and 21 visitors came, respectively to SRF (Table 1). The anomaly with Dhaka data is probably because Dhaka is the capital city and its residents are typically richer and more vacation demanding than other cities. The routes connecting SRF and Dhaka city can also be a factor, because the connecting roads and transportation systems are way better between these two than many closer cities/towns. Same trends can be seen for more major cities and semi-urban areas Chittagong, Rajshahi and Sylhet all of which being further away from SRF have contributed more visitors than their closer counterparts for similar reasons of better incomes (which make them more vacation-inclined) and improved transportation systems and roads. The most was spent by the visitors from Sylhet which is the farthest place recorded in the sample from SRF (over 425 km).

Two more points of significance from the data collected were that most of the visitors were male (over 60%) which might mean that females are less attracted to the place due to lowly tourist facilities or because of security reasons or simply because, they were rejecting to complete the questionnaires more than the males, and that Rangamati being closer than its further counterparts contributed only one visitor; this might be due to the fact that the transportation and road systems between it and SRF are poor or simply, because Rangamati itself is a nature-rich site and hosts a number of parks and sanctuaries. It is also important to note that the anomalistic trend among distance from site, travel costs and visitors‟ numbers may be simply because the population of each site is not equal and so it is important to take the visitations in terms of overall population from each
site to get the true trend. Only a couple of foreigners filled up the questionnaires, but their questionnaires were not taken into account because their valuation ideas and concept are very different from the country people.

Tab. 1: District wise travel costs and other TCVM related data

District	No. of visitors	Distance from SRF (km)	Total population	Travel cost* (Tk.)
Khulna	75	61	2354000	502.5
Dhaka	53	242	13875000	1356.2
Potuakhali	24	123	1527000	708.7
Jessore	21	127	2752000	800.1
Barisal	15	146	2299000	978.3
Madaripur	14	176	1159000	1002.7
Faridpur	12	180	1245000	1190.0
Chittagong	10	275	7519000	1780.2
Rajshahi	9	274	2583000	1702.7
Noakhali	9	211	3192000	1207.6

Manikgonj	9	225	1239000	1304.9
Chandpur	8	225	2493000	1319.0
Pabna	7	229	2498000	1375.5
Feni	7	254	1425000	1563.7
Comilla	5	265	5308000	1690.8
Tangail	4	266	3572000	1706.7
Kishorganj	3	277	2857000	1798.8
Sirajganj	3	283	3075000	1976.4
Brahmanbaria	3	307	2807000	2007.9
Sylhet	3	427	2445000	3109.9
Bogra	2	322	3375000	2278.6
Moulavibazar	1	325	1905000	2250.8
Mymensing	1	334	5047000	2340.7
Hobigonj	1	359	2069000	2498.5
Rangamati	1	317	708182	2176.6

*Travel costs were averaged

Almost 52% of the visitors had a monthly income of the 20,000 – 25,000 taka range, followed by around 19% with 15,000 – 20,000 taka monthly incomes. Around 15% visitors had incomes between 10,000 and 15,000 taka in a month, while the rest of the respondents have monthly incomes above 25,000 taka (Table 2). The lower levels of visitors from the lower income ranges is understandable, because the poorer people cannot afford to go on vacations and usually, spend their incomes on necessities rather than luxuries like nature-watching. The lower number of visitors from the above 25,000 taka might be for two reasons – first, because Bangladesh is a developing nation and only a measurable few earn higher income and this was reflected in the records and it can also be because most high-income people prefer visiting foreign countries than their own countries‟ nature sites. Bashar, R.

Tab. 2: Monthly income of site visitors

Income range (Tk.)	Observed no. of visitors in 7 days (V)	Actual no. of visitors per day (VR)	%
<10,000	23	46	7.67
10,000 – 15,000	22	44	7.33
15,000 – 20,000	56	112	18.67
20,000 – 25,000	155	310	51.67
25,000 – 30,000	15	30	5.00
>30,0000	29	58	9.67

To further the research, the places from which the visitors came from were divided into 5 zones, namely A to E depending on their distances from SRF (Table 3): this is why the approach that this study took is also called the zonal approach. From each zone, travel costs were calculated and it was found that the visitors from Zone E, which consisted the places furthest from SRF, had to pay the most (3109.9 Tk.) and there were only 6 visitors (VR) from this site (we must keep in mind that the visitors are not relative to the population of this zone and so any trend cannot be fully justified). We do observe a trend; as the distance increases from Zones A to E,

the travel cost shoots up. However, this did not reflect in the relationship between zone distances and VR; the maximum number of visitors was from Zone C (VR = 254) which holds places 200 – 300 km away from SRF. This might be attributable to the fact that this zone contained roads and transportation systems that were better than the rest of the zones. It may also be possible, because this zone boasts the four biggest cities in Bangladesh – Dhaka, Rajshahi, Chittagong and Comilla – the residents of which are richer than the rest of the districts and hence, more „vacation friendly." Similar reasons have caused more visitors to visit from Zone B than Zone A (which is much closer). Also, Khulna residents believed that many residents prefer going further for vacation than just 61 km and so, they visit site-seeing parks and forests further away.

Tab. 3: Zone wise visitors to site

Zone	Distance from site (km)	Population (P)	V	VR	Average Travel Cost (Tk.)
A	0 – 100	2354000	75	150	502.5
B	100 – 200	8982000	86	172	893.1
C	200 – 300	49636000	127	254	1459.45
D	300 – 400	15911182	9	18	2205.3
E	400 – 500	2445000	3	6	3109.9

To solve the problem of zone wise visitors relative to the population in each, another table was made before the regression analysis on the zones with actual number of visitors as a dependent variable. The research had started off on the premise that there is an inverse relationship between the travel costs and VR. This is why it is more important to get the visitors in terms of the population of each zones and that is why the study holds Table 4. For example, although Zone C shows the maximum number of visitors, this can easily be attributable to the fact that these places have good roads connecting them to Mongla Port directly, because it is not the closest to SRF, neither the cheapest to go from to SRF.

Tab. 4: Visits per population from different travel zones

Zone	Distance from site (km)	P	V	VR	Visits per P (per 100,000)	ATC (Tk.)
A	0 – 100	2354000	75	150	6.37	502.5
B	100 – 200	8982000	86	172	1.91	893.1
C	200 – 300	49636000	127	254	0.51	1459.5
D	300 – 400	15911182	9	18	0.11	2205.3
E	400 – 500	2445000	3	6	0.25	3109.9

Table 4 actually shows the reality of the relationship that exists between visitations and distance from site (and in turn the travel costs); as the distance increases from SRF so does the average travel cost. The first zone is the closest and has the least average travel cost of 502.5 Tk. only: its visits per 100,000 population is 6.37, while the least numbers of visitors per 100,000 population is from Zone D which is just second to being the furthest from SRF and has the 2nd -highest average travel cost of 2205.3 Tk. (0.11). The anomaly of Zone E with highest average travel cost of 3109.09 (as it"s the furthest from site) may be attributable to the fact that these people being

from Sylhet city were richer and so more people were able to visit the site even though they lived so far away; Zone D had semi-urban regions only and no big cities.

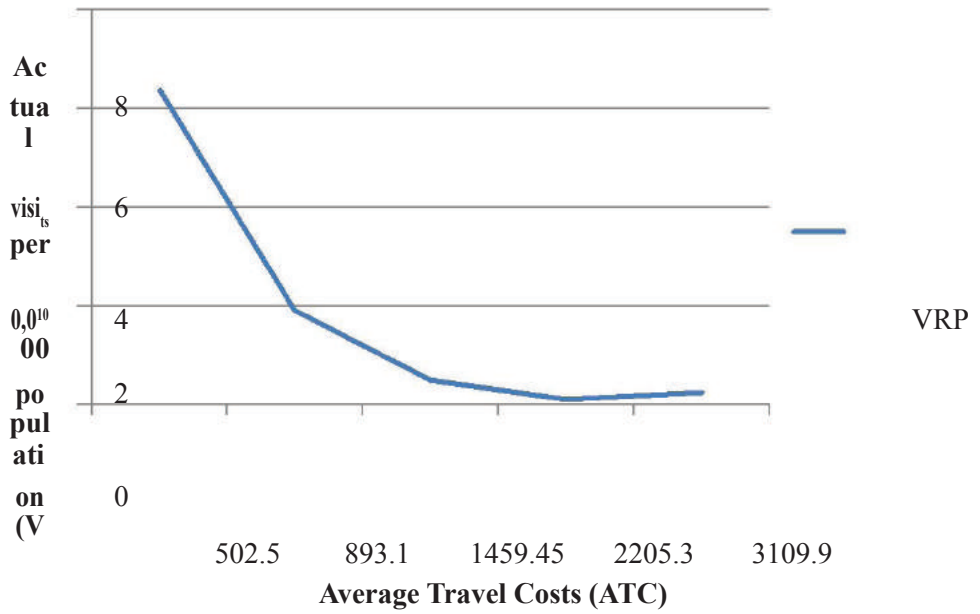


Fig. 1: Relationship between VRP and ATC

Through graphical representation (Figure 1) of ATC and VRP data collected, along with regression analysis it was established that a negative relationship exists between VRP and ATC with the following equation –

$$VRP = 4.93 - 0.002ATC/TC$$

The relationship is evidently correlated with an R^2 value of 0.56 and the p-value being less than 15% (p-value = 0.14). The p-value is still so large because of the Zone E anomaly (already explained).

Using the data collected by the study we find that Zone C boasts the maximum value of the environmental assets of SRF at 111,213,900 Tk. followed by Zones B and A at 46,083,960 Tk. and 22,612,500 Tk., respectively, in a year. The total value of the environmental resources of the whole of SRF is estimated to be 197,416,800 Tk. (around 197 million taka)each year through this study. We must note here that the SRF is usually inaccessible almost 2 out of 12 months of the year due to weather conditions; hence, 300 days were counted.

An overwhelming 92% have suggested an entry fee of 50 Taka/visit/person and so, that is also the suggestion of the study; initiate an entry fee of 50 Taka for every person every time they enter, the proceeds from which would be around 50 x 100,000 visitors per year = 5,000,000 Taka yearly and can go to the tourist facilities and conservation management improvement of Sundarbans. Fortunately, for the study SRF is the lone destination of the people who come to visit here and so their WTP opinion is only proposed for this particular site and no others that they might visit with the same entry fee or within the same vacation time.

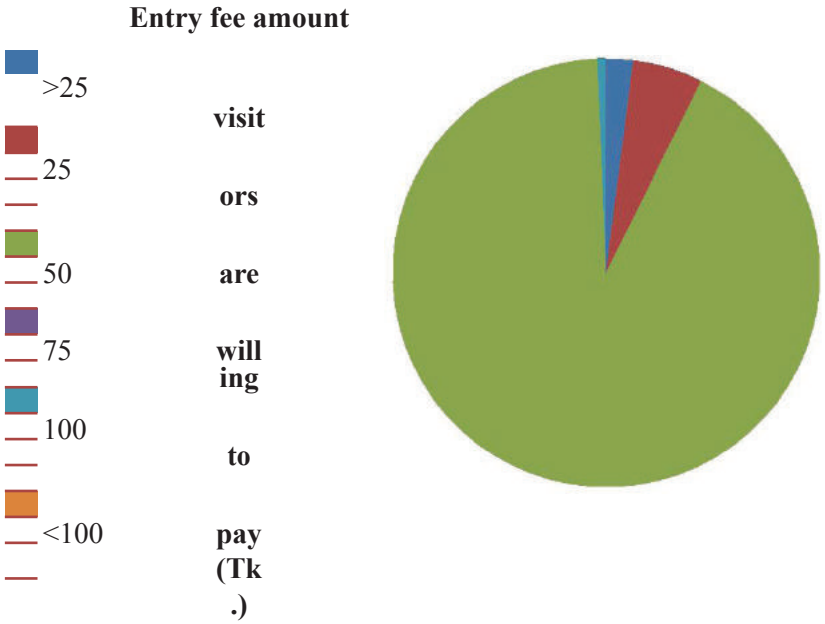


Fig. 2: Illustration of visitors' WTP to pay entry fee

4. Suggestions

- There are several advises and suggestions that can be proposed from the things and attitudes observed when performing the study. Starting from the resources management of SRF, to the importance of awareness of general public about its need to be preserved for them to pressurize the national and international policy makers to emphasize on proper planning and implementation for its conservation, to the evident requirement of an entry fee (which is separate from the fee paid to take permission (permission fee) from Forest department), many things need to be fixed at this site and beyond.

- From the literature reviewed what is clear is that SRF provides natural protection to the coastal zones from tidal waves and the destructive nature of cyclones (which is a common phenomenon in Bangladesh), especially during the monsoon seasons. It is unfortunate, however, that as a result of increased agricultural irrigation, industrialization and change of water route due to the Indian Farakka Barrage (in the mid-1970s), the ecosystems of SRF are threatened as both salinity and siltation levels are increasing rapidly. These have already led and are leading to the ultimate and depressing extinction of the Sundari trees which are the primary flora species of SRF. Added to this is the resultant top-dying disease problem faced by management from the Goran species of flora too. Most environmentalists and environment enthusiasts are of the opinion that the Ganges water sharing issue is not just a geo-techno-political one; it is more a humanitarian issue. It is important to solve this as soon as possible, before more permanent damage to SRF occurs, through educational awareness and interaction between the concerned states, people and corporations that play significant roles in its destruction and management.

- The aim of this paper was also to recall and emphasize on the management problems and lack of proper monitoring at the implementation levels to better conserve the ecosystems of SRF. The contributions of this great mangrove forest and its habitants are so great that it is indeed wrong to put a value on it. However, most people and definitely local and global decision makers understand better the speech of money and hence, the valuation. It is equally important for the schools and other educational institutions, along with the government (who have conflicting views as they can use the revenue allocated for conserving SRF for more short-term productive economic activities) to spread the awareness about the „going-ons" in SRF and its importance in the local and global environmental management. Only with added pressure from the general public will the relevant development institutions and concerned states take the initiative to solve the political, geographical and technical problems and look beyond their own use-values and egos to better the management and conservation attempts of the SRF.

This leads us to the most important and last suggestion of the paper – the introduction of a distinct, separate and most importantly, revenue maximizing (and „non-visitation declining") entry fee. An entry fee of Tk 50/person/visit is suggested as an astounding 92% of the respondents in the study have suggested so, instead of the zero entry fees that they are used to now. It is the general believe that increasing the fee above 50/- will cause a decline in the visitation levels to SRF because Bangladesh has just promoted itself into a middle income country with most still living in the lower class levels. About 2% of the respondents consisted of people who said point black that no entry fee policy should persist, because it is a place of nature and should be free to see for everybody and anybody. Rest of the respondents (consisting mostly of rich, non-resident Bangladeshis and higher-income people) proposed entry fees of more than 50 Taka, but less than 100, probably because they are able to afford it themselves, and such a low fee would not affect their visitation interest to a grand place like the Sundarbans.

The proposed entry fee would be able to generate a total revenue of 50/- x 100,000 (the usual visits per year) = 5000000/- (5 million taka) which can go into better management development plan for SRF. It is also important to take note that the entry fee can increase progressively when the revenue generated are used efficiently to better the facilities present at SRF and develop it for ecotourism prospects.Also, better, skilled and most importantly well-paid Forest Department officials can be appointed to important posts who would better monitor the conservation of SRF. Some of these funds can be used for two more purposes – diverting the livelihoods of locals to something rather than those that destroy forests like cutting wood, and building better tourist facilities. The former purpose would better the lifestyles of some of the locals and conservation attempts of management. The latter purpose would cause a positive chain reaction by attracting more tourists to the place, rather than the ones who brave this visit now, and help earn more revenue and spread the world of Bangladesh"s beautiful ecotourism spot, the Sundarbans Reserved Forest.

5. Conclusion

As SRF is such a place which provides value to the world on the whole by being a recreational site, a diverse ecosystem for hundreds of (and even unique) species of flora and fauna, provides protection from increased disaster destruction and moderates climate change and is a commercially important site in terms of ecotourism and business values (timber, medicines, fisheries, etc.), an

efficient valuation method is a must to calculate a value for its assets, and that is what this study has done through the TCV approach. This study revealed that there is huge potential for both managerial and conservational improvements, as well as ecotourism facilities‟ building and for that an entry fee of 50Tk/person/visit is proposed which would produce revenue of 5,000,000 Tk/ year. In addition to this, a recreational demand function has been successfully used to establish a relationship between visitation rates and travel cost, which in turn was used to determine the WTP of visitors. Also, a total value of 197 million taka per year was estimated for the total asset values of SRF. Furthermore, the need to attract the relevant authorities‟ attention on developing the ecotourism and conservation management policies for SRF and later, other national parks and sanctuaries was also addressed in the research, which is a must for a better environmental future for us all.

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The Endogeneity of Domestic Violence: Understanding Women Empowerment Through Autonomy

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Abstract

Women's autonomy is known to incite intimate partner violence (IPV) in developing countries. We argue for the endogeneity of women's autonomy with IPV, which is often ignored in the existing literature, for understanding the causal association. Using the Bangladesh Demography and Health Survey (2007), we isolate the effect of autonomy on IPV taking into account the possible endogeneity using instrument variables and special regressor estimations, proposing the special regressor as a more reliable approach to estimating binary choice models with discrete endogenous regressors. Our study finds increased women's autonomy to lead to higher incidents of IPV for a South Asian patriarchal society such as Bangladesh. Thereby, policies catered towards women empowerment by increasing women's autonomy should concurrently focus on other determinants of IPV. Undue male controlling behavior, witnessing inter-parental abuse as a child and early marriage are also found to aggravate IPV. Hence there should be simultaneous programs that aim to relax male controlling behavior over women, provide counselling for those who have witnessed inter-parental abuse as a child, and laws prohibiting child marriage, still prevalent in South Asian societies, should be reinforced. These findings have strong policy implications suggesting the dual nature of improving women's autonomy in empowering women while aggravating IPV.

Keywords Domestic violence; autonomy; South Asia; Bangladesh;

Author Contributions

Adnan M S Fakir was the lead researcher responsible for the analysis and consistency of the study. Anika Anjum and Nabilah Nawar conducted and prepared the literature review. Fabiha Bushra prepared the data and the descriptive statistics. All authors have read and approved the final article.

The endogeneity of domestic violence: Understanding women empowerment through autonomy

1. Introduction

The belief that women's autonomy in public and private spheres is crucial in affecting the power dynamics between husband and wife within households is widely held by policy makers and feminist activists alike. In order to subjugate women, intimate partner violence (IPV) is often employed as a tool to maintain male dominance. Attempts to break away from this patriarchal

trend of subjugating women through force has fostered policies that are geared towards securing women‘s independence in financial matters and household decision-making. However, whether such policies are truly helping by emancipating women from IPV is a debatable topic.

One proposition is that the subordination of wives in the household and public spheres is part of the cultural norm in resource-poor societies. Some uphold the belief that women‘s economic dependence on their husband, grant the husband the right to commit IPV, especially when women have no say concerning household matters (Schuler and Islam, 2008). Violence is accepted and internalised. IPV ergo also does the job of diminishing women‘s autonomy. On the other hand, it can also be reasoned that with greater autonomy there are greater prevalence of IPV. If masculine hegemony feels threatened by women exercising greater autonomy in financial, reproductive and decision-making instances alongside being more active in public life, it could elicit more incidents of violence contrary to the policy intentions (Eswaran and Malhotra, 2011).

The main focus of this paper rests to verify whether maternal autonomy, women‘s power within households and in public domains, affects incidence of spousal violence or is affected by it, in South Asian societies like that of Bangladesh where women are subjugated on the basis of a gender hierarchy.

It is naive to assume that there is a causal link running from greater autonomy towards reduction in the instances of IPV, and that, as a consequence, the key to lessening the acts of violence against the wife is to improve the woman‘s socioeconomic condition by allowing more physical mobility and greater decision-making power over the household and financial matters, as well as children‘s welfare. However, in light of possible endogeneity correlations based on changes in women‘s autonomy and changes in IPV incidents are not compelling. Developing a causal link necessitates an appropriate instrumental variables strategy, and although studies have recognised this endogeneity problem, not many have focused on attending to this problem in their econometric estimation leading to biased results.

Of course, besides autonomy, many other individual, economic and socio-hierarchical factors render women susceptible to increased incidents of domestic violence. In this study, we use data from the 2007 Bangladesh Demographic and Health Surveys (BDHS) and break down the investigation into exploring two primary questions: (1) We specifically look into the role of women’s autonomy, women‘s involvement with NGOs and controlling behavior of the husband as determinants of IPV; and (2) We study the relevance of intergenerational impact of witnessing IPV between parents on the present generation. Alongside, the influence of individual and household level control factors on IPV, such as employment, education, use of menstrual regulation, household wealth and household size, is also investigated.

The paper has been organised as follows: Section 2 generates a discussion on our variables of interest as determinants of IPV and previous findings in the available literature. Section 3 deals with the methodology, identifies and details how the outcome and predictor variables have been prepared, provides rationale for our instrument variables and finally discusses the estimation strategies being employed. In section 4 we present and discuss the results, finally concluding the study in section 5.

2. Endogeneity: Domestic Violence and Women's Autonomy

In feminist literature, patriarchy sees the need to control women's mobility, behavior and sexuality, where violence may be a plausible instrument of control. It may also be conferred, that the valuation of women in families where they have very weak autonomy, is poor due to cultural, economic or patriarchal normalization. Under such instances, the acceptance, thereby, perpetuation of IPV may be more likely to exist. In that accord, IPV may be said to stem from weak autonomy of the victim compared to the perpetuator. These women, with no other means of fending for themselves, are less likely to show any resistance lest they are left by their husbands.

Additionally, evolutionary theory suggests that a woman working outside of the house may invoke distrust and jealousy for they are in contact with men outside their marriage. This may trigger the need to control her movement, diminishing her autonomy. In fact, it is found that a woman who works for a family member is less likely to face IPV than one working for someone else (Eswaran and Malhotra, 2011). On the other hand, women with independent sources of income may face violence from their partners who use IPV as a means to acquire the resource, namely income, which would offset their autonomy (Schuler, Hashemi, Riley, and Akhter, 1996). Women's autonomy may therefore be seen to have a reverse causality with IPV.

Not much of the prevalent literature deal with this endogeneity. Eswaran and Malhotra (2011) define women's autonomy as their involvement in decision making and have found a negative effect of domestic violence on females' autonomy. The effect was larger when they treated domestic violence as an endogenous variable, compared to ordinary least squares (OLS) estimate, which only not only yielded a lower magnitude but also a wrong sign with regard to theory. Ignoring the reverse causality between the two resulted in completely biased results.

To account for this endogeneity between IPV and women's autonomy, instrumental variables have been used in this paper. As we will soon encounter, because our dependent variable is binary with a discrete endogenous regressor, we compare and contrast several instrument variables methods of estimation. To that note, it is worth mentioning that this study is novel in applying the special regressor method in the case of IPV.

2.1 Women's Autonomy

It is to be noted that drawing the line between what is considered as women's autonomy, or the lack thereof, and the results of controlling spousal behavior is rather difficult. Whether or not a person is submissive by choice is not captured in most of the surveys making the cause-effect association between controlling behavior and autonomy blurry. In the study by Schuler, Hashemi, Riley, and Akhter (1996), a case was reported where a woman, with weaker autonomy, faced spousal violence as a means to acquire her savings and spend it against her will. There were multiple incidences of women reporting that they were beaten whenever they asked about household debts or questioned their husbands about how they spent their money (Schuler, Hashemi, Riley, and Akhter, 1996). This suggests that men may feel compelled to exert physical force upon their wives to establish their dominance when their authority at any rate is questioned.

The association between women's autonomy and the chances of facing domestic violence was found to be statistically significant, albeit very slightly, among women in rural Bangladesh

(Koenig, Ahmed, Hossain, & Mozumder, 2003). Interestingly, a study in Sub-Saharan Africa looked into the acceptance of wife-beating attitudes and women from Mali (OR=1.05), Rwanda (OR=1.05), Uganda (OR=1.08) and Zimbabwe (OR=1.06) with no participation in the decision making process of the household were more likely to accept wife-beating (Rani, Bonu & Dio-Sidibe,2004). Reciprocally, men with the notion that women should not engage in decision-making were more likely to be accepting of domestic violence.

The association between decision-making power and domestic violence was seen to be positive in contrast to households with more equal decision-making settings in Colombia (Friedemann-Sanchez & Lovaton, 2012). Findings from an earlier study conducted in all of Latin America supports this association (Flake & Forste, 2006). Moreover, Kabeer (1997) puts forth that the potential to escape a bad marriage decreases the likelihood of domestic violence. On the other hand, for women, who have some form of autonomy but whose incomes are not sufficient for them to be able to support themselves outside the marriage, the risk of IPV does not decrease (Pitt, Rosenzweig & Hassan, 2012).

Heath (2014),from a household survey outside Dhaka, Bangladesh, found evidence that supports instrumental violence theory where a woman has a lower risk of encountering domestic violence upon entering the labor-force if she had a higher bargaining power to begin with. She posits that the relationship between the two lies not in the fact that a woman‘s working gives her more autonomy but that the woman had higher level of autonomy to begin with that decreased the probability of facing IPV.

Furthermore, Rahman, Nakamura, Seino and Kizuki (2013), using the 2007 BDHS data, targeted women of reproductive age between the ages of 15 and 49 but found no statistically significant difference between the experience of any form of IPV, whether physical, sexual or both, and the number of aspects they made the decisions for. Compiling this dataset with 2005-2006 Indian National Family Health Survey, Rapp, Zoch, Khan, Polmann, and Kramer (2012) constructed a ―final say‖ index where the wife reported to have participated in at least one or none of the listed decisions. This study also did not find any statistically significant relationship between the final say index and experience of IPV. However, neither studies controlled for the possible endogeneity.

Keeping with Eswaran and Malhotra (2011) we treat autonomy as an endogenous determinant of IPV, constructing the variable with mobility, financial and decision making dimensions.

2.2 Controlling Behaviour

From the theoretical household bargaining models, a link between a woman‘s autonomy over economic resources and domestic violence can be established with respect to her bargaining power at the time of marriage (Eswaran & Malhotra, 2011; Rao, 1997; Tauchen, Witte & Long, 1991). A woman faces larger probability of encountering IPV if she starts earning, as her husband might be eager to equalise her increased bargaining power. On the contrary, if a woman, whose initial bargaining power is higher than that of the formal, experiences a rise in economic resources, she may be less likely to face IPV as this gives her the opportunity to fend for herself if the marriage does not last. These suggest that domestic violence is used as in instrument of control apropos of household members‘ behaviour or the distribution of resources. As opposed to instrumental

violence theory as such, expressive violence theories posit that IPV is a direct tool, an outburst of emotion.

Villarreal (2007) ran a probate regression using the National Survey on Household Relationship Dynamics of Mexico and prepared two models with one treating the women‘s employment as exogenous and the other as endogenous. In the first model, women who experience coercive control were more likely to face domestic violence by their partners (OR=0.0247). However, the second model, denies the former result showing that a woman with active employment is half as less likely to experience IPV (OR=-0.507).

In rural Bangladesh, women were more likely to be beaten if she fails to fulfill the roles expected of them (Schuler, Hashemi, Riley, and Akhter, 1996). Women, in multiple instances, stated that they were beaten when they could not do the household chores even on the account of being ill in the same study. When the men were asked of their perception on wife-beating, many justified it as men‘s rights over their wives. Some normalized it with respect to alleged religious scripts and some reported it to be ―a normal way to keep women‘s unruly natures in check and make the household run smoothly,‖ (Schuler, Hashemi, Riley, and Akhter, 1996).

Further, in another dataset from rural Bangladesh combining that of Women‘s Health and Domestic Violence against Women (WHO multi-country study) and longitudinal data from Health and Demography Surveillance System, 31% of the women who were physically abused reported controlling behavior from their partners which included refraining her from speaking to her friends and family, having the expectation to be sought permission from before she pursued medical attention for herself, persistently accusing her of infidelity and getting cross if she communicated with a man beside himself (Asling-Monemi, Naved & Persson, 2008). Of the 226 women who suffered high levels of controlling behavior, 60% had also been physically abused, 32% had been so severely and 60% had been sexually violated by their partners.
Keeping in line with the discussion, we are interested to understand how and to what extend the controlling behaviour of the husband affects IPV within a household. Such a variable should also be explicitly controlled for such that it does bias the autonomy effect on IPV.

2.3 Non-Governmental Organization (NGO) Involvement

It is understood that education could also influence women‘s chances to be well-networked in their own communities. Whether making women‘s lives more public decreases the probability of experiencing IPV or increases is uncertain. The fear of exposure and consequently public shaming may diminish their chances of experiencing IPV. On the other hand, although active participation in NGOs and in associated credit programs is expected to entail greater economic and social empowerment (Bates, Schuler, Islam and Islam, 2004), this could simultaneously trigger spousal violence because women‘s involvement beyond the domestic sphere is seen as a direct threat to the patriarchal system (Schuler, Hashemi, Riley & Akhter, 1996).

For Bangladesh, the small and medium enterprise (SME) revolution has brought women out of the perimeters of their houses and engaged them in income-earning activities, the success of which is largely dependent on the group-based approach making the women‘s lives more public. Schuler,

Hashemi, Riley, and Akhter (1996) found a negative relationship between the probability of facing violence from an intimate partner and women‘s participation in a microfinance programme. Pinning women in villages without a credit programme as the reference, women participating in a Grameen Bank programme (OR=0.30), BRAC (OR=0.44) ornon-member living in a Grameen village (OR=0.66) were less likely to experience IPV.However, the study did not allude to whether the women participating in the programs had lower IPV incidence in the first place.

On the contrary, Bangladesh being a predominantly Muslim country, women‘s presence in the public domain can, in the more conservative rural regions, be seen as a defiance of the patriarchal social order causing *fatwa* (an institution that claims to enforce Islamic laws) to be issued against them. These *fatwas* often categorise women‘s involvement with NGOs as heresy and deploy means to control their mobility, such as by declaring them as social outcasts or immodest, thus invoking religious sentiments into keeping women‘s position under men‘s in the power hierarchy (Shehabuddin, 1999).

2.4 Witnessing IPV during Childhood

According to the social learning theory, IPV among married couples may have an effect on children growing up in households where abuse was commonplace, observing and assimilating it. That is, it is assumed that children acquire a violent outlook from witnessing domestic abuse in their preadolescence, internalizing the events and accepting it as being only ―normal‖ when the mother is abused by the father (Islam, Tareque, Tiedt & Hoque, 2014). It lays possible groundwork for later manifestation of IPV in future relationships that the child, possibly a male, may inherit from his father and for female children exposed to IPV to be more docile and accepting of it.

Children exposed to IPV tend to be emotionally unstable with behavioral irregularities and low cognitive status than those that did not witness IPV in their childhood, leading to aggression in later life, greater acceptance of violence and ―having lower verbal and social skills along with poor marital communication‖ (Roberts, Gilman, Fitzmaurice, Decker & Koenen, 2010). These tend to suggest greater possibility for intergenerational transmission of the ―tradition of IPV‖ as well as due to exposure to a gendered social structure within the household (Vung & Krantz, 2009).

Similarly, there are also studies that suggest that men who witnessed IPV were more prone to defend it and use it as a control mechanism than those that did not (Edleson, 1999). In the end, imitation of IPV in later life was more prevalent in households where children were not made aware of peaceful ―conflict resolution‖ (Roberts, Gilman, Fitzmaurice, Decker & Koenen, 2010). Possibility of intergenerational transfer of IPV acceptance can thus be evaluated by focusing on women who witnessed cases of abuse as a child and in the case of their male counterpart, likelihood of IPV perpetration can be evaluated by considering men who were exposed to domestic violence in their childhood.

A research conducted using BDHS 2007 data was used to reveal that there was indeed a correlation between witnessing of inter-parental abuse to the acceptability of IPV especially among women.

Bangladeshi women were 2.4 times more likely to experience any kind of IPV provided that they witnessed abuse as a child (Islam, Tareque, Tiedt & Hoque, 2014). In another study conducted on Vietnam women by Wold Health Organization (WHO) presented findings that the likelihood of lifetime IPV (OR=2.85) was considerably greater for those who had been exposed to inter-parental violence during childhood than those who had not witnessed it (Vung & Krantz, 2009). These findings recognized IPV to be a common element of family life.

In search of a counter measure, Roberts, Gilman, Fitzmaurice, Decker and Koenen (2010) assessed whether providing emotional support and guidance can mitigate prospects of IPV in the future. The results were not substantial but it suggested that providing counseling and support services to distressed children could safeguard them from the damaging effects of witnessing IPV such as perpetration of IPV in adulthood.

While Islam, Tareque, Tiedt and Hoque (2014) looked into the acceptance of IPV for women who witnessed inter-parental abuse as a child, we are more interested in the increased aggression towards IPV for men who witnessed inter-parental abuse as a child. We term this as inter-generational IPV, and our variable is constructed based on responses from the male participants. Inclusion of this variable, also further act an additional control in isolating the autonomy effect on IPV.

3. Methodology

3.1 Data and Sample

In order to conduct our analysis, we use data from the 2007 Bangladesh Demographic and Health Survey (BDHS). The dataset contains information from 10,400 households covering 361 clusters throughout Bangladesh, of which 134 were in urban areas and 227 in the rural areas. Randomly selected male and female respondents from the survey were also subjected to a module on domestic violence. The advantage of the module is that it included specific acts of IPV which substantially reduces the bias that arises from the respondents'subjective perceptions of abuse (Bates, Schuler, F. Islam & M.K. Islam, 2004). The number of women and men eligible for the module were 4,489 and 3,381 respectively. Our analysis employed a merged and matched dataset containing data on couples who reported as being married to each other or living together, further reducing the observations to 2,544 for both the sexes.

3.2 Outcome Variable

Our outcome or dependent variable of interest is intimate partner violence (IPV). We focus on physical IPV perpetrated by the husband, which is constructed from six dichotomous variables:

1) If he ever pushed his spouse, shook her or threw something at her
2) If he ever slapped his spouse
3) If he ever punched his spouse with fist or something harmful
4) If he ever kicked or dragged his spouse
5) If he ever tried to choke or burn his spouse

6) If he ever twisted his spouse‘s arm or pulled her hair

The six binary variables were then summed and dichotomized by coding to one if the husband has perpetrated in at least one form of IPV and zero if he had not. Note that we focus primarily on physical IPV and not sexual IPV. Table 01 reports the summary statistics of the outcome variable. About 61.3 per cent of the men in our sample have physically abused their wives at some time, with ―slapping‖ being the most reported act of violence (57%) and ―choke/burn‖ being the least reported (approximately 10%).
[Insert Table 01 here]

3.3 Predictor Variables

3.3.1 Variables of Interest

Keeping to the primary questions of this study, we have four variables of interest: women‘s autonomy, husband‘s controlling behavior, women‘s membership in NGOs and husband‘s intergeneration IPV, of which addressing the endogeneity of women‘s autonomy with IPV is of prime concern. To represent women’s autonomy, an index is created from seven dichotomous variables acquired from responses of female participants. These seven responses reflect domains of mobility, financial freedom and decision making autonomy:

1) Do you go to a health center or hospital alone or with your children?
2) Who usually decides how the money you earn will be used?
3) Who usually makes decisions on major household purchases?
4) Who usually makes decisions on making purchases for daily household needs?
5) Who usually makes decision about your own healthcare?
6) Who usually makes decisions about visits to family or relatives?
7) Who usually makes decisions about child‘s healthcare?

Each of the seven variables were dichotomized and then averaged to reflect the extent of autonomy. The woman was considered to have autonomy power if the decisions were made by the woman alone, with her husband or other members of the household, as opposed to the woman not having a voice at all.

Linos, Khawaja and Al-Nsour (2010) argue that women who are part of ―joint decisions‖ could simply be complying with the decision already made for them. In contrast, we assume that women who have sole decision making authority must be the household heads, uncommon in patriarchal societies like that of Bangladesh (Anderson & Eswaran, 2009). Out of our sample of 2,544 women, on average about 70 per cent claim to have autonomy, as per our definition, implying that most women are in fact involved in joint decision making. The category in autonomy that was least reported was the decision on their own healthcare, suggesting that the about 38 per cent of women have no say in such matters.

Similarly, we prepare the variable representing the controlling behavior of the husband out of five questions asked to the male participants about specific occasions during which they thought beating

their wife was justified, and an additional question about their opinion on the permissibility of married women to work outside if he failed to make enough money (questions listed in appendix A. In our sample, on average about 25 per cent of the men exhibit the type of controlling behavior defined by this study.

In preparing the variable representing NGO participation for women, we average number of memberships per woman in NGOs or external credit programs was coded between one and zero. Finally, to represent intergenerational IPV influence of husbands, a dummy variable is created from a question that asked the male participants if they had witnessed their fathers beating their mothers. About 26 per cent of the men in our sample witnessed their mothers get physically abused at the hands of their fathers. In addition, cross tabulation shows that about 33 per cent of the men who had ever physically abused their wives witnessed inter-parental abuse as a child.

Table 02 reports the summary statistics of the predictor variables, segregated under four categories.

[Insert Table 02 here]

3.3.2 Other Determinants

Education of the woman was classified into primary, secondary and higher education against a reference of no education. Only about 8 per cent of the women have attained higher education in our sample. Increased knowledge paves way for the development of feelings of self-efficacy that help alleviate perceived status inconsistencies within a marriage. However, the extent of knowledge attainment has rarely been used as an explanatory variable in existing literature to assess its impact on women's experience with IPV. Thus we included a knowledge index which was constructed from the responses to five dichotomous questions (reported in appendix A), averaged into one variable. Menstrual regulation (MR) is a procedure of artificially inducing menstruation within 14 days of a missed menstrual period so as to terminate any possible unintended pregnancy (Kessel, Brenner & Stathes, 1975). A woman unwilling to bear a child is likely to have used menstrual regulation, and if against the consent of her husband, could potentially lead to IPV (Huda, Chowdhuri, Sarker, Islam and Ahmed, 2014). Menstrual regulation is taken as a binary variable, where past usage is coded as one and zero otherwise. Only about 7 per cent in our sample of women have used MR in the past, of which about 65 per cent of the women had experienced IPV.

A wealth index constructed from data on household assets and dwelling characteristics is used a proxy for household wealth status, since such asset indices are often used as analogous to measures of consumption expenditure (Filmer & Pritchett, 2001). The index in turn was divided into quintiles of Richest, Richer, Middle, Poorer and lastly Poorest as our reference category.

The total number of household members is used to represent the family structure of the household. A larger household presence could either empower a woman or perpetuate her subordination within the household. Previous research has found both negative (Rahman, Nakamura, Seino & Kizuki, 2013) and positive (Kishor & Johnson, 2004) associations between number of household members and the risk of IPV. We thus include a continuous variable accounting for increasing number of members in a household. As controls, the employment status of women was categorized into

six categories, with unemployed women being the reference category, are also included. Finally, religious, type of residence and regional controls are also included in the estimation.

3.4 Instrument Variables

We seek to isolate the impact of several determinants on domestic violence, especially that of women‘s autonomy. We do this by regressing domestic violence as our dependent variable on women‘s autonomy while controlling for factors that determine domestic violence and could bias the estimation. A prime concern that impedes an accurate estimation is the potential endogeneity of autonomy with domestic violence, as demonstrated by Eswaran and Malhotra (2011) both theoretically and empirically. Using the Hausman-Wu test for endogeneity, we test for the possible exogeneity of autonomy and reject the possibility (p-value = 0.0439). The endogeneity would cause the error term to be correlated with the OLS estimation picking up both forward and backward effects, leading to inconsistent and biased estimation (Wooldridge, 2006).

We instrument autonomy in order to address this endogeneity. The selected instruments are (a) whether the woman lives in an extended family or not, and (b) whether there are other females in the household, such as the mother-in-law or the sister-in-law, who may be identified as household heads. Our reasoning for selecting these variables as instruments is that we believe a woman is more susceptible to lower autonomy if she lives in an extended family, or if some other woman retains a similar (or higher) household rank. In a South Asian context, especially that of rural Bangladesh, where arranged marriage is still the norm, being married into extended families or the rank of a married woman in the in-laws‘ household, is determined prior to marriage and is likely to be exogenous. There are of course other factors that might make a woman concede to lower autonomy which we control for in order to negate their effects.

Furthermore, we find empirical support for our sample in the first-stage of the two-stage least squares (2SLS) regression (reported in appendix B), that living in an extended family, and dominated rank of a woman in a household is significant in determining autonomy.

It is necessary that the instrument variables and autonomy be highly correlated in order for the instrument variables to qualify. The pair-wise correlation coefficients and the significance level between the endogenous regressor, autonomy, and the instruments are reported in table 03. Both the instruments are seen to be significantly correlated with autonomy.

[Insert Table 03 here]

The exclusion restriction requires that the relationship between the instrument variables and IPV be completely mediated by women‘s autonomy. The instruments are of course not without any objection which we gradually address in this section.

The first potential source of objection is the existence of external influence that affects the instruments and IPV. The income level of the households could be one such external influence. It is possible that low income households are more likely to be extended families and also suffer from more greater IPV due to their lower wealth (the correlation coefficient between higher wealth and wife living in an extended family in our sample is -0.2025; similarly for higher wealth and

intimate partner violence is -0.1749). It can thus also be argued that wealthier households tend to be more nuclear and face lower IPV. In our estimation, we control for the income level of family by including a composite wealth index in our regression. This allows us to overtly control for the effect of the instruments on domestic violence that may be operating through household income. A similar argument can be made for the controlling behaviour of the husband, which we also include in our regression to explicitly control for its effects.
Assortative matching in the marriage market causes women to be married to similar income households, as shown by Deolalikar and Rao (1996). Furthermore, women from lower income households tend to be undernourished with lower height, thus more susceptible to IPV. It can be thus argued that provided extended families tend to be less wealthy, they will marry undernourished women into their households (the correlation coefficient between extended families and women‘s height in our sample is -0.0364; similarly, for women‘s height and other equal, or higher, ranked women being present in household is -0.0358). This creates a scenario where the woman‘s height may affect both the instrument and domestic violence. We explicitly control for this possibility by including women‘s height in the regression, as before allowing us to

overtly control for the effect of the instruments on domestic violence that may be operating through women‘s height.

Another objection against our choice of instruments might stem from an argument built from the assortative matching mentioned above. Case and Paxson (2008), using data from the United States and United Kingdom, argue that there may be a correlation between a person‘s height and her cognitive ability. If extended households, due to lower wealth, do marry undernourished women into their households, and given that the women has lower cognitive ability thereby receive lower returns from the labour market, this makes her more susceptible to IPV. If this is true, it will affect the exclusion restriction of our instrument; the effect of the extended family variable on IPV will no longer be completely mediated by women‘s autonomy.

The first argument against this objection is that higher returns from the labour market should permit higher autonomy for women; implying autonomy is the pathway through which IPV is affected. Furthermore, while this objection may hold for Western countries, this may not hold to be true for the South Asian context. In fact, the correlation coefficient between women‘s height and working women is -0.0278, indicating that height does not necessarily translate to higher income for our sample. In a South Asian context majority of women work in agriculture (about 16 per cent in our sample) where physical prowess is mostly employed, undermining the importance of cognitive ability (Eswaran & Malhotra, 2011). Lastly, even if this unlikely objection holds, we still explicitly control for wealth.

By virtue of being selected as instruments, we are positing that autonomy is a major pathway through which the instruments affect domestic violence. This leads to a bigger concern of self-selection bias. A man from an extended family, or from a family with other female household heads, may choose to wed a woman who will be more submissive to his family. We can argue that in rural villages majority of marriages are arranged by the families where the groom and bride often see other only at the wedding ceremony. However, it is entirely possible that the extended families themselves when arranging the marriage may seek for a submissive bride. Thus the

instrument may cause some self-selection bias. In order to keep this bias to a minimum (if it exists) covariates are included in the first-stage (reduced form) equation, as is conventional. The primary role of the covariates is to control for any such self-selection bias caused by the instrument, so that the coefficient of the endogenous regressor captures a covariate-adjusted effect ensuring the _ignorability‘ assumption (Abadie, 2003).

3.5 Estimation Strategy

Given that our dependent variable, IPV, is a binary response and our endogenous regressor, women‘s autonomy, is a discrete variable, special attention needs to be paid in the estimation procedure selected. Four estimation methods persevere in addressing such a model, each with their pros and cons: maximum likelihood such as the bivariate probit, control functions such as the IV probit, traditional instrument variables (IV) linear probability model (LPM) using the two stage least squares (2SLS) and Lewbel‘s (2000) special regressor based estimator. We will briefly state each of their strengths and weakness in estimating such a model before we present our results.

3.5.1 Maximum Likelihood

Typical maximum likelihood methods estimate the following model for binary outcomes with endogenous regressors (Dong & Lewbel, 2015):

$$= (\; ' + {}^{0}{}'_{0} + \geq 0)$$
$$(\quad) = 0$$

Let denote the binary IPV dependent variable with outcomes of either zero or one, be the discrete endogenous regressor, women‘s autonomy, ^{0} a vector of included exogenous regressors and the unobserved error term. The vector of exogenous variables, ^{0}, include the determinants of IPV as well as control variables discussed under section 3.3.

Note that this specification is simply a threshold-crossing model where switches from zero to one when $'+{}^{0}{}'_{0}+$ crosses the threshold zero. Logit and Probit are special cases of this threshold-crossing model with having logistic or normal distributions respectively. Blundell and Powell (2004) point out that when an endogenous regressor is involved, for to equal one will depend not on the marginal distribution of , but rather its conditional distribution.

Maximum Likelihood estimator requires that the function G (which is $(\cdot)$*probit* for biprobit estimation), reflecting how the endogenous regressor relates to , be known up to the parameter vector . In this first stage function, is a vector of instruments and is the error representing how the endogenous regressors depend on .

In order for the maximum likelihood estimation to be valid, two initial assumptions need to be fulfilled. Firstly the correct parametric model for needs to be specified, which requires a complete set of instruments , as dropping any element of would lead to misspecification. Secondly, the joint distribution of the two error terms, and , conditional on , also needs to be correctly specified and fully parameterized. Specifically for a biprobit model, and , conditional on , would require joint

normality. This would lead to consistent estimation of the parameter of interest , and hence the choice probabilities and marginal effects of Thus while the maximum likelihood estimation is a reliable estimation for such models given the conditions hold, correctly specifying the complete set of instruments is a difficult task. The major problem however lies in the issue that, should the endogenous regressor be discrete in nature, the covariances between and might not be strongly identified, leading to ridges or multiple local maxima for the maximum likelihood estimation, making both and latent. With the presence of multiple local maxima, one need to prove global concavity of the function or else it remains unknown whether one has converged at a global maximum.

Since our endogenous regressor is discrete in nature, we face this problem for a biprobit estimation, casting doubt on the covariance‘s between and being strongly identified, and whether and , conditional on , follows joint normality.

3.5.2 Control Functions

The second set of possible estimators involves the control functions such as the ivprobit. For the binary choice models, this methodology can be traced back to Heckman and Robb (1985). Advantage of the control function estimators over the maximum likelihood estimators is that the first stage function, where the endogenous regressors is modeled as a function of instruments, can be semi-parametric or non-parametric, and the joint distribution of and does not need to be fully parameterized.

Similar to the maximum likelihood estimator, the control function estimator requires that the set of instruments be exactly defined. Given that (, ,) = 0 is needed for a consistent estimation, if any element of is dropped; will change causing violation of the required assumptions.

However, the major limitation that hinders this approach for binary choice models is that the endogenous regressor is required to be continuous. Assume that the function can be estimated linearly by $-'-= 0$ and that and are jointly normal. The control function estimator as part of its first stage function would linearly regress on obtaining as the residuals. As Lewbel, Dong and Yang (2012) show, because of the normality, can be linearly decomposed to = + where being independent of and the depends on the covariance of and . Inserting = + into the original model gives us the probit model,

$$= (\ ' + {}^{0'}{}_{0} + + \geq 0)$$

is the independent normal error with being included in the model as another regressor (and is just another coefficient) along with and ^{0}. This is estimated by ivprobit in Stata.
One assumption in the control function estimation is that relates to completely through. A discrete endogenous regressor, as is our case, would mean that from the first stage function would not be normal or independent of the other regressors included in the second stage function, causing violations of the assumptions regarding . This would thus lead to inconsistent estimates.

3.5.3 Instrument Variables (IV) Linear Probability Model (LPM)

Unlike the two estimators discussed above, the standard IV LPM estimates using linear 2SLS in presence of endogenous regressors. Therefore the estimation is simply,

$$= {}^{0\prime}{}_{1} + {}^{\prime}{}_{2} +$$

$$= {}_{1} + {}_{2} +$$

As before is the endogenous women's autonomy index, is intimate partner violence, ^{0} denotes a vector of exogenous independent variables, is a vector of the two instrument variables for women's autonomy and , are the respective error terms. In the first stage or reduced form equation the endogenous variable, autonomy, is regressed on all the independent variables including the instrument variables using a LPM. The discrete autonomy index is treated as approximately continuous defined over the range of zero and one. The predicted values of this first stage regression, ,is then used as the instrumented variable in the second-stage regression for estimation, under the assumption that (|) = 0 and that ( ) has full rank equal to the elements of ^{0}.

The reason for LPM's popularity is thanks to its relatively less imposing assumptions. When modelling the endogenous regressors, it does not require a correct specification. In other words, (, ,) = 0, or simply the errors of the first-stage regression do not need to be correctlyspecified. It only requires that be correlated with and uncorrelated with . Relevant to our study, can also have discrete distribution and LPM also allows general forms of heteroscedacticity in .

However, the LPM estimator has its own share of limitations. Lewbel, Dong and Yang (2012) point out that because of the nature of a binary choice model, where for each possible realization of the regressors, will equal one of two possible values, either 1 −( ), both of which are functions of the elements of the regressors. This or −(means that cannot be independent of the regressors.

The other more commonly recognized problem of LPM is its embarrassing knack to predict probabilities more than one or less than zero. This problem arises because the fitted probabilities of LPM estimates are of a linear ′ whereas the fitted probabilities should typically look like a shaped distribution function where the average structural equation is _( ), with _ being the marginal distribution function of − . Wooldridge (2006) however states that the

LPM is meant to approximate the predicted probabilities of the regressors over a limited range, and that over this range, LPM should provide reliable approximations of marginal effects. The arguments against this is that because a linear line is being used to approximate a S shape distribution function, LPM is liable to provide extreme fitted probabilities, either underestimating

towards zero for ranges of ′ > 0.5 or overestimating towards one for ranges of ′ < 0.5.

Angrist and Pischke (2009) provide an example where the marginal effect of a binary regressor on a binary dependent variable estimated by probit and LPM is almost the same, thereby concluding that while nonlinear models may fit conditional expectation functions for such models better than linear models, ―when it comes to marginal effects, this matters little.‖ In contrast, Lewbel, Dong and Yang (2012) show that even in a simple model, LPM can potentially provide vastly different marginal effects (even with opposite signs) than the more reliable probit estimations. This shows that while LPM is accepted by many as an approximation of nonlinear distributions, this is certainly not robust to all estimations, especially in the case of highly non-linear binary choice models. Hence one should be careful in putting too much faith in LPM estimations for binary choice models, and also for ones with discrete endogenous regressors, as in our case.

3.5.4 Special Regressor

The special regressor estimation requires a set of assumptions that are quite different from the maximum likelihood or the control functions approach, although some similarity persists with the LPM. Analogous to the LPM, the special regressor estimation does not require the relationship between endogenous and exogenous regressors to be specified, nor does it impose restrictions on the model errors. It also permits endogenous regressors to be discreet, as is our case. The consistency of its estimation instead depends on one special regressor that is continuous, independent of the model errors conditional on the other regressors and has a large support.

The estimation rewrites the binary choice model as follows,

$$= (+ ' + {}^{0'}{}_{0} + \geq 0)$$

The special regressor, , is separated from the other regressors, is normalized to one, and must satisfy three conditions: that is continuous and varies on a support that is as large as the support of $'+{}^{0'}{}_{0}$, that is exogenous and that ($|{}^{0}$, ,)increases with . The interesting feature of such a model is that it requires only one special regressor regardless of the number of endogenous variables, although in our estimation we simply have one. This also means that should only affect , and not the endogenous variable.

Briefly the steps to special regressor estimation are as follows: (1) De-mean such that it has a mean of zero. (2) Perform ordinary least squares regression of on (^{0}, ,) and obtain the residuals, . (3) Compute the non-parametric kernel estimator, $\hat{}$, of the density of , followed

$\hat{}$

$\hat{}$

h

$\sim\sim$. This requires choosing a bandwidth h, or one can also use Lewbel and

by = ( ) Schennach's

(2007) ordered data estimator, which is however known to be less efficient

$\hat{}$ $-(>0)$ $\hat{}$

(Lewbel, Dong and Yang, 2012). (4) Compute = (thus Since can be very small

have large absolute values of), this can lead to large absolute values of . This in turn can lead to large standard errors in the 2SLS estimation in the next step. Hence, Lewbel (2014) suggests removing these extreme values either by trimming or by using the Winsorisation
(Tukey, 1962) approach. (5) Finally, estimate the coefficients using 2SLS regression of on (^{0},) using the instruments . See Dong and Lewbel (2015) for a more detailedpresentation of the procedure.

The special regressor also permits discrete endogenous regressors by nesting logit and probit as special cases and allows for unknown forms of heteroscedasticity. We use Baum's (2013) sspecialreg command in Stata to run the estimation. Standard tests of instrument validity, similar to the ivreg2 command by Baum, Schaffer and Stillman (2002) in Stata, are conducted at the final stage of the special regressor estimation to check for instrument validity. Finally, it is worth noting that while the conditions of whether is exogenous and whether ($|^0$, ,) increases with can be tested, whether has a large support cannot be empirically tested, which is possibly the main drawback of this estimator.

4. Results

We compare results from different estimators based on the arguments put forth in section 3.5 We do not report the control function estimator, ivprobit, because in the presence of a discrete endogenous regressor the estimates are known to be inconsistent. The maximum likelihood estimator, biprobit, is also excluded due to lack of joint normality of the two errors, as discussed above. We thus report the IV LPM and the special regressor estimates. For comparison the probit results are also reported. IPV is the dependent variable and we add all independent variables discussed earlier in section 3.3. The prime variable of interest is wife's autonomy which is deemed endogenous with IPV. We perform the Anderson-Rubin endogeneity test for autonomy using the endogtest option which is robust to violations of conditional homoscedasticity. The endogeneity test rejects the null hypothesis of exogeneity at 5 per cent rejection level confirming our suspect of endogeneity.

The Hansen J-statistic is well over rejection threshold accepting the orthogonality condition and indicating the validity of the instruments. A test of homoscedasticity using ivhettest yields a Pagan-Hall statistic of 57.54 (p-value = 0.0096) indicating the presence of heteroscedasticity.
Hence we report heteroscedastic standard errors for all estimations. Thus for the IV LPM estimates, we report the generalized method of moments (GMM) estimator and the continuous-updating estimator (CUE) estimator, for more efficient estimation as recommended by Stock, Wright and Yogo (2002).

In a 2SLS weak instrument test, our instruments yield a Kleibergen-Paap Wald statistic of 10.59 which is greater than the Stock-Yogo 10 per cent critical value of 9.08, however less than the five per cent critical value of 13.91. Thus since our instruments can be argued to be border line strong, for comparison we also report the Fuller's modified limited information maximum likelihood (FULL) estimates and Moreira's conditional likelihood ratio (CLR) estimates. FULL and

Moreira's CLR are, respectively, considered to be partially and fully robust to weak instruments (Stock & Yogo, 2005). Following Hahn et al. (2004), = 4 is used in the FULL estimation for the unknown parameter to reduce finite-sample bias.

As discussed under section 3.5.4, a special regressor is needed for the special regressor model that satisfies the aforementioned assumptions. We selected the height of the women, as the special regressor, since it is continuously distributed over a large support (varying between a range of 1324 and 1856 centimetres). Height is also exogenously determined and based on our earlier discussion under section 3.4 we have established that, for our sample, height does not significantly affect autonomy. This can also be seen from the first stage of the 2SLS regression (reported in appendix B) where height is not significant. The special regressor , should also be such that ($|^0$, ,) increases monotonically with , which is also satisfied once the data is cleaned of outliers.

We normalize such that it is a mean of zero and a ninety-five per cent trimming and Winsorisation is also applied to remove outliers. For comparison, the same Winsorised sample (2,416 observations) was used for estimation in the other models (Probit, GMM, CUE, FULL and Moreira's CLR). Because of the presence of heteroscedasticity, we account for unknown form of heteroscedasticity in in the special regressor estimation. Finally, the standard kernel density approach using the Epanechnikov kernel function with the bandwidth according to Silverman's rule of thumb was used to estimate the density required in order to compute the non-parametric kernel estimator, $\hat{}. h$ In order to conduct tests for the special regressor we use a modified version of Baum's (2013) sspecialreg command where the instrument validity tests were incorporated by Bontemps and Nauges (2015). The updated procedure is available upon request. Performed at the last stage of the special regressor estimation, the Anderson under-identification test resulted with a p-value of 0.001, indicating that the instruments are correlated with the endogenous regressor, and the Sargan-Hansen test of over-identification resulted with a p-value of 0.3655, indicating that the instruments are uncorrelated with the error term and are correctly excluded from the estimated equation, confirming the validity of the instruments. Also the kurtosis of the special regressor was 3.027, above the threshold of 3.00, reaffirming the validity of the results. Results are reported in Table 04.

[Insert Table 04 here]

Column 1 presents the probit estimation which does not account for the endogeneity and is provided as a baseline for comparison. Columns 2 to 4 present the various IV LPM results using different estimators; the GMM, CUE, FULL and Moreira's CLR respectively, where the discrete endogenous regressor is treated as approximately continuous defined over the range of zero and one. Finally column 6 presents the marginal effects (not the coefficients) from the special regressor estimation that permits discreet endogenous regressors. Each of the regressions also has cluster fixed effects according to the 361 sampling units.

4.1 Variables of Interest

The discrete endogenous regressor, maternal autonomy, has a positive estimated marginal effect throughout, indicating that increased autonomy does lead to increased IPV in Bangladesh. Unlike the other specifications, autonomy is not significant in the probit estimation and is considerably

underestimated. Ordinary probit estimation fails to account for the endogeneity and yield an underestimation of the impact of autonomy on IPV probabilities.

Once endogeneity is accounted for by purging the reverse causality using instrument variables, each of the IV LPM specifications provide significant estimations with higher magnitude. The GMM and CUE estimators account for heteroscedasticity and FULL and Moreira's CLR account for potential instrument weakness. While the magnitude of the GMM, CUE and Moreira's CLR estimations are comparable, the FULL estimation is smaller. One can argue that the linear nature of LPM estimations and it's inefficiency in dealing with discrete endogenous regressors can lead overestimations towards one for ranges of < 0.5. The special regressor estimation that permits such discrete endogenous regressors provide an estimation that is significant and much smaller than the IV LPM estimates, but larger than the probit estimation. To elaborate, under this specification a fully independent woman (according to our definition of autonomy) faces a probability of encountering 27 per cent more IPV, than a woman without any autonomy.

To compare with previous work, Koenig, Ahmed, Hossain and Mozumder (2003) using a sample from two rural areas in Bangladesh (Sirajganj and Jessore) and multilevel logistic analysis estimated a significant effect of 0.1093 of autonomy on IPV. While differences in index construction persist, our special regression estimation provides a much larger significant impact of 0.270. While Rahman, Nakamura, Seino and Kizuki (2013) using logistic regression and the same 2007 BDHS dataset find no statistically significant difference between the experiences of any form of IPV and women's decision-making autonomy, our holistic autonomy index do find significant impact on IPV, while accounting for endogeneity.

The differences among estimated marginal effects of the different models beget the importance of checking underlying assumptions of models. Given the binary nature of our dependent variable and discrete endogenous regressor, the probit estimation is known to be not reliable, as reflected in the results. While it is common place within the literature to use IV LPM estimation procedures for such endogenous cases, the discrete nature of the endogenous variable once again can cast doubt on the reliability, often overestimating the impact. We thus propose the special regressor to be a more reliable estimator for such binary dependent and discrete endogenous variables cases.

Unlike Schuler, Hashemi, Riley and Akhter (1996) who, using logistic regression, find that participating woman in BRAC and Grameen credit programs tend to have significantly lower IPV, our variable representing women participation with NGOs in general, result in negative (except for probit estimation), but not significant estimation. Nevertheless, this conclusion is important to note in order to actualize that women participating in NGO programs does not exhaustively face lower IPV.

It is important, however, to remember that this is in no manner an impact evaluation; women involved with NGOs might have had lower prevalence of IPV within their households even before being associated an NGO. A randomized control trail would be required to explicitly study such an impact analysis, which is not the aim of this study. The male controlling behaviour is also of interest as a major determinant of IPV. Expectedly, even after controlling for a host of relevant factors, we find significant positive impact of increased controlling behaviour on IPV. The special

regressor specification once again estimate a smaller marginal effect of 0.0842 compared to the IV LMP estimates (ranging between 0.337 and 0.341). Villarreal (2007), in a Mexican study, posited that working women, with more economic independence, encounter less IPV due to male controlling behavior. In order to check this, we include an interaction term of non-working women with male controlling behavior index and re-run the regressions (results not reported). The special regressor estimation yield a marginal effect of 0.132 on male controlling behavior and -0.0618 on the interaction term, both significant at the 5 per cent rejection threshold.

While this indicates contrary evidence to Villarreal's elucidation, that for our Bangladesh sample non-working women face a probability of 6.18 per cent less IPV from a fully controlling husband compared to a working woman, this result should be taken cautiously. Villarreal (2007) showed that by treating employment as endogenous, non-working women faced higher IPV; hence further work needs to be done in order to reach any conclusive result. It could also be true, according to Heath's (2014) argument, that the relationship lies not in the fact that working gives a woman more autonomy but that the woman had higher level of decision-making autonomy to begin with that increased the probability of facing IPV.

As mentioned earlier, our intergeneration IPV variable focuses on the husband witnessing IPV as a child. Interestingly, the special regressor estimate (0.263) here is larger than comparable IV LPM estimates (between 0.183 and 0.814). Elaborating this, the special regressor estimates that a husband who witnesses IPV between his parents as a child faces a 26.3 per cent higher probability of engaging in domestic violence than a husband who did not. It is interesting that the magnitude of the impact of intergenerational IPV is very similar to that of autonomy, accentuating the importance of this intergenerational behavioral transmission.

4.2 Other determinants

Higher education of women expectedly reduces IPV as found in the literature (Koenig, Ahmed, Hossain & Mozumder, 2003; Rapp, Zoch, Khan, Pollmann & Krämer, 2012). Furthermore, higher education gap between the husband and the wife (where the husband has higher education) also is found to reduce IPV, although this is insignificant for the special regressor specification. Interestingly, compared to poorer households, wealthier households face higher incidence of IPV for our sample, while it is insignificant for the richest quartile. This is not a novel finding and has been reported in earlier studies (Eswaran & Malhotra, 2011). It is possible that the wealthier families are more concerned about their family status or honour, inflicting higher restraint to women's mobility and thus leading to higher IPV. As ironic as it is, we do find negative coefficients with higher wealth status in the first stage of the IV 2SLS regression (reported in appendix B). Thus paradoxically, it seems that women in more affluent families have lower bargaining power.

In line with our expectations and as found earlier by Bates, Schuler, Islam and Islam (2004), women married at an older age face lower IPV, although the magnitude of this impact, after controlling for the other factors, is relatively small, and is insignificant for the special regressor. Also small in magnitude, women with greater height face lower IPV as expected. This can be due to better health and thus a lower chance of the husband over powering the woman. Interestingly, after controlling for the various factors, the knowledge index of the woman and the use of menstrual regulation do

not significantly affect IPV. However, the direction of the effect is as expected; higher knowledge is expected to reduce IPV and greater menstrual regulation is expected to lead to more conflict with the husband due to abstinence in child bearing and thus increase IPV.

Finally, increased number of household members is found to lead to significantly higher IPV in contrast to Rahman, Nakamura, Seino and Kizuki (2013) but in support of Kishor and Johnson's (2004) findings. A larger household requires greater income to sustain; hence a non-working woman is more prone to IPV in such cases. This is easily verified by including an interaction term of non-working women with the number of household members and re-running the regression (results not reported). The interaction term yields a positive value of 0.00481 and the coefficient on the number of household members also yields a positive 0.0396 in the special regressor estimation, both significant at the 5 per cent rejection threshold. This shows that non-working women in larger households face greater IPV than working women in large households. Once again however, this finding should be taken with a grain of salt because of the potential endogeneity of women employment, as identified by Villarreal (2007).

5. Conclusion

In this study we argue for the endogeneity of women's autonomy with IPV, which is often ignored in the existing literature. We set up an econometric framework for accurately estimating the effect of autonomy on IPV, while dealing with endogeneity and isolating the impact by controlling for patriarchy, jealousy triggered by genetic paternal uncertainly or intergenerational impacts, among a host of other control factors. In the hunt for an exemplary method, various estimation strategies were explored for our binary outcome with discrete endogenous regressor model, with several forms of IV LPM specifications and the special regressor specification being reported.

For our sample, autonomy was confirmed to be endogenous and tests confirmed the validity of the instruments used. In addition, mother's height was used as the special regressor for the special regressor estimation, which we believe satisfied all the required conditions for the proper identification of the parameters of interest. This study is also novel in applying the special regressor in IPV models. While the IV LPM results were found to overestimate the results, the special regressor, due to permitting discrete endogenous regressors by nesting logit and probit as special cases and allowing for unknown forms of heteroscedasticity, resulted in much more moderate and pragmatic estimates. This leads us to recommend to practitioners the use of the special regressor model if a special regressor is available.

Many policy makers believe increased woman's autonomy would lead to lower IPV by granting them greater bargaining power. However, as we have seen, the story is not so simple. Increased women's autonomy was found to lead to higher incidents of IPV for a South Asian patriarchal society such as Bangladesh. Does this mean policies should not aim for increased women's autonomy? Policies certainly should; however what is equally important is for policies to discourage increasing IPV incidents due to greater women's autonomy.

This can be done by simultaneously executing policies that focus on the other determinants of IPV. We also find significant positive effect of husband's controlling behaviour and witnessing inter-

parental abuse as a child on IPV. Thus, in addition to increasing women's autonomy, there should be simultaneous programs that aim to relax male controlling behaviour over women by nudging community socio-political and religious environmental changes, and by promoting socialization activities for men as suggested by Bowlus and Seitz (2006). Counselling can also be provided for those who have witnessed inter-parental abuse as a child, so as to dampen the intergenerational IPV transfer. Furthermore, because women marrying at a younger age have been found to face greater IPV, laws prohibiting child marriage, still prevalent in rural South Asian cultures, should be strictly enforced. Most importantly, it is pertinent to take all of these dimensions addressing IPV as complementary, not as substitutes, to existing policies that empower women, acknowledging that simply promoting women's autonomy can be a double edge sword.

Tables

Table 01: Summary Statistics of Outcome Variable(n=2,544)

Variable	Mean	Std. Error	95% Confidence Interval
Physical IPV	0.613	0.010	0.594 - 0.632
Ever pushed, shook or threw something	0.355	0.009	0.337 - 0.374
Ever slapped	0.573	0.010	0.553 - 0.592
Ever punched with fist or something harmful	0.177	0.008	0.162 - 0.192
Ever kicked or dragged	0.140	0.007	0.126 - 0.153
Ever tried to choke or burn	0.096	0.006	0.084 - 0.107
Ever twisted arm or pulled her hair	0.148	0.007	0.134 - 0.162

Table 02: Summary Statistics of Predictor Variables (n=2,544)

Variable	Mean	Std. Error	Type of Variable	Pearson Chi-square P-value
Variables of Interest				
Woman's Autonomy	0.700	0.005	Discrete	0.050
Husband's Controlling Behaviour	0.246	0.005	Discrete	0.000
Woman's NGO Involvement	0.084	0.002	Discrete	0.043
Intergenerational IPV	0.260	0.009	Binary	0.000
Individual Characteristics				
Woman's Age (years)	29.908	0.164	Continuous	0.321
Woman's Age at First Marriage	15.351	0.054	Continuous	0.000
Age Difference in Couple	8.917	0.097	Continuous	0.841
Woman's Education Class 1 ≤ Primary	0.325	0.009	Binary	0.000
Woman's Education Primary ≤Secondary	0.308	0.009	Binary	0.000
Woman's Education ≥Secondary	0.079	0.005	Binary	0.000
Education Difference in Couple (years)	0.249	3.886	Continuous	0.052
Woman's Knowledge Index	0.613	0.004	Discrete	0.026
Woman used Menstrual Regulation	0.068	0.005	Binary	0.333
Woman's Height (in centimetres)	1506.3	54.259	Continuous	0.326

Socio-Economic Characteristics				
Household Wealth = Poorer (Ref: Poorest)	0.193	0.008	Binary	0.000
Household Wealth = Middle	0.200	0.008	Binary	0.066
Household Wealth = Richer	0.194	0.008	Binary	0.153
Household Wealth = Richest	0.250	0.009	Binary	0.000
Number of Household Members	5.831	0.054	Continuous	0.634
Woman Working in Agriculture (Ref: Unemployed)	0.160	0.007	Binary	0.000
Woman Working in Services	0.055	0.005	Binary	0.069
Woman Working as Semi-Skilled	0.038	0.004	Binary	0.413
Woman Working as Professional	0.018	0.003	Binary	0.002
Woman Working as Entrepreneur	0.058	0.005	Binary	0.873
Other Control Variables				
Islam (Ref: Other Religion)	0.887	0.006	Binary	0.063
Urban (Ref: Rural)	0.379	0.010	Binary	0.008
Barisal (Ref: Dhaka)	0.128	0.007	Binary	0.829
Chittagong	0.160	0.007	Binary	0.079
Khulna	0.171	0.007	Binary	0.042
Rajshahi	0.125	0.007	Binary	0.003
Sylhet	0.131	0.007	Binary	0.000
Rangpur	0.088	0.006	Binary	0.049

Table 03: Pair-wise correlation coefficients

	Autonomy	Woman does not belong to extended family	Other equal (or higher) ranked women not present in household
Autonomy	1.0000		
Woman does not belong to extended family	0.1366*	1.0000	
Other equal (or higher) ranked women not present in household	0.2044*	0.5105*	1.0000

Table 04: Regression Results

Variables	(1) Probit	(2) GMM	(3) CUE	(4) FULLER	(5) Moreira's CLR	(6) Special Regressor

	(robust standard errors in parentheses)					(t statistics in parentheses)
Variables of Interest						
Woman's Autonomy	0.117	0.811*	0.871*	0.697*	0.804*	0.270*
	(0.104)	(0.475)	(0.483)	(0.400)	(0.472)	(1.75)
Husband's Controlling	1.101***	0.341***	0.341***	0.337***	0.337***	0.0842***
Behaviour	(0.134)	(0.0410)	(0.0417)	(0.0402)	(0.0423)	(5.69)
Woman's NGO	0.104	-0.0784	-0.0873	-0.0544	-0.0700	-0.0479
Involvement	(0.240)	(0.111)	(0.113)	(0.103)	(0.114)	(-0.12)
Intergenerational IPV	0.556***	0.183***	0.184***	0.184***	0.184***	0.263***
	(0.0665)	(0.0220)	(0.0223)	(0.0216)	(0.0232)	(4.22)
Individual Characteristics						
Woman's Age	0.0503**	-0.0159	-0.0185	-0.0125	-0.0170	-0.00503
	(0.0245)	(0.0220)	(0.0223)	(0.0190)	(0.0221)	(-0.64)
Woman's Age Squared	-0.00080**	0.000185	0.000221	0.000139	0.000202	0.0000731
	(0.000383)	(0.000312)	(0.000317)	(0.000272)	(0.000314)	(0.66)
Woman's Age at First	-0.0331***	-0.00882*	-0.00850*	-0.00891**	-0.00845*	-0.000990
Marriage	(0.0118)	(0.00468)	(0.00475)	(0.00448)	(0.00499)	(-0.56)
Age Difference in	-0.00723	-0.00197	-0.00189	-0.00197	-0.00189	-0.000352
Couple	(0.00579)	(0.00212)	(0.00215)	(0.00206)	(0.00219)	(0.46)
Woman's Education	-0.0842	-0.0388	-0.0395	-0.0334	-0.0343	0.00144
Class 1 ≤ Primary	(0.0737)	(0.0267)	(0.0271)	(0.0263)	(0.0268)	(0.15)
Woman's Education	-0.342***	-0.132***	-0.133***	-0.128***	-0.129***	-0.0164
Primary ≤ Secondary	(0.0899)	(0.0329)	(0.0333)	(0.0322)	(0.0329)	(-1.41)
Woman's Education ≥	-0.485***	-0.242***	-0.248***	-0.229***	-0.238***	-0.0350
Secondary	(0.147)	(0.0689)	(0.0699)	(0.0645)	(0.0674)	(-1.47)
Education Difference	-0.0126**	-0.00399** -0.00394**	-0.00395**	-0.00403**		-0.0000658
in Couple (years)	(0.00550)	(0.00190)	(0.00192)	(0.00187)	(0.00167)	(-0.11)
Woman's Knowledge	-0.0498	-0.156	-0.167	-0.136	-0.156	-0.0313
Index	(0.186)	(0.106)	(0.108)	(0.0949)	(0.112)	(-0.79)
Woman used	0.217**	0.0591	0.0580	0.0610	0.0590	0.0169
Menstrual Regulation	(0.107)	(0.0386)	(0.0390)	(0.0377)	(0.0411)	(-1.17)
Woman's Height (in	-0.000729	-0.000306* -0.000316*	-0.000311*	-0.000305*		-0.000131*
centimetres)	(0.000483)	(0.000181)	(0.000183)	(0.000176)	(0.000191)	(-1.95)
Socio-Economic Characteristics						
Wealth = Poorer (Ref:	0.285***	0.121***	0.123***	0.115***	0.119***	0.0336***

Poorest)	(0.0919)	(0.0372)	(0.0378)	(0.0355)	(0.0368)	(2.58)
Wealth = Middle	0.168*	0.0644*	0.0652*	0.0613*	0.0622*	0.0163
	(0.0910)	(0.0335)	(0.0341)	(0.0327)	(0.0345)	(1.34)
Wealth = Richer	0.200*	0.0819**	0.0830**	0.0771**	0.0786**	0.0244*
	(0.107)	(0.0398)	(0.0404)	(0.0389)	(0.0377)	(1.83)
Wealth = Richest	-0.0223	0.0104	0.0125	0.00347	0.00640	0.0166
	(0.115)	(0.0445)	(0.0452)	(0.0432)	(0.0441)	(1.07)
Number of Household	0.0686***	0.0317***	0.0323***	0.0306***	0.0318***	0.0114***
Members	(0.0103)	(0.00634)	(0.00647)	(0.00560)	(0.00652)	(4.99)
Working in Agriculture	-0.00378	0.0122	0.0132	0.0118	0.0139	0.00106
(Ref: Unemployed)	(0.0813)	(0.0281)	(0.0285)	(0.0273)	(0.0308)	(-0.10)
Working in Services	0.00578 (0.127)	-0.0508 (0.0588)	-0.0539 (0.0603)	-0.0391 (0.0552)	-0.0458 (0.0536)	-0.0114 (-0.60)
Working as Semi-Skilled	0.00401 (0.140)	-0.00001 (0.0510)	-0.000152 (0.0516)	0.000247 (0.0502)	0.000303 (0.0528)	0.0183 (0.98)
Working as Professional	-0.0450 (0.205)	-0.0563 (0.0800)	-0.0593 (0.0808)	-0.0514 (0.0780)	-0.0569 (0.0854)	-0.00710 (-0.24)
Working as Entrepreneur	-0.0722 (0.125)	-0.0500 (0.0472)	-0.0517 (0.0478)	-0.0451 (0.0459)	-0.0479 (0.0450)	-0.00903 (-0.57)
Other Control Variables						
Islam (Red: Other Religions)	0.0450 (0.0839)	-0.0125 (0.0366)	-0.0150 (0.0373)	-0.00633 (0.0346)	-0.0101 (0.0358)	-0.0155 (-1.23)
Urban (Ref: Rural)	0.0676 (0.0728)	-0.00964 (0.0361)	-0.0130 (0.0367)	-0.00330 (0.0335)	-0.00780 (0.0313)	-0.0161 (-1.45)
Barisal (Ref: Dhaka)	-0.106 (0.104)	-0.0165 (0.0399)	-0.0146 (0.0405)	-0.0228 (0.0387)	-0.0200 (0.0384)	0.00113 (0.08)
Chittagong	-0.145 (0.103)	-0.0280 (0.0398)	-0.0262 (0.0402)	-0.0327 (0.0385)	-0.0297 (0.0363)	0.00330 (0.26)
Khulna	0.0710 (0.0913)	0.0127 (0.0319)	0.0116 (0.0323)	0.0126 (0.0313)	0.0108 (0.0340)	-0.00394 (-0.33)
Rajshahi	0.227** (0.0947)	0.0979*** (0.0359)	0.0990*** (0.0366)	0.0912*** (0.0349)	0.0934** (0.0372)	0.0172 (1.31)
Sylhet	-0.343*** (0.102)	-0.0930** (0.0439)	-0.0907** (0.0449)	-0.0988** (0.0417)	-0.0950** (0.0411)	0.00689 (0.48)
Rangpur	0.129 (0.135)	0.0112 (0.0519)	0.00892 (0.0526)	0.0138 (0.0498)	0.00837 (0.0470)	-0.00231 (-0.14)
Constant	0.396 (0.810)	0.785*** (0.303)	0.793*** (0.307)	0.793*** (0.295)	0.814** (0.323)	0.0688 (0.60)
Observations	2,416	2,416	2,416	2,416	2,416	2,416

Note: Marginal effects at the mean, average index function are reported for the special regressor estimation. *** p<0.01, ** p<0.05, * p<0.1

Appendix A

Knowledge Index: 2007 BDHS questions relating to exposure to mass media and knowledgeof illnesses used to create the women's knowledge index:

1) Do you read a newspaper or magazine?
2) Do you listen to the radio?
3) Do you watch television?
4) Have you heard of AIDS or other sexually transmitted diseases?
5) Have you ever heard of an illness called tuberculosis or TB?

Husband's Controlling Behaviour: 2007 BDHS questions relating to the controlling behaviourof the husband towards his wife:

Sometimes a husband is annoyed or angered by things that his wife does. In your opinion, is a husband justified in hitting or beating his wife in the following situations:

1) If she goes out without telling him?
2) If she neglects the children?
3) If she argues with him?
4) If she refuses to have sex with him?
5) If she does not obey elders in the family?
6) If for some reason the husband cannot make enough money for the family, do you believe it is acceptable for married women to work outside the home to earn an income?

Appendix B

First-stage regression results of IV 2SLS estimation (t statistics in parentheses)

Dependent Variable: Women's autonomy

Woman does not belong to extended family	0.0136* (2.31)
Other equal (or higher) ranked women not present in household	0.0679*** (3.41)
Husband's Controlling Behaviour	-0.00477 (-0.22)
Woman's NGO Involvement	0.124* (2.36)
Intergenerational IPV	-0.00533 (-0.50)
Woman's Age	0.0380** (7.48)

Woman‘s Age Squared	-0.000531*** (-6.73)
Woman‘s Age at First Marriage	-0.00257 (-1.07)
Age Difference in Couple	-0.00133 (-1.25)
Woman‘s Education Class 1 ≤ Primary	0.000708 (0.05)
Woman‘s Education Primary ≤ Secondary	0.00416 (0.24)
Woman‘s Education ≥ Secondary	0.0667* (2.57)
Education Difference in Couple (years)	-0.00419** (-2.76)
Woman‘s Knowledge Index	0.136*** (5.20)
Woman used Menstrual Regulation	0.0188 (1.08)
Woman‘s Height (in centimetres)	-0.000115 (1.22)
Wealth = Poorer (Ref: Poorest)	-0.0288 (-1.62)
Wealth = Middle	-0.00113 (-0.06)
Wealth = Richer	-0.00179 (-0.09)
Wealth = Richest	-0.0115 (-0.49)
Number of Household Members	0.00626 (-1.67)
Working in Agriculture (Ref: Unemployed)	-0.0195 (-1.29)
Working in Services	0.0622 (1.95)

Working as Semi-Skilled	0.00716 (0.30)
Working as Professional	0.0498 (1.52)
Working as Entrepreneur	0.0266 (1.18)
Islam (Red: Other Religions)	0.0289 (1.36)
Urban (Ref: Rural)	0.0373* (2.57)
Barisal (Ref: Dhaka)	-0.0222 (-1.06)
Chittagong	-0.0297 (-1.55)
Khulna	0.0164 (0.88)
Rajshahi	-0.0185 (-0.84)
Sylhet	-0.0401 (-1.64)
Rangpur	0.0551* (2.41)
Constant	-0.249 (-1.52)
Observations	2,416

*** p<0.01, ** p<0.05, * p<0.1

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Is Poverty and Sexual Harassment During Extreme Weather Events a Matter for Early Marriage in Vulnerable Areas (Bangladesh)?

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Abstract

This study tries to explore how poverty and sexual harassment is related with early marriage in vulnerable areas to extreme weather events. This study hypothesized that people living in vulnerable area may perceive to tackle poverty due to the adverse impacts of extreme events such as floods by choosing their daughter get married at early marriage. This study also hypothesized that people's fear of sexual harassment during flood periods may influence to consider their daughter get married at early age. We selected Sunamganj district as flood prone area and Brahmanbaria as tornado and flood prone area. We collected relevant information from 120 household heads and analyzed data by using quantitative and qualitative methods. Key findings of this study show that many household heads consider early marriage of their young daughters as a strategy to cope with poverty and reduce their fear about sexual harassment to their daughters during extreme weather events. These two factors influence them to perceive early marriage of their daughters as a strategy to tackle the adverse impacts of extreme events and maintain their reputation from sexual harassment. It was evident that 86.2 percent and 62 percent girls were married before 18 years in Sunamganj and Brahmanbaria respectively. That implies the increase of early marriage and consequently the low age at first birth and high fertility in vulnerable areas. Findings of this study may help to advocate for development programs for vulnerable populations who regularly face extreme weather events especially in developing countries like Bangladesh.

Keywords: *early marriage; extreme weather events, poverty; sexual harassment; vulnerableareas*

1. Introduction

Bangladesh is the most vulnerable country to extreme weather events. Bangladesh is highly flood prone country and is presumed as the sixth most flood prone countries in the world (UNDP 2004). Notably, 80 percent of the country coincides with flood plains of Brahmaputra, Ganges and Meghna. These flood plains sustain a predominantly poverty-stricken rural population (Brouwer et al. 2007). Floods are the most annihilated natural hazards which bring a large number of people affected and properties damaged in the country (Nasreen 1998; Kumbetoglu & User 2010). The biggest proportion of population and percentage of economy is exposed to floods in developing countries such as Cambodia, Bangladesh and Vietnam (Peduzzi et al. 2009). Adverse impacts of natural disasters, limited natural resource and over population are responsible for widespread poverty (Karim 1996; Emdad 1997). Mostly poor people living in vulnerable areas live at greater density and poorly constructed housing in settlements that are highly prone to natural hazards in

Bangladesh. Every year extreme weather events especially floods affect poor people in some part of the country (Azad, Hossain & Nasreen 2013). Vulnerability and poverty is closely related. For instance, flooding brings effects not only on the environment but also people's socio-economic conditions such as income, education etc that are very low for vulnerable populations (Philip & Rayhan 2004). From the poverty maps of Bangladesh, it comes to know that Chittagong (26.2) and Sylhet (28.1) division have lowest incidence of poverty. Contrarily, Rangpur (43.2) and Barisal (39.4) have highest incidence of headcount poverty. In terms of early marriage, Chittagong and Sylhet division have lowest rate of early marriage than other divisions (**Table 1**). Thus, in this study two areas were selected from the Chittagong and Sylhet division to know the practice of early marriage as a coping strategy to poverty.

Table 1: Poverty and early marriage in Bangladesh

Division	Extreme poverty (%)	HIES 2010 poverty headcount (%)	Rate of early marriage (%)
Rajshahi	16	29.7	73
Dhaka	15.6	30.5	66
Khulna	15.4	32.1	75
Barisal	26.7	39.4	72
Chittagong	**13.1**	**26.2**	**58**
Sylhet	**20.7**	**28.1**	**48**
	Source: Bangladesh Poverty Assessment 2013, World Bank (Gimenez et al. 2013)	Source: Poverty maps of Bangladesh 2010 (Ahmed et al. 2010)	Source: BDHS 2007

Poor people consider to marrying their daughter at an early age for economic survival and they perceive to have one less person to feed, clothe and educate (Malhotra 2010). People also consider early marriage as protection of daughters from fear of rape (Bierman 2006), hunger or starvation, and vulnerability to natural disasters (Ferdousi 2014). It is also due to a strategy for economic survival, getting rid of suffering from poverty, lacking of education of their daughters (Hossain, Mahumud & Saw. 2015), forcing of societal norms as well (Malhotra 2010). In the case of Bangladesh marriage is common and 66% girls are married before the age 18 (UNICEF 2011). The mean age at first marriage of girls was 16.8 years for the country (Streatfield et al. 2015).

This study aims to explore the impacts of poverty and sexual harassment due to extreme weather events on early marriage in rural Bangladesh. Since disaster prone areas are more vulnerable and suffer from poverty due to the adverse impacts of extreme events. In this study we hypothesized that *people who suffer from poverty due to extreme floods are more likely to perceive earlymarriage*

as an option to escape from poverty. In this case age at first marriage of girls may be low (before 18 years) in vulnerable areas. People who take shelter in shelter house for extremeevents think that early marriage can be an instrument to protect their daughters against sexual harassment (Bierman 2006). We also hypothesized that people who have fear of sexual harassment of their daughters are more likely to perceive early marriage as an instrument for protection. This study also aims to compare the perception of early marriage for areas vulnerable to different extreme weather events such as Sunamganj District as floods affected area and Brahmanbaria as tornado and flood affected area in Bangladesh.

2. Relevant Literature Reviews

Vulnerability and poverty are closely associated and poor people are the most vulnerable to extreme weather events. Ecological fragality and the vulnerability dimension of poverty is affected by the likelihood of natural disasters (Nelson & Agbey 2005). Household's vulnerability of poor is characterized by low income (Philip & Rayhan 2004; Carter & Barrett 2006). Vulnerability affects economic sustainability and forces to people remain poor. Poverty is a state of deprivation and a circumstance of vulnerability (Karim 1996).

In poor households the decision of early marriage is related with poverty and early marriage is perceived as an optimal preference for young girls (Bajracharya & Amin 2010). Early marriage is more frequent among the poorest families (Hossain & Islam 2013; Haq 2013). Poor people consider daughters as an economic burden to the family and perceive daughter's marriage at early age as a significant shift of the expenses such as rearing, educating and as a strategy of maintaining their reputation from sexual harassment (Hossain & Islam 2013). Moreover, the practice of paying dowry during marriage is associated with girl's age. Poor family considers marrying off their daughters at early age to keep giving dowry with low cost. They consider that investment may be larger if daughters get older (Dyson & Moore 1983; Mathur, Greene & Malhotra. 2003). Such decisions are considered as an economic survival strategy. Factors involved with early marriage include poverty, lack of education as well as job opportunities, tradition and the force of custom (Malhotra 2010). Some mothers in rural Nepal consider that if they got any opportunity to marry their daughters off to a man of wealth, they accept the offer to enable them to get relieved from burden (World Vision UK 2003; Malhotra 2010). But in Ethiopia people perceive early marriage of girls as a sign of economic prosperity and social prestige. They also consider having more girls in family as a stressful condition which may turn them to be poor (Ezra 2001). It is evident from a report by UNRWA Microfinance Department (2011) that poverty exposure and size of family is highly correlated and marriage is a strategy to secure income of household during crisis periods such as natural disasters or fragility. In addition rates of early marriage tend to be high where poverty, birth and death rates are high (World Vision UK 2003).

Sexual harassment may lead early marriage of daughters. Parents fear about rape and sexual violence to their girls is assumed a reason for early marriage. Rape or sexual harassment is also related with family's shame and dishonor (World Vision UK 2003). Perception about early marriage of girls is strengthened by the fear and anxiety during fragile contexts and vulnerability to extreme events (World Vision UK 2003). In the tsunami of 2004, there were an increased rate of early marriage and different forms of sexual violence in Indonesia. Poor families those who live

in shelters/refugee camps think early marriage as the only protection for their daughters against rape or any forms of sexual harassment (Bierman 2006; Marife & Ballesteros 2010). Parents also perceive that their married daughters will be in a comfortable economic circumstance and safe from sexual harassment (Ferdousi 2014). During extreme events such as floods and cyclones, affected people take shelter in school, hospital, local office etc. for a short period or a long period in Bangladesh. It is evident that young girls face different sexual harassment at the time of staying in shelters. For instance the rate of sexual harassment is high in the coastal belt of Bangladesh due to poverty and the impacts of extreme weather events (Plan International 2011). Girls in shelters are more vulnerable when their parents pass away or become separated (Plan International 2011).

3. Methodology

3.1 Study Area

We selected two vulnerable villages of Bangladesh from Sunamganj district (flood prone area) and Brahmanbaria district (tornado and flood prone) respectively. Every year Sunamgonj district is affected by floods extensively (IFAD 2010). Brahmanbaria is also was affected by extreme weather events such as tornado and regular floods. Severe local storm is one of the most important natural hazards in Brahmanbaria District of Bangladesh (Yamane et al. 2010).

3.2 Sampling Size & Method

We used a four stage stratified random sampling design. At first stage we selected vulnerable districts Sunamganj and Brahmanbaria. Subdivisions Jamalganj upazila and Basudeb were selected at the second stage. At the third stage, we selected Ali pur village from Jamalganj and Chandi from Brahmanbaria. We included 120 households in our study by using sampling size formula from a total of 340 households in both villages respectively. We separated sample size for both villages by using proportionate stratified sampling as the most widely used method of allocation (Islam 2008). In this way, we included 78 households from Chandi village of Brahmanbaria district and 42 households from Alipur village of Sunamgonj district. The allocation scheme is shown in **Table 2** below.

Table 2: Sample sizes of the study villages

Stratum	N	N
Brahmnbaria	220	78
Sunamganj	120	42
Total	N=340	n=120

3.3 Data Collection Tools

We collected data by using questionnaire survey and in-depth interviews of household heads. We also collected opinions and experiences from respondents by using a semi-structured questionnaire. By using questionnaire we collected quantitative information. We used in-depth interview for

qualitative information on the relationship between poverty, sexual harassment and early marriage as open ended responses (Nachmias & Nachmias 1996). We gathered quantitative information from respondents on their socio-economic and demographic characteristics, issues related to early marriage. We included 40 household's heads (including male and female) for in-depth interview. Those households were considered as well informant for in-depth discussion on their experiences during extreme weather events. We used five point Likert scale and asked respondents to provide their reactions on different scale items.

3.4 Data Analysis Techniques

We used both quantitative and qualitative methods to analyze collected data. We took the help of Chi square test, factor analysis, and frequency distributions. We used Chi square test to test independence and factor analysis to explore potentially influential factors on early marriage whether it is due to poverty and sexual harassment during extreme events. We also broaden our understanding by analyzing qualitative method such as paraphrased translation of key information collected during in-depth interview. We used local language to interpret and collect information from respondents and then we transcribed their answers in English and summarized key information to present in analysis.

4. Results and Discussions

4.1 Early Marriage, Sexual Harassment, Socioeconomic and Demographic Characteristics

From field level survey, it was found that 38.1 percent households in Sunamgonj ***and*** 16.7 percent in Brahmanbaria are female headed. Field observations show that female headed households are more vulnerable to poverty and sexual harassment during extreme weather events. In terms of ***literacy***, 71.4 percent respondents from Sunamgonj and from Brahmanbaria were illiterate and mentioned that they don't know reading and writing. For ***income***, in Sunamgonj 95.2 percent respondents couldn't earn more than BDT 8000 and 37.2 percent respondents from Brahmanbaria were able to earn more than BDT 8000 (per month) respectively. Low income in Sunamganj highlights that household heads in Sunamgonj consider taking loan ***during crisis and taking loan*** was relatively lower among household heads in Brahmanbaria. 23.8 percent and 7.7 percent respondents from Sunamgonj and Brahmanbaria took loan to maintain and tackle the adverse impacts of extreme weather events. About 50 percent respondents from Sunamgonj mentioned that they were not able to manage two meals each day whereas in Brahmanbaria, 90 percent respondents were able to take their regular meals. Field visits suggest that people from Sunamgonj are more vulnerable to extreme events than Brahmanbaria.

Regarding age at first marriage, 13.8 percent household heads from Sunamganj and 38 percent from Brahmanbaria mentioned that their daughter were not married off after 18 years old. In Sunamganj and Brahmanbaria 34.5 percent and 14 percent girls were married off even before 14 years respectively. In Sunamganj and Brahmanbaria, total 86.2 percent and 62 percent girls were married off before 18 years respectively. From Figure 2, it is clear that the early marriage is higher in Sunamganj than Brahmanbaria.

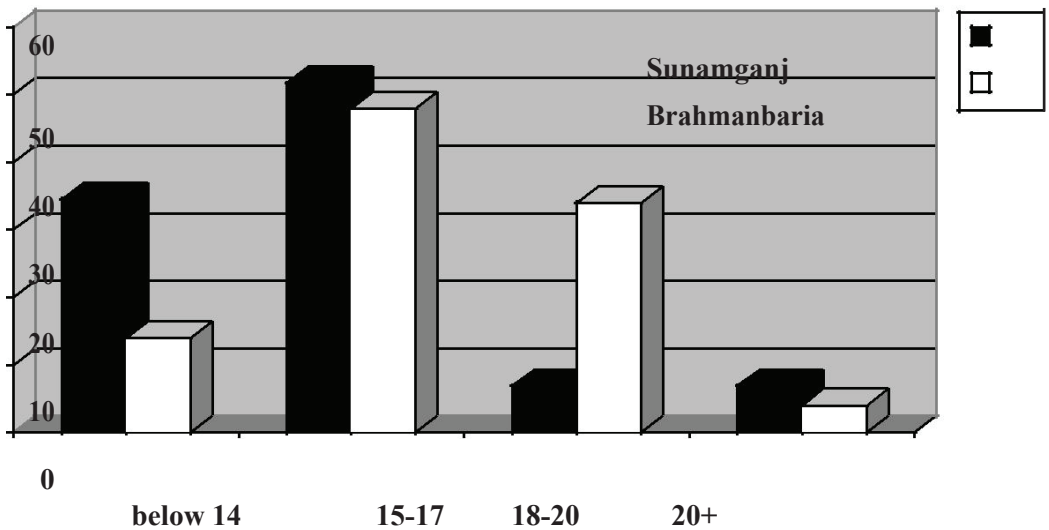


Fig. 1: Age at first marriage in vulnerable areas (Bangladesh)

Source: Field survey, 2014.

Regarding ***family size*** average family size is 6 per household head in both study areas. , Marrying off girls was not dependent on family size. Majority of girls were married from both families who had lower family size and larger family size ($p > .05$ for both study areas Sunamgonj and Brahmanbaria). Household vulnerability is associated with low income (Philip & Rayhan 2004). For Brahmanbaria, *age at first marriage of girls was not influenced by the incomeof households (P>.05) but it was dependent on the income of households for Sunamganj (P<.05)*.In Sunamgonj (floods affected area) early marriage was mostly present in low income households. ***Household expenditure*** (Carter & Barrett 2006) is also associated with age at first marriage. *Age at first marriage of girls was not linked with household expenditure* for both study areas (p>.05). There was a difference before giving marrying off girls and after in the terms of household expenditure. Findings show that *households spend more money before giving theirgirl's marriage and household's expenditure get a bit larger after giving their girls marriage (p<.05).*

Small loans are effective instrument for addressing mass poverty as most poor cannot afford any amount to expand. Poor households take loan to lead their back and belly. Households consider taking loan to give marriage off their daughters and it happens for households which suffer from vulnerability to areas adverse impacts of extreme weather events (Kasali and Sowunmi 2013). It is true for Sunamgonj *that age at first marriage of girls occurs by taking loan from NGOs or welloff persons (p<.05) but it was opposite for* Brahmanbaria (p>.05). In terms of***land ownership***ofhouseholds and age at first marriage of girls, 40 percent of households who had some land ownership and 22 percent of households who didn't have land gave their daughters marriage off before 18 years in Brahmanbaria. For Sunamganj, 14 percent households with some land ownership gave their daughters married off and 71 percent households with no land ownership gave their daughters married off (p>.05).

4.2 Extreme Weather Events, Sexual Harassments and Early Marriage

In our study, we hypothesized that those who have a fear of sexual harassment of their daughters are more likely to consider to marrying off their daughters at ***early age***. Findings show that a small number of household heads felt the fear of sexual harassment of their daughter and they decided to get married off their daughter. They also mentioned that during extreme weather events especially floods; they usually go to shelters and sometimes stay in their relative's house. In those places many people stay together due to the floods and their daughters faced sexual harassment in different ways and that influenced them to think getting marrying off their daughters at early age. They think that they can maintain their reputation since knowing something by others about their daughter's harassment is related with their family reputation. Results show that in Brahmanabria, 6 percent girls were experienced married off before 18 years and 6 percent girls were married off after 18 years due to sexual harassment during flood periods. In Sunamgonj 13.8 percent girls were married off those who were experienced with sexual harassment. But many girls who didn't face sexual harassment were also married off before 18 years in both study areas. Although Chi-square test didn't show any statistical significance between age at marriage and sexual harassment ($p>.05$), but cross tabulation shows that some girls were married off 18 years and some were married off after 18 years due to sexual harassment. They mentioned that sexual harassment happened during extreme floods and that influenced their parents especially household's head to decide giving their daughter's married off at early age. Results also show that early marriage was higher in Sunamgonj than Brahmanbaria. Sunamganj is vulnerable to extreme floods and Brahmanbaria is vulnerable to floods and tornados. In general Sunamgonj is more vulnerable regarding socio-economic conditions and the adverse impacts of extreme floods at regular basis. Having fear about sexual harassment may lead to early marriage of daughters as most participants agreed that.

> *'In 2004 floods, we took shelter in the primary school. There were a lot of people in that small building. Some people passed their whole time in boat. My family was on the corridor of the school including my two younger daughters (shiyan maiya). There were also young boys. One of them boys irritated my elder younger daughter. I was in fear with my younger daughters (shiyan maiya niya bipode chilam). Having fear of this, I decided to get my daughters married early of their age'- (Female, 50).*

In shelter house, all affected peoples are gathered to stay for few days. In Brahmanbaria, after tornado, they had to stay in shelter camp for more than 30 days; while in Sunamganj, they had to stay for 7 days to 10 days when floods turn into extreme. During floods, most of the tube well is covered by water that creates more vulnerability drinking safe water and taking bath. After taking bath they change their dress staying inside of house or in the round wall of a tube well. Thus staying in a shelter might not be free from sexual harassment.

> *'In our traditional society, younger unmarried girls feel very shy to stay in front of younger male. During 2004 floods, when we were in a shelter house, we have to take bath in an open tube well. My younger daughter felt very shy to take bath in this tube well as well as it was difficult gathering of people to change her dress. She told me she would take bath in the dark night. Thus, younger daughters have fear of sexual harassment during devastating floods. It creates more vulnerability for me staying in shelter house*

with my younger daughters. Thus the occurrence of floods creates the fear of sexual harassment that forces to decide for the early marriage of daughters'- (Female, 43).

4. 3 Extreme Weather Events, Poverty and Early Marriage

Most household heads mentioned that they consider early marriage due to having a large family. Paraphrased translations of qualitative information show that many household heads consider early marriage due to have a burden of large family. A household head from Sunamganj mentioned that family size is a burden and they prefer to reduce it. Another household head from Brahmanbaria also mentioned that a large family size brings unhappiness because we can't bear expenses. Another household mentioned that if we can give marrying off our daughter we can transfer our cost of bearing our daughters to groom's family. They think that a large family with many daughters requires more money to maintain their expenditures. Daughters are considered as burdensome to households especially head of the household (Dyson & Moore 1983; Mathur et al. 2003).

'*We gave marriage off our four daughters out of five and still one daughter remains toget married off. If we can give our all daughters marriage off, then we can reduce our burden for their expenditures and following this way we can also reduce family size as well'- (Male, 55)*

'*Oh my son ('bap-re' witha long breathe), my family is a large family (boro songhshar) and we struggle to manage our daily expenses. We also face extreme floods (boro boro bonna) that destroy our rice production and we have a small piece of land. If this land and our home are affected by floods, we suffer a lot such we need to go to shelters or relatives home. As there is usually a gathering of many people, we don't feel comfortable with others and have a fear of sexual harassments of our daughters'-(Female, 50)*

'There is more expenditure for daughters than having sons. We face crisis from floods and tornados and lose our crops, sources of income and work opportunity. We understand how poverty is in the circumstances. Having more daughters is more burdensome and fear than having sons. So we try to them give marring off at their early age, because this is the only way we can transfer our burden and also keep our family reputation. We think that after marring off daughters we can save some money for tackling crisis especially from floods and tornados (bonna and jhar tufan)'-(Male, 65).

4. 4 Poverty, Reputation of Daughters & and Early Marriage

To find answer of this study research question, I used five points Likert scale and collected responses on different items from 120 household's head. We decided to do a factor analysis because KMO was .633 and the value suggests factor analysis. We found two principal components and that are significantly related with different items. First component included poor living condition due to extreme floods and tornados, early marriage a strategy to poverty, and fear of sexual harassment influencing early of girls. Results show that many household heads consider *early marriage as a strategy to poverty from the adverse impacts of extreme weatherevents for both study area*. Many household heads also think that giving marriage off theirdaughter's with a well off family is way to transfer cost and maintain their family reputation and protect reputation of their daughters. This

implies that early marriage is considered among many vulnerable population to extreme events as a coping strategy to poverty as well as maintaining family reputation from sexual harassment during crisis periods ($r=.444$ with $p < .05$). Many household heads also consider that their low socio-economic conditions and poor living environment influence them to consider early marriage of daughters as a coping strategy to poverty due to the adverse impacts of extreme events ($r= .703$ with $p< .000$).

5. Conclusions and Recommendations

Bangladesh is recognized as one of the most disastrous countries and every year several extreme weather events kill many lives as well as affects people's lives (Azad, Hossain & Nasreen 2013). People those who live in areas which are vulnerable to extreme weather events such as floods, cyclones, tornados and droughts get affected and think different ways to cope with adverse effects. Findings indicate more occurring of early marriage in extremely flood prone area (Sunamganj) than flood and tornado prone (Brahmanbaria). In general most parts of Bangladesh get affected by floods and many areas are from extreme floods. Data analysis suggests household heads thinking on early marriage as a strategy to cope with poverty and maintain family reputation from sexual harassment. Many people also consider early marriage as an economic survival and transfer of cost to groom's family. This finding also corresponds with Malhotra (2010) study child marriage in developing countries. During extremely events especially floods, people stay in shelter camps or any relative's house. Staying in shelter camp with others, people feel fear of sexual harassment their daughters. They feel early marriage as a way to escape from sexual harassment and even poverty. In this way they think that they can protect their family reputation and daughter which also matches with Ferdousi's study (2014) on child marriage in Bangladesh. It was also reported by World Vision UK.

As findings of this study implies that many early marriage occur due to poverty and sexual harassment from the adverse impacts of extreme events, it is important to have a surveillance team in shelters and raise awareness among people to respect girls and consider sexual violence is a crime against law. It is also important to have disaster management system and that needs to be administered by experienced and qualified person. People living in vulnerable areas don't work during flood periods and they can't maintain their subsistence. Government initiatives to create opportunities for work of vulnerable populations after the crisis to cover losses can reduce to consider early marriage as a coping strategy and transfer of cost to groom's family. Government could consider offering loan with low interest to household heads and provide training to engage with income generating activities. Government should also increase the number of shelters especially in highly density areas vulnerable to extreme events especially floods in Bangladesh.

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Women Safety in Public Transports

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Abstract

Women safety in public transport is one of the key challenges across the globe. It is very important to understand that the travel needs of men and women are very different. In developing countries like Bangladesh, lots of women are forced to remain at home owing to lack of safe transportation option. It is found that women are more likely to travel shorter distances and to stop more frequently than men during their journey inside the city. As a result, women‟s movement through the city has been described as „trip-chaining‟. It is estimated that there are 7100 buses operating in fixed routes which comprises 44% modal share of trips in Dhaka city. But they feel much less safe especially after dark. They even feel harassment in the public transports in the presence of daylight. In 1980s Bangladesh Road Transport Cooperation (BRTC) launched "women only" bus but shut down immediately after some days. So in this study, we have tried to find out the existing scenario of the problems faced by the women in public transports of Dhaka city by conducting survey over some particular areas and to give some tentative reliable solutions to overcome those situations effectively. It is very necessary to ensure the safety for women in their movement in public transports as they constitute a larger portion of travelling inside the city for unmixed valuable reasons.

Keywords: Women safety, public transport, harassment.

1. Introduction

It is widely acknowledged that women‟s travel patterns are different from men‟s, and these differences are characterized by persistent inequalities. Within any given urban setting, women have inferior access to both private and public means of transport while at the same time assuming a higher share of their household‟s travel burden and making more trips associated with reproductive and caretaking responsibilities (Peters 2013). The difficulties faced by women with regard to their mobility are a form of social exclusion which affects all aspects of their lives and in particular hinders their economic output and health (Duchene 2011). The type of incidents that women experience on public transport that leave them feeling unsafe or victimized, yet often don‟t constitute a „crime‟ can be categorized under the heading of sexual harassment. Sexual harassment refers to unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature, targeted at a woman because of her gender identity. In most instances of sexual harassment on public transportation, the perpetrators are men, because they "can exploit a certain anonymity, leaving women vulnerable and unsecure. Because sexual harassment curtails women‟s movement in public spaces, it has the potential to negatively affect their productive role and participation in the public sphere.

Studies from around the world show that women depend more on public transport than men, especially when they are part of the lower income strata.

- In France, two-thirds of public transit passengers are women (Hasson 2011).
- In the United States in 2007, 55% of public transit passengers were women (Buehler 2012).
- In Germany, women use public transport more than men (Buehler 2012).

The success of transport systems across the globe in meeting women's needs and the unexpected impacts that its development has on women's lives are poorly understood and documented. Hence they are also poorly addressed (Turner and Fouracre 1995). Globally, women specific barriers to safe public transport include fear and experiences of sexual harassment and violence while accessing and using public transport. While "bad design" of public spaces may not cause direct verbal or sexual assault, the inverse does hold true. Thus, there is a need to devise guidelines that mainstream gender in all aspects, including planning, operations, participation, maintenance and procurement of bus-based public transport. To ensure increased presence of women in economic activities, availability of safe and reliable transport services is not just desirable but mandatory.

2. Objectives

- Ø To identify the interventions to address women‟s safety on public transportation.
- Ø To explore the current scenario of women safety in public transport in Dhaka city.

3. Literature Review

3.1 Sexual Harassment as a Contemporary Phenomenon

Over the last two decades, sexual harassment received much attention as both a social and a legal problem (CPD, 2004). The most obvious cause for sexual violence, including harassment, is unequal power relations in society as a whole. However, contemporary forms of harassment have a more proximate cause - the increasing numbers of women who are entering the workforce. A technical report of the ILO compiled in 2001 noted that the scale of sexual harassment increased considerably in the last two decades. During that period, women have come to constitute an increasing share of the world‟s labor force, at least one-third in all regions except Northern Africa and Western Asia. In most of Asia, the share is even higher.

Working women in Bangladesh face a double jeopardy when it comes to sexual harassment. Not only are they vulnerable to physical, verbal and sexual abuse inside the workplace but they are also frequently subjected to harassment in "public" places, as they commute to and from work. A survey of health and safety regulations in the garment industry found that sexual harassment likely to be the most dominant source of stress for garment workers. Even it is also seen that women often feel unsafe even in the public places as such at the time of waiting in the bus stands (CPD, 2004). If a worker is verbally or physically abused or publicly humiliated for making mistakes, the ensuing fear and anxiety increases the likelihood of mistakes in her work which affect her

productivity (CPD, 2004). In a very recent time, a lady named Afroza Soma reported that she had faced something very heinous while travelling through a public bus in Dhaka after sunset. A man standing beside her kept the zipper of his pant opened and touched his penis to the back of Afroza. She suddenly felt something soft skinny and saw the incident. When she raised her voice, almost everyone overlooked the matter taking it false or unusual (Soma, 2016). In fact, now a days women harassment in the public spaces is a quite normal issue.

3.2 Interventions to Address Women's Safety on Public Transportation in different countries

A range of interventions have been adopted by governments and civil society around the world to address women‟s safety and harassment on public transportation. As part of New York City‟s fight against sexual harassment on public transportation, it is no longer treated as a misdemeanor but instead is a felony (Van 2012). In the United Kingdom, the Project Guardian campaign, aimed at encouraging women to report sexual assault on public transportation, was launched in 2013 (Blundy 2015).

Azerbaijan

Women in Azerbaijan enjoy the same legal rights as their male counterparts. The country is committed to gender equality; it participated in the 1995 Beijing Women‟s Forum and has ratified the United Nations (UN) Convention on the Elimination of All Forms of Discrimination against Women (CEDAW). In 2006, the State Committee for Family, Women and Children‟s Affairs was established to spearhead governance practice and policy making on women‟s issues and gender equality. In 2010, the country adopted the Law on Combating Domestic Violence. In 2011, the criminal code was amended to prohibit early and forced marriages by increasing the sanctions for such offenses (WARD 2015). Despite robust legislation, gender stereotypes are prevalent in educational materials and in the media, which affect women‟s role in society and their participation in public life and in paid employment (UN CEDAW 2015). In Azerbaijan, there is a law on sexual harassment in the workplace. This legal provision, however, is seldom enforced, due to a lack of proper mechanisms to implement the law (Zeynalov 2013). However, there is no law or policy measure specific to sexual harassment in public transportation.

Georgia

Georgia ratified CEDAW without reservations in 1994 (Chkheidze 2010). In 2004, the Gender Equality Council was established and has become the permanent institutional mechanism for women‟s rights and gender equality. The following year saw the adoption of the State Concept on Gender Equality as a framework policy document for equal rights and opportunities. In 2010, the Law of Georgia on Gender Equality was promulgated; the law preserves the "equal rights and obligations, responsibilities, and equal participation of men and women in all spheres of personal and public life (UN Women 2014). The most recent national plan for gender is the Gender Equality National Action Plan for 2014– 2016, which aims to address gender inequality in the economic, health, and social protection sectors (ADB n.d). In 2006, the Law of Georgia on Elimination of Domestic Violence, Protection of and Support to Its Victims was promulgated (MIAG 2013).

However, there is an absence of legislation on acts of harassment against women in other arenas, such as sexual harassment in the workplace or in public.

Pakistan

Pakistan ratified CEDAW in 1996. Women‟s rights are protected under both civil law and sharia. Nonetheless, although the Constitution acknowledges women as equals to men and guarantees their full participation in all spheres of national life, violence against women remains, in the form of domestic violence, so-called honor killing, rape, and gang rape (PPMUN 2011). The national assembly unanimously passed the landmark bill, The Protection against Harassment of Women at the Workplace Act 2010. Section 509 of the Pakistan penal code makes sexual harassment, including harassment on public transportation, a punishable offense. Prosecution under Section 509 is historically low however. Annual data from 2001 to 2014 show an average of 293 prosecutions per annum

(AGHS Legal Aid), which seems low for a country with an estimated population of 191 million.

3.3 Examples of policy gaps in national legislation

Bangladesh: According to police headquarter statistics, incidents of rape, killing,abduction and sexual harassment in Bangladesh are steadily rising, reaching 12,904 cases in 2009 and 16,212 in 2010 (Bangladesh Police). Yet, the Bangladesh National Policy for Women‟s Advancement of 2011 has no specific section on women‟s safety and security in public places.

Ethiopia: Women account for 60% of informal vendors in Addis Ababa and face robbery,theft and sexual assault in their daily life. Yet, the three major policies that focus on women‟s economic empowerment – Addis Ababa Women‟s Development and Change Package, the Growth and Transformation Plan and Ethiopian Women‟s Development and Change Package – do not specifically address the safety and security concerns of women (Action Aid 2011).

Liberia: Violence against women in urban spaces is a widespread phenomenon. However,Liberia is yet to domesticate the Convention to Eliminate all forms of Violence against Women (CEVAW) and lacks any domestic violence legislation. There is also no explicit legislation to address sexual exploitation and abuse in schools, and no punitive system in place for perpetrators except for the Rape Law (Action Aid 2013).

4. Methodology

To conduct this study firstly we formulated objective. Then we followed three way to collect data. Firstly we reviewed literature and existing law, policies, news in country and over the country. Secondly we conducted street survey. We selected seven places where we can find women passengers mostly. They are Motijheel, Moghbazar, Ajimpur, Eden College, Farmgate, Mohammadpur and Banani. We surveyed 384 women and followed random sampling method. With 95% confidence level and 5% confidence interval, sample size would be 384. The sample was consisted caring about different class of people by age, occupation and income range. Thirdly,

we conducted three focus group discussions (FGD). One is with the passengers of local bus, second one is with the passengers of "Dhaka Chaka", a special bus service caring at elite corporate people in Banani area. The third one is with the women travelling to Mohammadpur regularly in women only bus service launched from 15 march 2016. Then we analyzed our collected data and put all of those in this paper. This is the brief methodology of this study.

5. Analysis

An extensive field survey was conducted to watch the reflection of women respondents on the issue of harassment. 400 women respondent from different age group, income class and occupation were there telling their experiences. There were 25% from the age group 15 to 25 and 45%, 27%, 3% from the age group 26 to 35, 36 to 45, 45 and above respectively. We found 25% student, 65% service holder who are usually in regular travelling for job. Along with these two big class there were also 7% home maker and 3% business person. We attempted to track out there experience specially the type of harassment they face regularly.

5.1 Type of harassment faced by respondents:

We asked respondents about different types of harassment they face like verbal, physical, visual, humiliate, stalking, violent physical attack, pick pocket and none of them. 87% of them face any of the type of harassment (fig 5.1). 13% told they had not face any. A big portion is suffered with physical harassments. Then comes the visual and verbal harassments. People stare at women

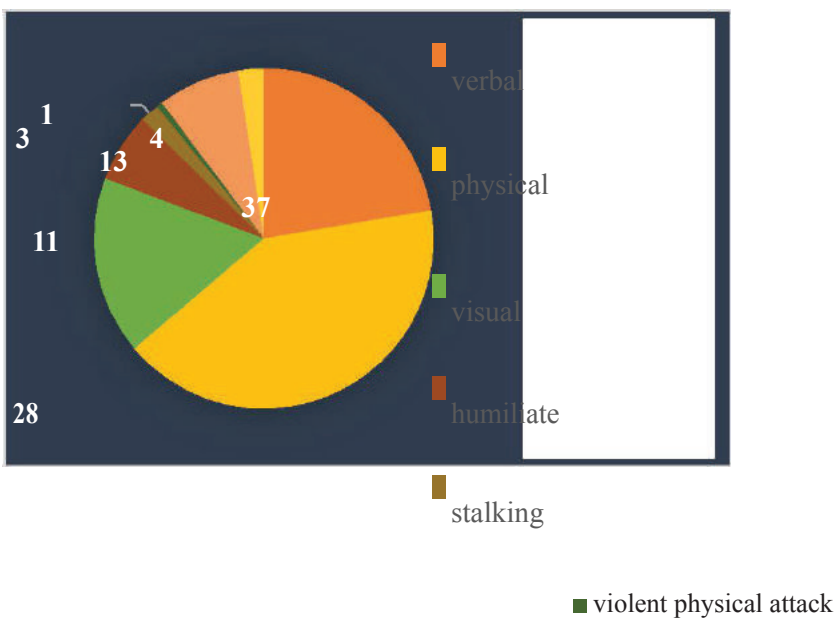


Fig 5.1: figure showing percentage of different type of harassment experienced

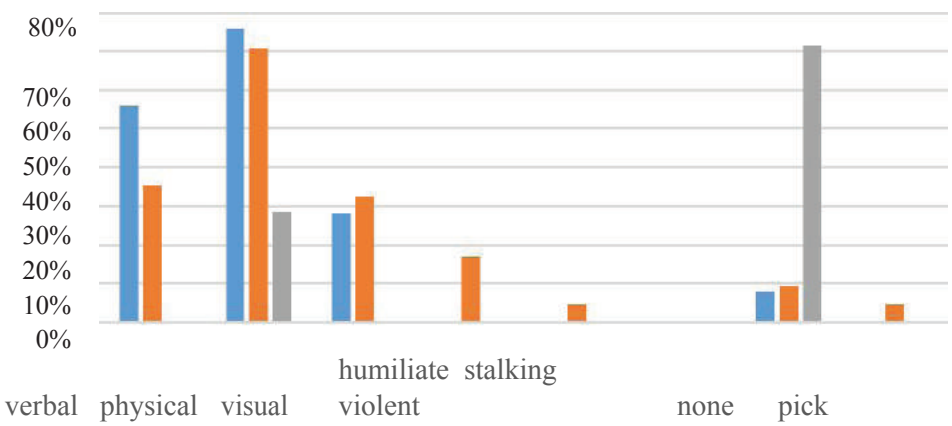
annoyingly. It is such a form of harassment that cannot be complained and not with evidence but kills women inside. This study builds relationship with the type of harassment and the age of respondents (table 5.1). It found the younger age group faces much more verbal, physical and visual harassment. 60% respondent of the age group 15 – 25 are verbally harassed and 80% physically. Weather in the age group 26 to 35 face 38% and 67% of them (age 26-35) face verbal and physical harassment.

Table 5.1: Table showing percentage of different age group experienced different type of harassment

type of harassment	15-25	26-35	35-45	45 and above
verbal	60%	38%	15%	33%
physical	80%	67%	63%	67%
visual	28%	31%	19%	67%
humiliate	0%	22%	4%	0%
stalking	0%	7%	0%	0%
violent physical attack	0%	2%	0%	0%
none	4%	7%	30%	33%
pick pocket	0%	7%	4%	0%

These denotes the younger age group are relatively helpless in bus. Again the relatively mature commuter face diversified assault. They are also target for physical attack and pick pocketing. And the physical and verbal assault decreases with age of women. And a big portion of 35 to 45 age group (30%) say they have not face any of the harassment. So the age group 15 to 35 are the mainly sufferer.

We wanted to see women of what occupation suffers what type of assault. We got 25% student respondents. 76% of them are physically harassed (fig 5.2). This form of harassment is also predominant in service holders. 71% of service holder face it regularly where 74% of the service



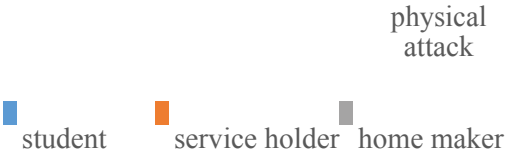


Fig 5.2: Percentage of different occupation group experienced different type of harassment holder travels 10+ times in a week. The home maker usually travels less in public transport. So the feedback of "never harassed" from 71% of home maker is too weak to be considered as they don"t use bus frequently and other respondent"s opinions are not going in similar path.

5.2 Responsible persons for harassments

From this study it is found that women are generally harassed in bus and while they board (fig 5.3). The helper usually touches the back of women while they board women. Usually in Dhaka local bus stops here and there to pick and drop passengers. There is a built tendency in driver not to stop the vehicles properly. So passengers need to board in a slowly moving bus. Helper sometime care passengers and assist them to board. But in most of the cases they take this as a chance to touch girls. 59% of the respondents accuse

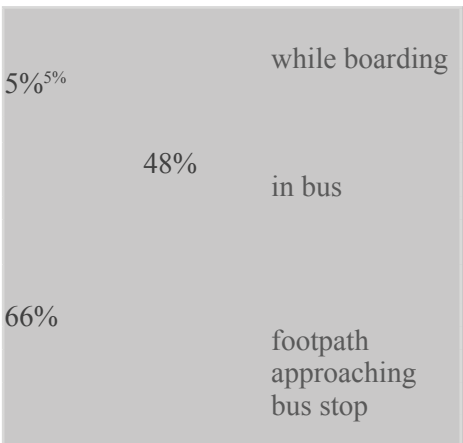


Fig 5.3 place of harassment

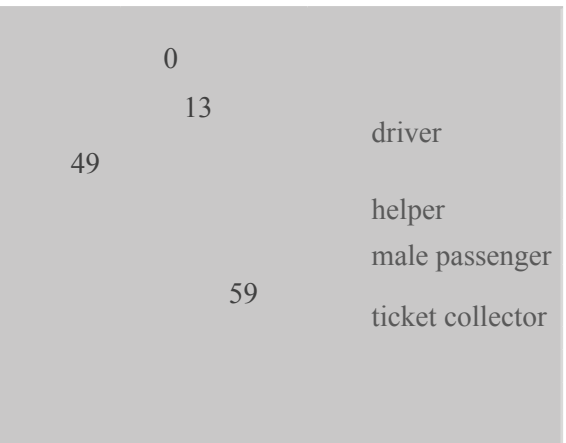
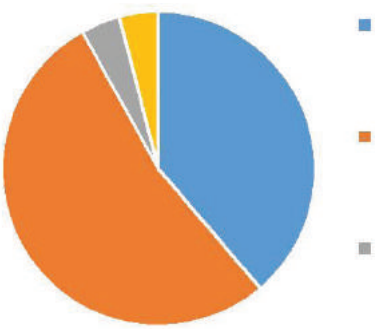
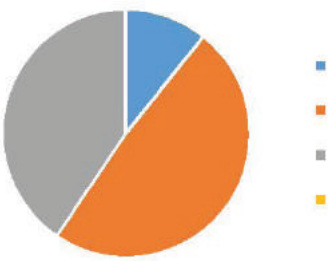


Fig 5.4 responsible for harassment





helper for harassing (fig 5.4). Male passengers are also responsible in this regard. They touch, push women intentionally. Driver are responsible because sometime they support culprit and most of the time they use vulgar word easily in which women feel very offended.

5.3 Other information regarding harassment:

Respondents said that they feel most insecure in evening (41%). A big portion also said to be harassed during the office time (25%). The women are the regular sufferer who told that harassment has no time bound. This actually depends on the mentality of the responsible person. Whenever he get chance, he attempts. To look at how often the respondents are harassed in last

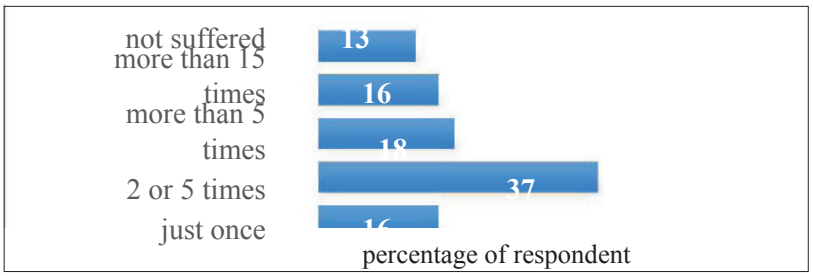


Fig. 5.5 frequency of harassment in two month

two months we find 2 to 5 times occupying the largest portion (5.6). But the cumulative amount of more than five times and more than 15 times is much more alarming. It shows harassment has turned into a daily phenomenon. They have marked some point that are threatening their safety in bus and bus stop (fig 5.6).

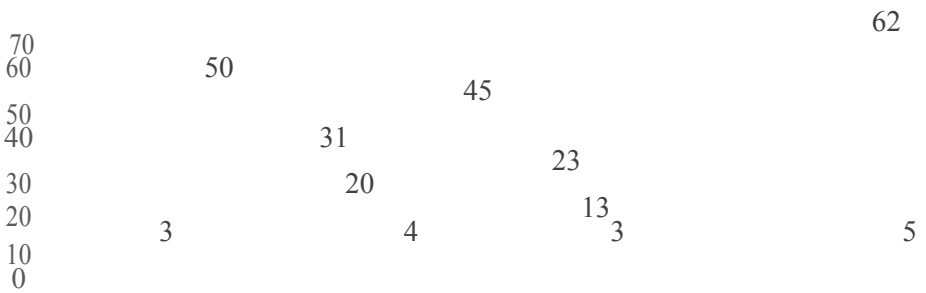


Fig 5.6: safety factors the respondent felt to be developed

5.4 Reaction of respondents:

It is another important finding of this study. We asked respondents what they do when they are assaulted or humiliated. They confront the perpetrator or report to police or ask bus authority or bystanders or do nothing. This study found 53% of total respondents confronted the perpetrator and 32% did nothing. 6% reported to police. We analyzed the data with the age of respondents. The women who are in the age of 15 to 25 are also both typed. 40% of them say nothing and 52% of them confronted (fig 5.7). The percentage of confronting is higher in the age class 26 to 35.

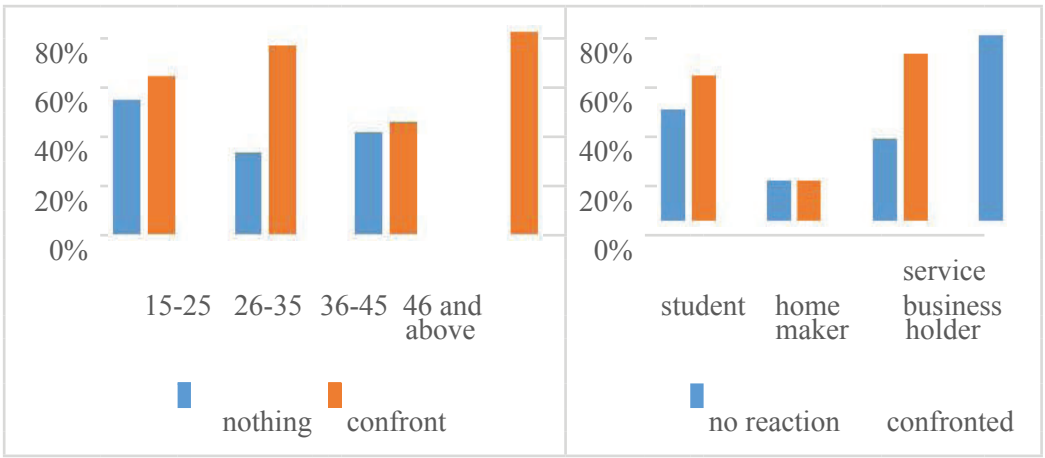
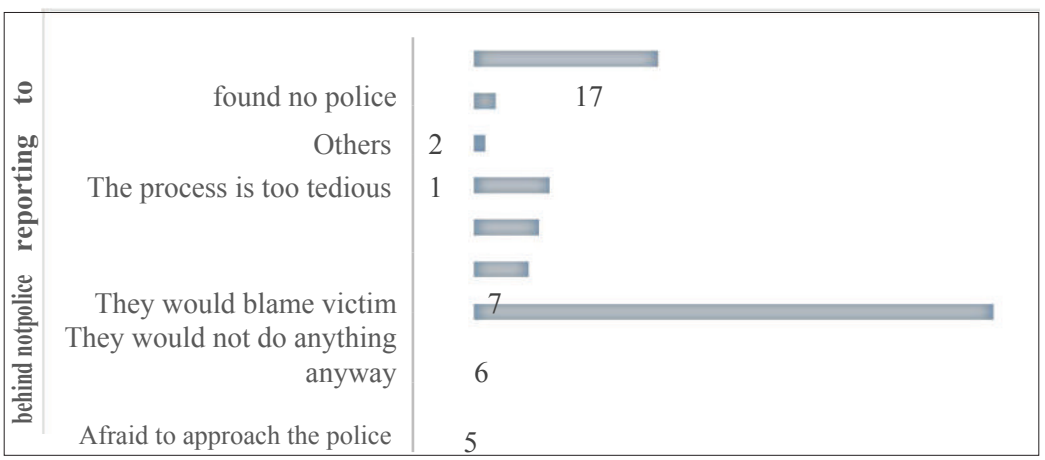


Fig 5.7 percentage of different age group in defensive role or confronting role
Fig 5.8 percentage of different occupation group in defensive role or confronting role
If we look at the reactive attitude of women from different occupation we see the service holder are mostly highly reactive. 60% of service holder confronted the perpetrator (fig 5.8). In students the tendency to tolerance is 40%. 6% of our total respondent is found keeping little items like knife, hair clip to protect themselves.

5.5 Police attitude:

Police attitude towards violence against women in public transport is not up to the mark. Why they didn‟t report to police, answering the question 17% women told with utter anger that they don‟t find police anywhere (fig 5.9). 48% women don‟t find it too serious to report. And only 6% of our total respondents reported to police. Police minimized the case in only 1%, they did nothing in 4% case, and the police blamed the victim in rest 1% case. So one findings is that the



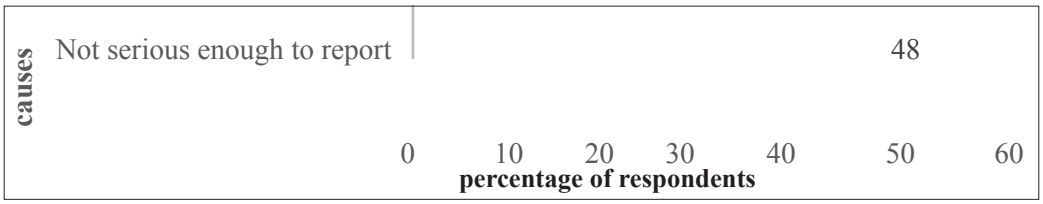


Fig 5.9 causes behind not reporting to police

type of harassment is sometime silent, sometime supported by bystanders, sometime it is shameful to confront. So these cases wouldn‟t do anything be presence of police and also it‟s not possible all time to find police. Some other solution with the help of technology may work in this field.

6. Recommendation from focus group discussions

We have conducted three focus group discussions. We have got different kind of recommendations. Important recommendations are given here.

6.1 "Public attitude should be developed"- women uses local bus:

The women who usually use local bus told that there are lots of scope of developing public attitudes. It‟s another important determinant. It‟s the public who harass, who support harassment, who also confront harassment. They jot at the front of gate, they push women in bus jerk. When women confront they reply them to have CNG or other private mode leaving bus. There are seat allotted for women. Male passengers jot beside those seat and annoy women in many way. "I was telling to leave him the ladies seat but he replies that he was first in the bus and told me to find another seat"- a respondent shared this. They told to increase seat for women as they participation in outwards is gradually increasing.

"Public bus is for male, not for female" is still a dominating belief in public. Another important thing is the vulgar words in between drivers and helpers. The female passengers are usually from well-educated family who feel offended with these utterings. These are non-quantifying barriers in the way to women-friendly public transportation.

6.2 "The fare and the stoppage system need to be revised" – the passenger of Dhaka Chaka:

"Dhaka Chaka" a new initiative established in*Kakoli*to*Notun Bajar.*There are 30to 32 coach with capacity of 38 seat. It is usually for the corporate people moving in this route. It has stoppage in Kakoli, Bonani bus stand, Gulshan-2, Gulshan-1, Notun bazar. The fare is fixed 15 taka. The female commuters are now completely free from harassment. The boarding system is convenient. The bystanders are also corporate and educated, so chance of harassment is less for the environment. There is separate chamber for female passengers. In talking with them two major problem arouse is the fare is 15 taka for any distance. The distance is too short for this fare. Going from point A to B is of 15 taka, if one drop at point C in between A and B, and again want to board she needs to pay 15 taka again. And there are scopes to think about its stoppage design by demand analysis.

6.3 "Frequency should be increased and information also"- the passengers of Women only bus*:*

There are 12 women only BRTC coaches move in the city twice in a day; at 7 a.m. and at 5 p.m. Motijheel is destination of all of them. Except from Motijheel to Mohamadpur coach, the rest 11 coach are not filled. Government need to give subsidy on those. "We don‟t know the timing"- said Mahfuja Akter, lecturer of Geography, waiting on a queue of normal bus. The exceptional coach moves even with standing passengers. Their passengers demanded to increase bus on that route.

7. **Conclusion**

Incidence of sexual harassment is a common phenomenon. The frequency of sexual harassment increases as frequency of public transportation usage rises. In addition, targets tended not to receive help from those around them who were aware of the incident, and witnesses were less likely to provide help to a target, out of fear of a range of personal consequences. Finally, a significant proportion of respondents are of the opinion that serious measures should be taken to address sexual harassment in public transportation. Although sexual harassment involves private acts perpetrated by an individual or group and directed at an individual, it is a public issue, because it violates the rights of women to safe movement in public spaces, and thus it necessitates a legislative or public policy solution.

The role of transport companies, whether privately or publicly owned, is critical in addressing sexual harassment. The goals of public transportation should be aligned with the goal of making public transportation facilities safe and friendly toward women. The management of transport companies should aim to ensure that all commuters feel safe in public transportation, including the metro or buses. Moreover, the management of transport companies in the surveyed countries should work with the governments of these countries to provide a safe transport environment for women. A safe travel environment also would benefit transport companies by increasing commuter travel among women, who comprise a significant proportion of public transportation users. A regulatory environment to combat sexual harassment on public transportation could include city ordinances or public safety policies requiring public transportation operators to prevent and respond to sexual harassment.



Fig 7.1: FGD at local bus FGD at *Dhaka Chaka*



Fig 7.2: After FGD at women only bus



Fig 7.3:



Fig 7.4: Well accommodation in Dhaka Chaka

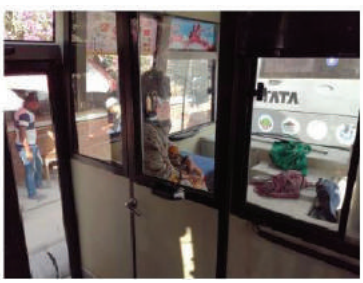


Fig 7.5 separated women chamber



Fig 7.6 drug addicted in Farmgate bus stop

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Combating the Twin Epidemic: Addressing Gender Based Violence for HIV & AIDS Response in Bangladesh

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Abstract

Bangladesh remains a low HIV prevalence country with a total of 4721 registered cases of HIV infection where the estimated number of people living with HIV is around 9600. Although the prevalence continues to be low (0.01%) among general population, it is significant among key population groups. Persistent gender inequalities and human rights violations continue to hamper progress and affect on country"s overall efforts in achieving Sustainable Development Goals (SDGs).

Gender inequalities, gender-based violence (GBV) and harmful gender norms promote unsafe sex and reduce access to HIV and sexual and reproductive health services for women, men and transgender persons. GBV including the threat or fear of violence makes women and girls, sex workers (Male & Female), men who have sex with men (MSM), People who inject drugs (PWID) and transgender people more vulnerable to HIV by making it difficult or impossible to set the terms of an equal relationship. Norms of masculinity can encourage high risk sexual behavior by men and make their partners more vulnerable. Norms of femininity can prevent women from accessing HIV information and services. Gender Based Violence is both a cause and a consequence of HIV infection. Therefore, GBV needs to be dealt with multispectral Gender Transformative HIV responses. While a strong multi-sectoral and Human Rights Based (HRBA) approach is needed to address the wide-spread of GBV in Bangladesh, the current HIV response must include community empower communities and support building their social capital to develop partnership with the law enforcement agencies and other powerbrokers, set-up crisis response mechanism to ensure services for those who experience violence including access to justice for redress as well as raise awareness among young people, especially young boys on gender norms, debunk myths around gender roles and masculinity and finally to ensure Gender Good Governance among institutions.

Keywords: *HIV, Gender Based Violence, Gender transformative, Human Rights, Gender Governance*

1. Context Analysis

1.1 HIV Prevalence & the National Response: The national HIV prevalence is less than 0.1%among general population. But HIV prevalence among Key Population varies across the country and is reported as 1.2% among PWID and heroin smokers nationally, with a prevalence of 5.3% among male PWID in Dhaka (2011, Round 9 Surveillance).[1] 0.6% among Male sex workers (MSW) and 0.5% among Hijra (2013)[2], 0.3% among Female Sex Workers, though as high as

1 IEDCR& ICDDRB National HIV Serological Surveillance, Bangladesh 2011
2 Icddrb, A survey of HIV, Syphilis and Risk Behaviors among MSM, MSW & Hijra

1.6% among some areas like Hili. Bangladesh remains a low HIV prevalence country with a total of 4721 registered cases of HIV infection and 799 were AIDS related death[1] as per World AIDS Day (WAD) presentation of National AIDS/STD Control program (NASP), where the estimated number of people living with HIV is around 9600[2], NASP/UNAIDS estimated range report 2015 said. . Although the prevalence continues to be low with 0.01% among general population, it is significant among key population groups such as people who Inject drugs (PWID), sex workers (SW), transgender persons (TG) and Men who have sex with Men (MSM). 27% of newly identified HIV cases in 2015 were among women and transgender and 73%of the newly reported HIV cases were among general married population[3]. At the same time, Bangladesh is one of the only four countries in Asia and the Pacific where prevalence has increased more than 25% over a decade till 2012.[4]

The Government of Bangladesh has strong political commitment in national response to the HIV epidemic. AIDS/STD Control Program (NASP), established by the Ministry of Health and Family Planning Welfare (MOHFW) under the Directorate General of Health services (DGHS), is the nodal body to manage the country HIV response. Presently the country response is guided by the framework of revised 3rd National Strategic Plan for HIV and AIDS Response (2011-2017). The Current Size Estimation and National Coverage is given bellow Size estimation 2016 and Program Information

Tab 1.1.1 National Coverage:

Key Population	Size Estimation 2016	% Covered
Female Sex Worker (FSW)	102,260	25%
MSM & MSW	131,472	23.6%
Transgender/Hijra	10,199	39.8%
People Who Inject Drugs (PWID)	33,067	35%

1.2 Status of Women in Bangladesh: Historically, socially prescribed roles have limitedwomen's access to economic resources, political participation, and other forms of decision making. Bangladesh is a highly patriarchal society and gender discrimination is evident across all levels. But the situation has been improved in the recent years. According to the Global Gender Gap Report 2016, Bangladesh ranks 72 out of 144 countries with overall score 0.698[7]. In terms of ranking of sub-index Health and Survival (0.971) comes out top followed by Educational attainment (0.950), Political empowerment (0.462) and Economic participation (0.410). Bangladesh ranked 7th position out of 144 countries in the political empowerment sphere which is much encouraging. Bangladesh was awarded the prestigious Women In Parliament (WIP) the Global Forum award 2015[8] and for its outstanding success in closing gender gap in the political sphere. In spite of the recent success there continues to be persistent challenges with respect to realization of girls‟ and

1 bd NASP: WAD Presentation, 1. Dec. 2016

2 Estimated range : 8400-11000, NASP/UNAIDS, 2015

3 NASP: WAD Presentation, 1 Dec, 2015

4 World AIDS Day report, 2012

women‟s human rights and full potentials. Women and girls are often subjected to early marriage, sexual abuse and violence in intimate and marital relationships. Again, women are subject to frequent domestic violence, trafficking, acid attacks and rape which put them into higher risk of violence and exposure to HIV.

1.3 Prevalence of GBV: Bangladesh is high prevalent country on GBV. Prevalence of any typeof violence among physical, psychological, sexual or economic aspect experienced at least once in lifetime among ever-married women by husband is 72.6%[9], prevalence of any type of violence experienced at least once in last 12 months among ever-married women by husband is 54.7%, prevalence of any type of violence experienced at least once in life time among currently-married women by current husband is 80.2, prevalence of any type of violence experienced at least once in last 12 months among currently-married women by current husband is 65.1%. Legal and policy reforms to address gender-based violence have been limited in impact because less than 2% of married women who have experienced physical violence seek any kind of remedy or service.

1.4 GBV among Key and vulnerable population: Gender based violence is a key concern for key population that has a life threatening impact on them and dramatically increase the risk of HIV STIs for the key population. According to the Behavioral Surveillance 2006-2007, female sex workers also report high levels of violence. Almost one-half of the street-based sex workers in all locations reported being beaten particularly by members of law enforcement agencies and by local mastans (extortionists). Among adolescent sex workers, forced sex ever was more experienced by street based FSWs (53%) than hotel based (40%), brothel based (38%) and home based FSWs (39%). A study in 2012 revealed, 44% of the FSWs, who ever had experience forced sex, admitted of having forced sex in last 12 months. A study in 2011 of the street and hotel based sex workers in Dhaka revealed that 43% of hotel based and 80% of street based sex workers had experienced violence resulting in injury in the last twelve months. 28% of hotel based and 54% of street based sex workers had experienced forced sex in the same period[10] . Violence experienced by MSM, especially effeminate MSM and TG is also considerably high, especially intimate partner violence (IPV).

2. Rationale of the Study

In Bangladesh, though HIV prevalence is low among general population, it is significant among key population groups. Gender-based violence (GBV) is a cause and consequence of HIV. Across Asia and the Pacific, key populations - including sex workers, men who have sex with men, transgender people, people who inject drugs, as well as persons living with HIV - are subject to gender-based discrimination and violence. Violence or the fear of violence can increase the vulnerability of key populations to HIV by making it difficult or impossible to set the terms of an equal relationship. It is more difficult for individuals to refuse sex when in a relationship, to get their partners to be faithful, or to use a condom. Violence can also be a barrier for key populations and PLHIV in accessing HIV prevention, care, and treatment services. This in turn limits their ability to learn their HIV status and adopt and maintain protective measures ranging from negotiating safer sex to getting and staying on treatment[11]. Again harmful gender norms promote unsafe sex and reduce access to HIV services. Norms of masculinity (including homophobia) can encourage high risk sexual behavior by men and make their partners more vulnerable. Norms of

femininity can prevent women (especially young women) from accessing HIV information and services. More over Lack of education, social norms and positioning, and economic insecurity limits decision-making power, mobility and access to information and services. Health seeking behavior is influenced by gender and, stigma and discrimination.

For Bangladesh, persistent gender inequalities, widespread discrimination, injustice and other factor such as high levels of violence against women and girls and transgender populations will undermine the efforts in curbing HIV epidemic and progress made under MDG[12] . It will also continue to impact on country‟s overall efforts in achieving Sustainable Development Goals (SDGs) for Bangladesh. Therefore addressing GBV, gender needs and rights of women, men, transgender persons in all their diversity, in particular those living with HIV and key populations at higher risk of HIV become urgent for sustainable HIV responses for Bangladesh.

3. Objective of The study

To explore suitable strategies for addressing Gender Based Violence (GBV) among Key Population, Emerging & Vulnerable Groups, PLHIV & Affected Family members and general population for effective, efficient and sustainable HIV & AIDS response in Bangladesh.

4. Methodology

This study involves 50 representatives from different the key and vulnerable population & HIV positive and their affected family members, partner organizations, stakeholders and government officials through three separate workshops. Besides, relevant documents have been reviewed for the study. The study identified the forms of GBV, perpetrators and actor of GBV, vulnerability network among the key and vulnerable population for HIV & AIDS and general population. The process identified gaps and challenges in programming, analyze legal framework and finally recommended suitable strategy and interventions. Also the participants agreed the definition of GBV.

5. Key findings

5.1 Definition of GBV: The study has recommended adopting the following definitions of GBVfrom CEDAW General Recommendation No. 19 on VAW

GBV is defined as “violence that is directed against a woman because she is a woman or that affects women disproportionately”, thereby underlining that violence against women is not something occurring to women randomly, but rather an issue affecting them because of their gender. Further, GBV is defined as including “acts that inflict physical, mental or sexual harm or suffering, threats of such acts, coercion and other deprivations of liberty.” GR 19 also specifies that GBV may constitute a violation or women‟s human rights, such as the right to life, the right to equal protection under the law; the right to equality in the family; or the right to the highest standard attainable of physical and mental health. (Source: CEDAW General Recommendation No. 19 on VAW).
5.2 Working definition of GBV: The study has recommended to adopt the working definition ofGBV from UN ECOSOC in 2006 and to add Transgender/Hijra into it

Any harmful act that is perpetrating d against a person"s will and that is based on socially associated differences between males and females an Transgender. As such violence is based on socially ascribed differences, gender-based violence includes, but it is not limited to sexual violence. While women and girls of all ages make up the majority of the victims, men and boys and Transgender are also both direct and indirect victims. It is clear that the effects of such violence are both physical and psychological, and have long term detrimental consequences for both the survivors and their communities

(Adopted by the UN ECOSOC in 2006, and consultation in the expert in the workshop. Hijra is added here)

5.3 Target Population for HIV program : The Revised 3rdNational Strategic Plan for HIV andAIDS Response for 2011-2017 of Bangladesh prioritizes the provision of services for specific vulnerable and infected and affected group of people. The strategic plan targeted populations have been categorized for sustainable national response. The definition of target people is given as per the Size Estimation 2016 by NASP, DGHS

ü Key populations:
- Female sex workers brothels (BFSW), hotel/residence (HFSW) or street (SFSW))
- Male sex workers, MSW
- Hijra/Transgender
- Men who have sex with men, MSM
- People who inject drugs, PWID (male- female)
- Most At Risk Adolescent (MARA)

ü Emerging risk populations and vulnerable groups

The following groups outside the key populations were identified in the original 3rd NSP as having higher rates of risk behavior and are more likely to be exposed to HIV:

- International migrants - can be divided into official and informal international migrants as well as cross-border migrants

- Especially vulnerable adolescents (EVA) - refers to adolescents who have an elevated risk but do not belong to any key populations, and are thus not considered MARA. It includes children and adolescents who are likely to develop high risk behaviors, for example those who use (but do not inject) drugs, children of sex workers, street children and others who suffer severe social circumstances

- Heroin smokers - are at risk as many shift to injecting drug use over time

- Transport workers – truck drivers, rickshaw pullers, dock workers etc. Mainly at risk due to a high level of commercial sex
- Prisoners – high prevalence of injecting drug use, high-risk sex and unsafe health Services put prisoners at elevated HIV risk

The NSP recognizes that Garments workers, Tea garden workers, refugee, displaced person and minority ethnic population may have a heightened vulnerability but interventions are not prioritized considering unavailability of strong supportive evidence and low HIV prevalence in the country.

- ü General population and young people: All people have a basic human right to be provided with the information and basic services to protect themselves from HIV infection and People living with HIV (PLHIV) & their affected family members.

5.4 Forms, Perpetrators, actors and setting of Gender Based Violence for Key population: Keypopulation in Bangladesh face several different types of GBV, ranging from being teased by people on the street to being raped and murdered, from a large range of different groups of people, ranging from boys on the street to religious leaders, police, and sex partners. Gender-based violence is included into physical, sexual, psychological or economic. Stigma, Discrimination, exclusion, harassment, blackmail, client refusing to pay after having sex, rejection or non acceptance by family or community members, disrespects, police ignoring GBV complaints, health care staff refusing to provide care and humiliation. The violence are often stated-sponsored, structural discrimination, some are associated to traditional or customary practices.

Key populations face GBV mainly at their venue of sex work, work place, service center, police stations and residence[13]. Those are

- Hotel and street-based sex work venues
- Transport terminal
- Entertainment venues
- Parks and roadsides
- Festival sites
- Drug use location
- Residence
- Police station
- Service centre

5.5 Main Causes of GBV for Key Population: Engaging in sex work is a major source of GBV forFSW, MSW & Transgender. This makes them more vulnerable for GBV along with prevailing with Patriarchy, Social Norms, and Gender inequality both to their clients and to the community at large. The existence of sexual identities and feminine behaviors of Transgender and MSW go against societal norms. So they are viewed as" unacceptable" in the society by violating the norms that break traditional gender roles. Vicious cycle wherein an individual"s social marginalization makes it more difficult for FSW, MSW & Hijra to secure regular employment, wherein they engage in sex work as their only viable source of livelihood, which only further reinforces their marginalization and vulnerability.

6. Correlation among HIV & GBV and Vulnerability Network among KP, PLHIV and general population

It is globally recognized that there are strong linkages between violence against women and HIV. First, there is a strong link between actual or threat of violence and sexual risk taking, including unprotected sex and multiple sex partners. Second, actual or the threat of violence affects women"s ability to negotiate condom usage. And third, there is a link between intimate partner violence and unequal gender relations and HIV.

§ Female Sex Workers, MSM, MSW, Transgender, PLHIV and general population are interlinked in their sexual and marital relationship, Needle-syringe sharing and other high-risk behaviors and those are the potential spread of HIV and GBV. Married women have contracted HIV from having unprotected sex with their husbands. Stigma and discrimination against women living with HIV are severe. Often they are mistreated and even evicted from their in-laws home when their HIV status becomes known. So the family rights are being violated.

§ As per 4rth round Serological Surveillance portion of FSW are married who has sexual relationship with Truckers, PWID, Rickshaw puller, MSM and male from the society and part of them are intravenous drug user. MSW and Transgender have sexual relationship with MSM, Male client from the society and part of them are PWID. Portion of MSMs are married with women in the society.

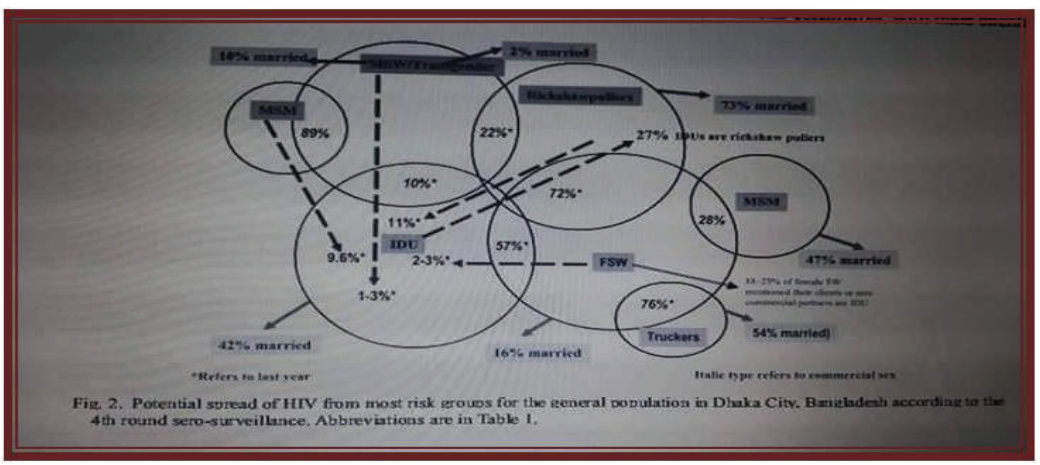


Fig. 2. Potential spread of HIV from most risk groups for the general population in Dhaka City, Bangladesh according to the 4th round sero-surveillance. Abbreviations are in Table 1.

Fig 6.1: Potential spread of HIV among target people and general population

§ The emphasis on masculine gender roles and the expectation of heterosexual marriage, in this context means that many Bangladeshi MSM also have female sexual partners as a means to be culturally masculine, and may feel shame for their homosexual feelings. It precipitates GBV as well as increased risk of HIV infection. For instance, low rates of consistent condom use among Transgender persist even after intensive interventions, and are in part the result of "low self-esteem induced by stigma and social exclusion". The chief perpetrators of GBV are the gangsters and police, who claimed that they are "allowed" to rape MSM and hijra persons because these individuals contradict traditionally masculine gender roles.

§ Drug use and sex work are mutually reinforcing, with sex workers who use drugs experiencing increased vulnerability to HIV and violence [14] . Needles and Syringes were sometimes shared between sex workers and their PWID clients who paid their services with drugs. Many of the FSW, who use drugs, had been coerced by clients who were un willing to use condoms. PWID sometimes sell or buy sex, FSW sometimes use drugs. Some MSM ad Hijra sell or buy sex, many MSM are married to women.

7. Recommended Strategy for Gender Transformative HIV Response

Addressing GBV and HIV are addressing the twin epidemics. This involves a two-pronged way of integrating action on gender and GBV into existing programme packages for key populations and developing „key population- inclusiveness‟ gender program, incorporate into mainstream development activities institutional governance structure. Following are the specific strategic recommendations

- Empowering people and promoting gender equality towards minimizing the spread of HIV and minimizing the impact of AIDS on the individual, family, community and the society.

Effective prevention of new Gender Based Violence (GBV) incidence among the target and general population requires the empowerment of Key Population, emerging risk population and vulnerable groups and general and young people and equitable services for them. Therefore improving human capability, economic gain, enhancing community voice and enabling environment interventions needed as per the need of specific group to cover the key aspects of their empowerment and gender equality.

- Integrated, inclusive and focused response services for GBV victims to establish human rights and dignity in family and society

For addressing the immediate need and the long term requirements of a victim of Gender Based Violence integrated, inclusive and focused response services will be provided in a non-judgment way so that the victim becomes able to tackle immediate mental shock, get physical remedy, safe shelter and justice and live a dignified life by protecting human rights in the long run.

- Enhance programmatic and institutional capacity of National Aids/Std control Program (NASP), other government agencies, service providers and partner organizations for coordinated and quality service and action through ensuring Gender Good governance

This is for the readiness and skill of institutions working with GBV in the implementation, management and coordination of the national HIV response. The ongoing National HIV Strategic Plan involves 11 types of actors and their different functions[15] . HIV has been primarily incorporated into activities in various strategies of five ministries namely Ministry of Information (MoI), Ministry of Home Affairs (MoHA), Ministry of Youth and Sports (MoYS), Ministry of Education (MoE) and Ministry of Religious Affairs (MoRA).

- Creating protective and favorable and legal and policy environment through evidence base policy advocacy

Strategies towards ensuring positive legal and policy environment through Effective execution of existing laws and policies review of discriminatory and punitive laws and policies, reform punitive laws, policies and law enforcement practices to protect sex worker‟s rights including the rights to be free of violence and Law for Third Gender address HIV related human rights issues[16].

8. Conclusion

If the identified areas can be addressed successfully HIV and GBV will jointly will jointly minimize the risk and contribute towards protecting human rights and establishing gender equality. NASP needs to take the lead to develop gender transformative HIV program response.

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Challenges of Women Journalist in Media of Dhaka City

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Abstract

Journalism is a challenging profession and female are less encouraged to be a journalist. In recent year women are entering into the media professional, yet their representation across all areas of the media remains inadequate. Women continue to be restricted by stereotypical beats and face job insecurity, lower wages and gender discrimination but they are multi-skilled and usually working across more beats than men. Now a day social attitude is changing towards women in Bangladesh, which are symbolized by women‟s advancement in journalism sector. So it is important to find out what are the challenges that women journalists face in their professional environment. The study explores the challenges of women journalist working in media. And also to figure out the number of women journalist in Dhaka city.

Data for this study has been collected from two sources, primary and secondary sources. Secondary sources are internet, newspaper, journals, organizations website and Ministry of Information of Bangladesh website, website of journalism departments at different universities, information from media houses. Primary source of data was interview with male and female journalists.

In Bangladesh, women are not too many in this profession like the western county. Still very few women take journalism as their profession. Women journalists face issues more than male journalists. The ratio of women journalists is unequal in media. Although in electronic media the number of male and female are almost same. But still we are far away from equality and it`s not sure whether someday the amount of male and female will be equal or not. In media, most of the recruiting ends with the internal recruitment process. Very few women get that internal recruitment opportunity. From the beginning women journalists face discrimination. Here discrimination means assigning weak beats, child and women based news, human story, feature writing, promotion, salary etc. Women journalist gets fewer chances to work important and challenging places to work. However, still women are coming towards this profession overcoming all the barriers.

Introduction

In the history of the newspaper of Bangladesh, we can easily find that the society was not encouraging to do work outside for female. Pre-independent era women are not acceptable to work outside. Nevertheless, a few women contributed to change the society by their writings. “Monthly Begum” is a milestone of it. In fact, this periodical was the forum of female writers of that period. At this stage, regular newspapers introduced women pages. As a result, from that

time and yet today the women pages are mainly edited and written by a female. The female journalists recognized stereotyped attitudes, unreasonable treatments, and harassments by male colleagues and job insecurity as the other reasons that prompt them to give up the profession. According to a workshop on "Women in Bangladesh Media 2008" only six percent female keeps going in the mainstream of journalism. The reality pointed out that females were paid less as compared to male colleagues in some media houses, and they worked under huge social pressure and mobility problems. Participants urged removal of gender imbalance in media, and there is need to provide the female with equal opportunities as enjoyed by men. Recognition of their works and better wages are needed to encourage female journalists to stay in the profession. It is difficult to encourage female journalists to work on hard beats, which are reserved for male journalists.

The number of female journalists is on the rise in Bangladesh, along with the growing number of prints and electronic media. But women journalists have to go a long way to get equality. Journalism is a challenging profession for both male and female journalists. In most cases the challenges are different and the list is far bigger than male. The main challenges of female journalist are being recruited in a media organization. Although at present time with the rising of electronic media some female journalists have held a prominent place in media. They are very eager to work in all the sectors of journalism because they are brave, courageous and adventurous, but there is little recognition of their issues and struggles. Yet their representation across all areas of the media remains adequate. While the advantage of a class, cast and higher education has seen some women climb to the top rungs of the profession. While improvements have been achieved by and for women in journalism, many problems still remain because of the disproportionate number of men in decision-making roles within the unions and media organizations. Abuse remains a critical issue for the industry. Here abuse is defined as assigning female journalist for the soft or human story; women and child affairs based story, working environments, low responsibility, fair wages, time scheduling, maternal leave etc. In newsrooms, female journalists often face disparities in working assignments. Though there are women reporters in all types of news beats like political, parliament, energy, economic, crime, sports and election commission, their numbers are negligible. Also in the absence of support systems, women find it difficult to balance out familial or parental responsibilities with that of the workplace. With poor facilities and a discouraging environment, upward mobility is a struggle. Women suffer discrimination in training, recruitment and promotion and also denied decision making positions.

In Bangladesh, there is need to improve the environment to empower women in journalism. Improving working conditions, equal assignments, fair wages and job security are the rights of every woman but too often they are deprived of it. In the terms of policy making, women are largely ignored. Ironically, women journalists win awards, but in their own workplaces they are disregarded and often referred to in the most disparaging manner.

According to the Ministry Information of Bangladesh, there are 1078 Daily Newspapers in Bangladesh. Among them four hundred and two newspapers published from Dhaka Zillah. On the other hand, Information Ministry approved forty-one private-owned television channels. The number of FM radios is twenty-eight and community radio is thirty-two. Although the exact figure of online newspapers, television channels and online radios are not yet included in the information ministry. But more than thousands of online newspapers had applied to the information ministry

for registration. At the eleventh secession of parliament on 27thJune 2016 information minister confirmed the amount of online media. There are one hundred and five online television channels, eighteen online radios and one thousand seven hundred and seventeen online newspapers are waiting for approval registrations. Although, many people of our country are directly and indirectly working in the media is not still confirmed. But in recent years‟ media is growing like mushrooms in Bangladesh. To find out the number of journalist we need to mention about the top most journalist association members in Dhaka. There are five journalist associations in Dhaka, which are mostly talked about. Dhaka reporter‟s unity (DRU), BFUJ- AL

& BNP, DUJ- AL &BNP, Diplomatic Correspondent Association (DCAB) and Commonwealth Journalist Association. Among these forums, only DRU members are experienced journalist and to become a member of this forum one must have a journalistic background. Dhaka Union Journalist (DUJ) has two parts, one is an Awamileaug follower and other is Bangladesh National Party supporters. But DUJ members are not only reporters but also it consists of the members who are directly and indirectly working with media. Around three thousand members are included in DUJ AL party, among them, women members are fifteen to twenty. From which only five women are in decision making position. On the other hand, in BNP follower DUJ consist of six hundred thirty members among them there is no women decision-making position.

The Bangladesh Nari Sangbadhik Kendra (BNSK) is the oldest women journalists‟ organization in Bangladesh and was established in 2001. However, it is still kept out of decision-making by the government and media houses on media-related issues and there is regretful, little gender specific work done by media unions. According to BNSK, the number of women journalists is increasing in Bangladesh, but their numbers are still woefully low. BNSK estimates around 6000 male journalists and only around 300 female journalists in Bangladesh. Sadly, there are fewer women at the policy-making level.

In Bangladesh female‟s participation in journalism, including electronic and print media market is raised in the last couple of years. A significant number of the female are working and contributing a lot in the changing process of social outlook. But in journalism female have always been discouraged from choosing this as a profession. But in recent decades, they have not made much progress in journalism because of disparities. Females are facing discrimination in education, employment, and access to resources and services particularly in healthcare. Discrimination against female works more faintly through the effects of sex-related beliefs and prejudices. It‟s true that society will gain a large benefit if we make gender balance in the media. In a perfect world male and female would equally contribute in the media both as reporters, editors and as subjects in articles. Though Bangladeshi constitution guaranteed equal rights in access for their female but females generally remain far from enjoying equal rights.

Ahrar Hosen reporter of BBC Bangla mention his report titled “How far women of Bangladesh are in journalism” mentioning about Taslima Mizi, who couldn‟t survive in journalism after fighting. She said to BBC Bangla that „to work in media as a woman my problems and challenges were so much that I couldn‟t survive in journalism at last. The real scenario is in Bangladesh women who want to take the challenge and work in the field their story like Taslima Mizi are available in every house. It‟s clear that women face an obstacle to working in media. In this report Giti Ara Nasrin,

mention about Global Media Monitoring Project and said, the number of women journalist doesn‟t increase in last ten years but to some extent, it decreases. Information Ministry of Bangladesh published a telephone guide name PID guide. In the last publication of this guide mentioned approximately two hundred Bangla, English and online newspaper among them women editor is only six. Among this six editor, all become an editor by ownership not because of doing journalist. From listed Twenty-five television channel women

CEO and Head of news are in two channels. In the history of private channels, women get priority mainly in news presenting, working as a journalist and get promoted to the top level of the organization like Munni Shaha is one or two. Senior Journalist and editor of English Daily News Today Riazuddin Ahmed said the environment of Bangladesh newsroom is not prepared yet. Where a woman editor who have to work until midnight and our social perspective is not in favour of women for this. He added I am not saying women are less eligible but they can‟t move forward because of the environment.

According to the report of "International Federation of Journalists 2014", apart from the killing of bloggers and numerous attacks on journalists, female journalists have also been specially targeted in the violence against the media by fundamentalist forces like the Hefajat e Islam. Females have been attacked and ridiculed while covering public meetings and stopped from reporting in the field. Journalist Nadia Sharmeen was on assignment to cover a Hefajat meeting when she was brutally attacked and subsequently hospitalised. She was supported initially including paying hospital bills by Ekhushey TV which she was working. The Bangladesh High Court directed the government to provide her with medical treatment free of cost. (Galhotra, 2013) Prof GitiaraNasreen (2003) conducted a research on "Women in Bangladesh media" and concluded as follows: "The main reason of this problem is the legal position of the female is still ruled by religious laws when it comes to legacy, marriage, divorce and child custody. Religious laws are privileged over constitutional guarantees, working against the interest of female journalist. Attitudes in society still stands against gender equality. Very often females are not aware of their rights, even when they are females who depend on male protection are convinced that it‟s not in their best interests to claim those rights." In recent times the trend is changing, a significant number of Bangladeshi female are becoming involved in journalism, especially in reporting along with the growing number of prints and electronics media. It‟s proving that female can get in any kind of challenging job like journalism alongside male, and female is doing well. There are more than 40 TV channels and according to the information ministry of Bangladesh, there is 1078 Daily Newspaper in Bangladesh. Among them four hundred and two newspapers are published from Dhaka Zillah. There are twenty-eight FM radio and thirty-two community radio. Although the exact figure of online newspapers, television channels and online radios are not yet including in the information ministry. But more than thousands of online newspapers had applied to the Information Ministry for registration. In Bangladesh, many females have been doing noteworthy work as journalists over the last decade. But the number of their presence in both print and electronic media is unimaginable less than expected. More and more women have been joining the ranks of journalists in the last few decades, but they still tend to occupy the lowliest jobs. Executive and editorial positions are continuing reserved for men. But it is time to recognise the challenges and explore the opportunities for women to encourage them. American journalist Mary Temple Bayard (1893) said "The newspaper is the educator of the public, and men and women

who write in newspapers have the best opportunities for creating public opinion. They know their colleagues of the other sex watch them with an attention naturally critical, but not always sympathetic; neither is there a royal road especially prepared or made smooth for either sex. A fair field and no favour must suffice for women in journalism. There is no claim to be set forward on the basis of sex. Women who have succeeded in journalism have succeeded as journalists and not as women, and this along with the same lines on which men have succeeded." In south Asia, female journalists are facing discrimination of work assigned, promotional opportunities, sexual harassment, lack of maternity benefits and poor support conditions for working mothers. Yet there are a number of female journalists who still strive to get the story and strive for fair and gender sensitive reportage. They put their lives at risk and try to uncover different and more human dimensions of the conflict they cover, seeking to speak to women survivors to find another story. They learn how to survive with courage amidst great odds. (CNC, 2013) Cheryl Lindsey Seelhoff said: That is true of a most professional female in journalism, specifically in the current affairs slots women aspired to, family life set serious limitations. Child rearing and family and domestic responsibilities without adequate support services were cited as important barriers to advancement. For instance, it restricted travelling on assignments for a female with small children or made female think twice before accepting jobs that required long, late and irregular hours. This included some kinds of supervisory jobs in journalism. It was suggested that female journalists should be able to work flexible hours but this is not practical in news organizations. Another point made was that domestic work (and social norms) prevented female, unlike men, working at their careers outside the office either by improving their knowledge or engaging in office politics and 'drinking with the boss'. The possibility of getting men to share domestic work was considered more utopian than getting domestic help or domestic appliances. (Shellhoff, 2007) The Bangladesh NariSangbadhik Kendra (BNSK) is the oldest women journalists‟ organization in Bangladesh and was established in 2001. According to BNSK 2006, the number of female journalists is increasing in Bangladesh, but their numbers are still woefully low. BNSK estimates around 6000 male journalists and only around 300 female journalists in Bangladesh. Sadly, there is fewer female at the policy-making level. In newsrooms, female journalists often face disparities in news beats like energy, economic, political, parliament, crime, sports and election commission, their numbers are negligible. With poor facilities and a discouraging environment, upward mobility is a struggle. Female suffer discrimination in training, recruitment and promotion and denied decision making positions. According to the report of South Asia Media Freedom and Solidarity Project (SAMSN) In Bangladesh TV female journalists are often treated as sex objects and expected to act and dress in that manner. They are rarely seen as serious journalists. Miserably sexual harassment in the workplace is increasing. This is largely hidden and undocumented and female journalists who raise sexual harassment charges against colleagues or seniors are often at risk of losing their jobs and their charges are either not taken up seriously or dismissed as false. Violating rights of a female journalist is not a new invention but it's verified on society to society.

In previous time there are so many researchers and Scholars tried to find out the conditions of female journalist in Bangladesh. Definitely, they did very good works. It is very clear in this position I am paying attention to do research as a brought section. I will enter the deep position of a female journalist in Bangladesh. I believe that after this research I will be able to find out the real scenery of Bangladeshi female journalists.

Objectives of my Research

Objectives of this study were to find out the number of women journalist in media of Dhaka City and to examine the challenges and issues confronting women Journalist working in the media, and to the extent of direct and indirect discrimination in the workplace and to identify contemporary issues that need to be addressed. My research also aimed at exploring the national culture and work behavior of journalism for female journalist in Bangladesh.

Methodology

I have collected data from both primary and secondary sources. Secondary sources are internet, newspaper, journals, organization website and website of Ministry of Information, Bangladesh.

To collect data from primary sources, at first, I made a list of different electronic, print media and online news portal that I knew. I consulted six electronic, print media and online news portal to compare the number of male and female journalist in these organizations. Then I went to the Press Institute of Bangladesh for the whole list of existing media in Bangladesh. But Press Institute has archive of twenty-six daily national newspapers of Bangladesh. Then I went to ministry of film and publication Bangladesh to find out the list of online portal of Bangladesh. I also took advantage from my colleagues and collect information from the tenth and eleventh sessions of National Parliament of Bangladesh where information minister reported about media in Bangladesh. After collecting the total number of media I tried to collect the number of male and female journalists in Dhaka city. I went to some of the journalist associations to collect number of journalists engaged in media in Dhaka city. I took help from Nari Sangabadhik Shansgtha to collect list of female journalists. The next step was making a list of male and female journalist to interview. I prepared a list of journalists and choose few of them from my checklist, and I contacted them for in-depth interview.

I have collected information about how many Universities offer degree program in journalism in Bangladesh. I took help from University Grant Commission (UGC). Then I collected data related to number of current students, number of graduates, male female ratio of the students and starting year of the Media Studies/Journalism program/department. I visited registrar offices of 10 universities in Dhaka city to collection data. I contacted some faculty members over phone to collect information about journalism department and their graduates. I tried to find out the exact number of current students and number of graduates to compare how many of the graduates are working with different media after completing their degree.

I visited „Nilkhet Book Market‟ to find out magazines published in Bangladesh on women issues and to find information about engagement of women journalists with these magazines. Not all but some of the magazines cover mostly women‟s fashion, beauty and lifestyle. Some of themagazines focused Celebrity News, Interviews with Stars, Experts‟Advice, RelationshipArticles & Advice, Revealing Quiz, and so on.

Findings

To figure out the number of women journalist in Dhaka city I tried to find out how many universities in Bangladesh offer journalism program. I have collected six kinds of information from the university authority. Categorises are Starting Year of the Journalism Subjects, Name of the Institution, Students in Per year/semester, Number of students, Number of Graduates, Ratio of Male and Female students. Recently in Bangladesh, seventeen public and private universities offer this subject. Some of the universities started this course recently. Among seventeen universities eight public and nine private universities offers journalism subject. Moreover, some of the universities recently have started this subject but they don‟t have graduate‟s student. Total five universities are in this list where students didn‟t complete their graduation. At first Dhaka university offered journalism subject under the department of mass communication and journalism in 1977. At present about four thousand six hundred and eleven students are doing their graduation in different universities. A number of graduates from the starting to present are about four thousand four hundred and ninety-five. Among the graduates, two thousand seven hundred and fifty-two graduates are male where one thousand seven hundred and forty-four are female.

Table below shows the statistical information about the list of Journalism departments in different Universities along with the number of graduates and ratio of male female students.

List of Journalism Departments in Different Universities

Year	Name	Per year/ semester	Number of Students	Number of Graduates	Ratio of Male Female
1977	University of Dhaka	64	253	900	60-40
1992	University of Rajshahi	50	250	800	60-40
1994	University of Chittagong	100	400	700	60-40
1994	American International University-Bangladesh	40	400	500	60-40
2002	University of Development Alternative	50	400	300	60-40
2004	University of Liberal Arts Bangladesh	200	780	363	55-45
2004	Independent University, Bangladesh	25	250	300	65-35
2005	Stamford University Bangladesh	40	400	253	25-75

2006	Jagannath University	80	310	148	60-40
2007	Daffodil International University	50	350	150	70-30
2011	Begum Rokeya University	45-60	250-60	No Graduates	60-40
2011	Jahangirnagar University	40	218	58	60-40
2013	Manarat International University	40	150	23	80-20
2013	Port City International University	50	100	No Graduates	80-20
2013	State University of Bangladesh	50	250	No Graduates	80-20
2014	Jatiya Kabi Kazi Nazrul Islam University	30-35	65-70	No Graduates	60-40
2015	Khulna University	35	35	No Graduates	60-40

Table 1. List of Journalism Departments in Different Universities

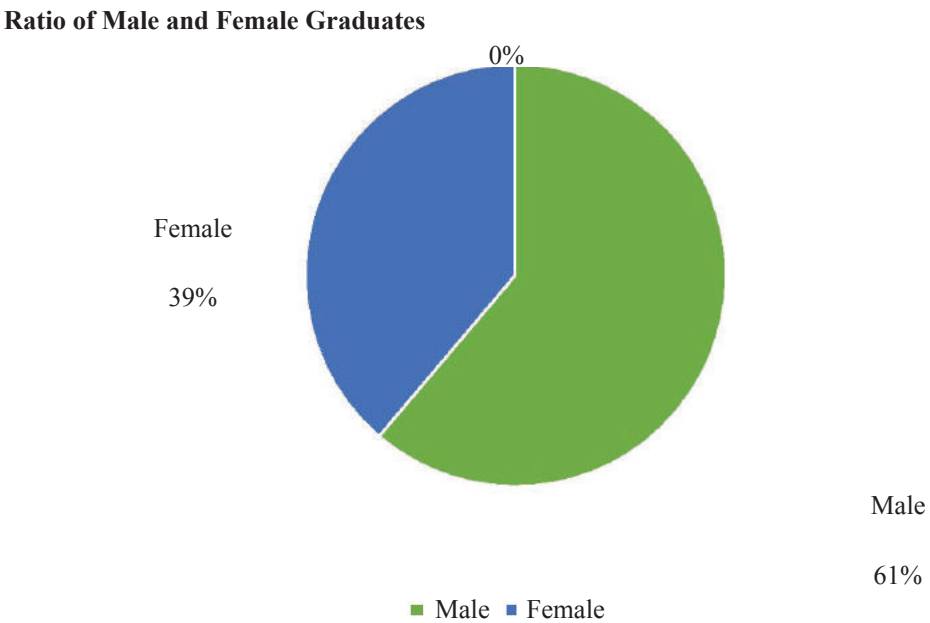


Figure 1. Pie Diagram Displaying Ratio of Male and Female Graduates

The pie diagram shows that female graduates are 39% and Male graduates are 61%. Female graduates are less than male graduates in different universities.

Women Journalist in Electronic Media

Organization Name	Number of Reporters	Number of female Reporters	Total Journalist	Number of Female Journalist
Jumuna Television	50	02	65	13
Somoy Television	69	13	90	21
Channel I	29	03	49	10
RTV	28	05	40	10
NTV	27	03	39	09
ATN Bangla	34	04	50	05
Percentage	35%	5%	49%	11%

Table 2. Women Journalist in Electronic Media

Information Ministry approved forty-one private-owned television channels, among them twenty-seven television channels are currently on air. I have collected six television channels for this paper. In the table Number of the reporter, the number of female reporters, total journalist, the number of female journalists are given. I have collected information from each channel to figure out the number of women journalist and also to compare with the number of male journalists. From the table in Jumana Television there are only two female reporters among fifty reporters. Only thirteen female journalists are there among the total number of sixty-five journalists. In the Somoy Television, the number of reporters is sixty-nine among them thirteen are female. Twenty-one are female journalists among the total number of ninety journalists. The table shows in Channel I there are only three female reporters where the total reporters are twenty-nine. Ten are female journalists from the total number of forty-nine journalists. According to the table in RTV total number of female reporter are five where male reporter is twenty-eight. Only ten female journalists are there among the total number of forty journalists. In NTV, the number of reporters is twenty-seven among them three are female. Only nine are female journalists among the total number of thirty-nine journalists. in ATN Bangla there are only four female reporters among the total thirty-four reporters. Only five female journalists are there among the total number of fifty journalists. Although female journalist is not recruited in all types of media. But with compare to other media print and online portal the number of female journalists is high in electronic media. Some female journalist mentioned to comply with the government policy pressure they recruit a minimum number of a female journalist. Some journalist thinks that the reason behind the increasing number of female journalist in electronic media is transportation facility. Primarily women journalists are working in newsroom or news desk and few are working as reporter and camera person.

Women Journalist in Electronic Media

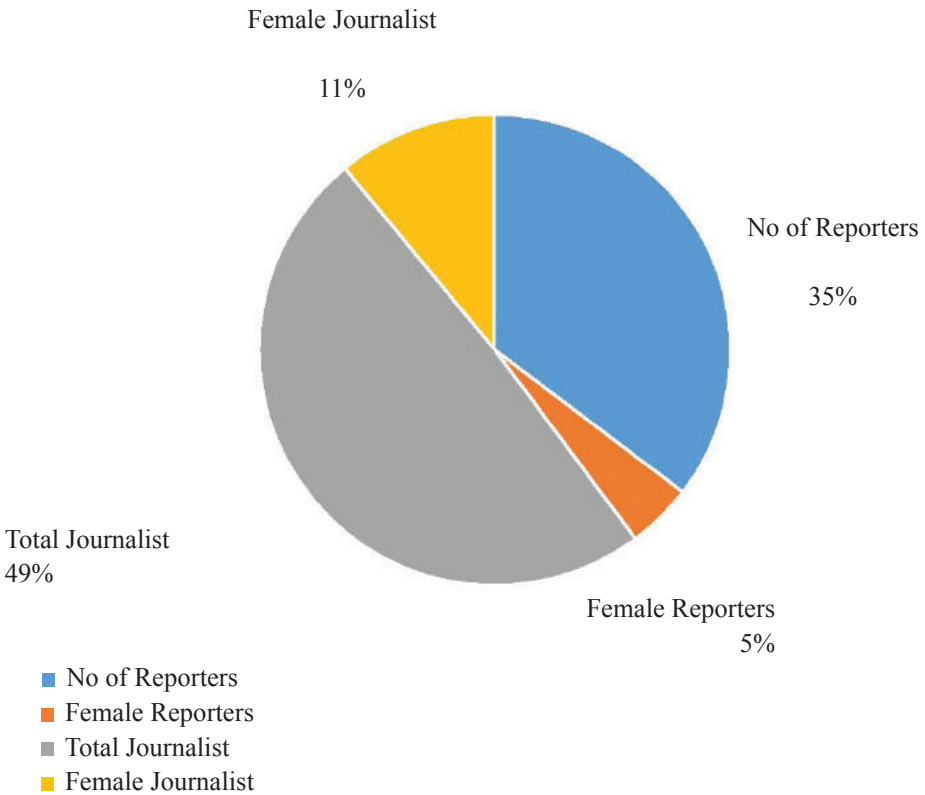


Figure 2. Pie Chart Displaying Women Journalist in Electronic Media

The pie chart displaying that a total number of journalist is 49% where the number of Female Journalists are 11%. And the number of reporters are 35% where only 5% are female reporters.

Women Journalist in Print Media

Organization Name	Number of Reporters	Number of female Reporters	Total Journalist	Number of Female Journalist
Daily Kaler Kantho	29	01	85	08
Daily Ittefaq	29	02	70	10
Daily Samakal	38	02	54	03
Daily Noyadigonto	32	00	45	05
Daily Manab	18	02	38	03

Zamin				
Daily Bonik Barta	19	01	45	13
Percentage	30%	1%	61%	8%

Table 3. Women Journalist in Print Media

According to the information ministry of Bangladesh, there are 1078 daily newspapers in Bangladesh. Among them, four hundred and two newspapers publish from Dhaka Zillah. In most of the newspaper publisher and owner are same and they also take the responsibility of the editor. Some of the newspaper publisher recruits professional editor for the newspaper. I have collected six newspapers for the study and mention following information, Number of the reporter, the number of female reporters, total journalist, the number of female journalists. The reason of collecting information from each newspaper is to figure out the number of women journalist and also to compare with the number of male journalists. According to the table total number of reporters in the Daily Kaler Kantho are twenty-nine among them only one is female reporter. And the total number of journalists are eighty-five among them female journalists are only eight. If we look up the Daily Ittefaq, then we can see the total number of reporters is twenty-nine among them only two are female. And from a total number of seventy journalists, female journalists are ten. The table shows in Daily Samakal among the thirty-eight reporter only two are female reporter. In the total number of fifty-four journalists, only three are female journalists. According to the table in the Daily Noyadiginto, Daily Manab Zamin and Daily Bonik Barta the total number of male and female reporter of this three newspapers are thirty-two and no female reporter, eighteen and two, nineteen and one. And the total number of journalists are forty-five and five, thirty-eight and three, forty-five and thirteen. With the compare of electronic media, the number of female journalists is less in print media. Some journalist thinks that the reason behind the less number of female journalist in print media is transportation facility. Excepting one or two leading newspapers other print media organization doesn‟t provide transportation facility.

Women Journalist in Print Media

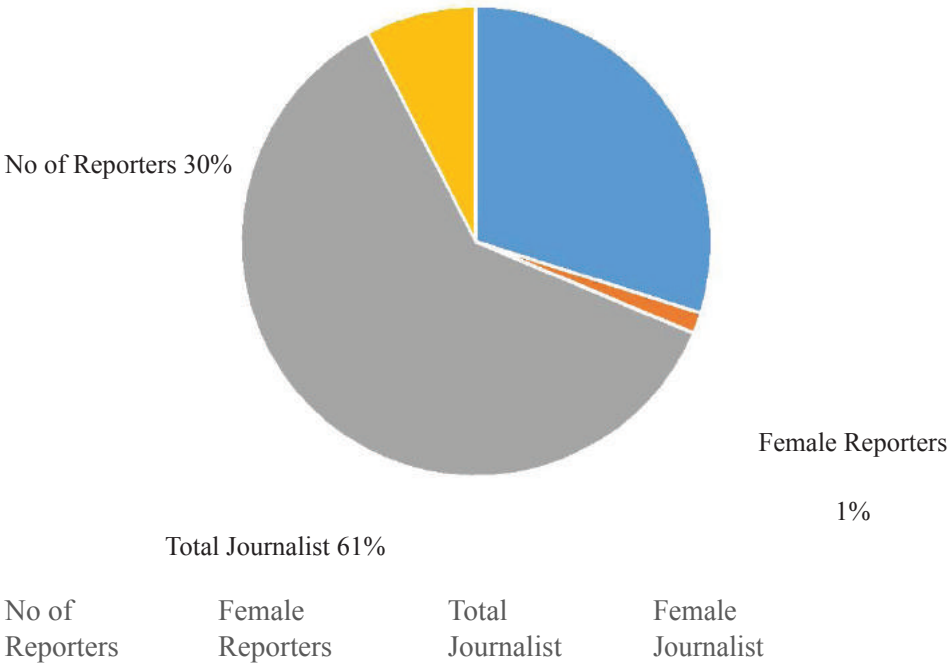


Figure 3. Pie Chart Displaying Women Journalist in Print Media

The chart shows in print media a total number of journalists are 61%. But the ratio of a female journalist is 8%. Where the number of reporters is 30% and the number of female reporters only 1%.

Women Journalist in Online News Portal

Organization Name	Number of Reporters	Number of Total female Journalist Reporters		Number of Female Journalist
http://www.banglatribune.com	16	02	75	12
http://www.bdnews24.com	22	03	82	19
http://www.jamunanews24.com	12	00	30	02
http://www..poriborton.com	15	01	50	04
http://www.risingbd.com	13	01	51	03
http://www.jagonews24.com	13	02	55	05
Percentage	19%	2%	70%	9%

Table 4. Women Journalist in Online News Portal

Although the exact figure of online newspapers, television channels and online radios has not yet included in the Information Ministry. But more than thousands of online newspapers had applied to the Information Ministry for registration. At the eleventh secession of parliament on 27thJune 2016, information minister confirmed the amount of online media. About one hundred and five online television channels, eighteen online radios and one thousand seven hundred and seventeen online newspapers are waiting for approval registration.

I have collected six online portals for the study and mention following information there are Number of the reporters, the number of female reporters, total journalists, the number of female journalists. The reason for collecting information from each online news portal is to figure out the number of women journalist and also to compare with the number of male journalists. According to the table, a total number of reporters in banglatribune.com are sixteen among them only two is a female journalist. And the total number of journalist are seventy-five among them twelve are a female journalist. The table shows that in bdnews24.com the number of reports is twenty-two among them three are female. And from a total number of eighty-two journalists, nineteen are female. There is no female reporter jamunanews24.com among the twelve reporters. In the total number of thirty journalists, two are female. According to the table poriborton.com, risingbd.com and jagonews24.com, the total number of male and female reporter of this three online are consistently fifteen and one, thirteen and one, thirteen and two. And the total number of journalists are fifty and four, fifty-one and three, fifty-five and five.

Women Journalist in Online News Portal

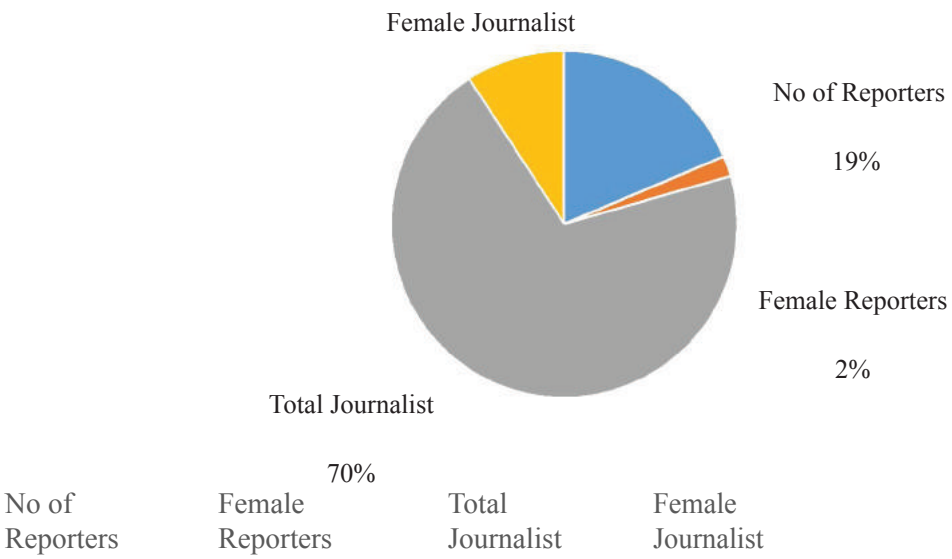


Figure 4. Pie Diagram Displaying Women Journalist in Online News Portal

The chart shows that in online media a total number of journalists are 70%. But the ratio of a female journalist is 9%. Where the number of reporters is 19% and the number of female reporters only 2%.

Mahmuda Chowdhury, Former Journalist Daily Dinkal

In our era female journalist who worked in the newspaper coming through their relatives, father or husband. Now the scenario is different, females are trying to come into this profession proving capabilities, using their talent and strength. The professional challenge is same for everyone. But we don't provide a working environment, security and mentality for a female journalist. When it's about assignment female journalist assigned mostly women based news. Most of the time they had to fight and prove themselves that they are capable enough as like as their male colleagues for assignments. The female journalist had to be very calculative to move forward. Some might think as she (female journalist) started working outside among men then she may be easily available. No job security and lack of proper guidelines. In some cases, female journalists are working by accepting this situation. When it`s about salary and promotion then females are mostly deprived than that of men. Nowadays they are learning the strategic way to compete men and achieving a higher position. But for me, the sad news is that those female journalists who take that position they hardly help or show path for newcomers and juniors. After entering into the decision making position female leaders fail to women friendly environment. The bad news is journalists are divided by political party but it's unethical for a journalist to become politically divided. May be this is the reason behind journalist doesn't have a strong union. Women journalists are working in a row with their male mates and sometimes female journalists are more hard worker than male journalist and they should get same respect like other.

Nadira Kiron, Chief reporter, ATN Bangla

At the very first moment, the female journalists have to prove that they are not women they are a journalist. They have to prove the same capability in reporting as like as men. If we look in the 14-15 years back, people didn't discourage female journalist to work as a reporter. They made an unwritten rule that women only can do desk oriented work. And even family members and relatives also think that because there were hardly fixed time scheduled in reporting. If female recruited as a reporter, then organization assigned her soft and women based news to cover. To work in crime, diplomatic and other strong beats female had to fight sixteen years back and the scenario is still same as female reporter still fighting to work in this section. A number of women are working in electronic media and we can say electronic media bring this revolution. But mostly women are working with desk oriented, editor and presenting work. If you do a research on a house, then you will hardly find out one percent female reporter. I must say challenges are every day. When any house thinking to recruit ten reporters, they do not keep in mind to recruit one female reporter among them. Because decision makers calculate after marriage office will have to suffer as she will needs leave for a family issue, maternal leave and all these. From the ancient, women are being a subject of Curiosity, gossip and entertainment, this practice remain same till now. But at present time by measuring or see the confident of women journalist male do not get the courage to abuse them. Girls who show the confident and prove herself from the beginning she hardly faces any kind of abuse. And my opinion is if you really want to choose this profession

she must have the courage and confident and family support. As there is no job security in this profession if one loses or terminated specially women then it's quite tough to get recruited another house. Women can't maintain public relation like men. In media most of the recruitment done internally so women get less chance to interact with other. We are far more away from equality and I am not sure whether someday number of male and female will be equal or not. I took every rising in a positive way but we need to look forward to how long it sustains. How many of them can survive after fighting?

Kazi Runa, Former Journalist

Kazi Runa worked with different television channels including RTV and Asian. She said journalism is a challenging profession for both male and female journalists. But women had to face more resistance with comparing man to work in this profession. Primarily resistance means social and family obstacles. But being a woman journalist I feel women had to bear more impediments in the workplace. Especially higher authorities do not want to make any concessions when a woman journalist is pregnant. My own experience has been bitter about this. I have been a long in television journalism. I got married while being in journalism. After being a mother I realised that I didn't get minimum from a quarter collaborative workspace from my office rather they were trying to explain to me that I am nothing but a burden for them. They sent me away from reporting to the desk. Other male colleagues of mine can choose convenient work shifts for them but I had to work 3pm to 12am. At this time as a mother, I was supposed to get more support from my colleagues that time they did extreme intolerance behaviour with me. It took the time to understand that all this happened to me with the sign of head of news. Once the head of news asks me to apply for leave without pay. He got ferocious because I disagreed with him and without promptness, he said to me that they didn't recruit me if they knew I am pregnant. I got conceived the month I left my previous job. Authority harasses me several ways only the fear of maternity leave. Once I became mentally week and left my job. In journalism, they consider conceiving as a crime because they had to issue six month of maternity leave. For this reason, an organization like NTV and RTV doesn't recruit women to work with them.

Labli Bithi, Reporter, Jamuna Television

In this profession, challenges are same for both male and female journalists. But social acceptance is different although now a day women are working in all sectors. She said, as a women journalist when I visit spot for information most people do not want to help as I am a woman. But they can easily help me. But they don't only because they think why should a girl need to out from home? Women meant to be at home. But in office, the environment is totally different. They treat me like other colleagues, inspire me, assign me different event. If they do not want to send me any risky or crime scene it does not mean they think I am not capable enough to do that work. They only think about my safety. Many times we heard gossip about some house where women journalist may have victimised or faced some kind abuse, discrimination. I know a girl who started her carrier from a television channel as a reporter. But she couldn't survive longer. One need to be enough stronger and courageous to handle such things. If you keep quiet, then other people try to take advantage of you. It's not only in media or journalism it's in everywhere. But it doesn't mean women will stop coming out from home.

Sajedul Huq, News Editor, Daily ManabZamin

Journalism is not a crime but powerful people do not want to accept every time. For this reason, the journalist had to face many challenges in the country to country. Sometimes they had to lose their life. A challenging profession like journalism women is also contributing side by side with men. In Bangladesh, women are not that much in this profession like the western county. For women to continue this challenging profession is not easy. Still very few women take journalism as their profession. But we have to accept that country like Bangladesh where coming out from home is still one kind of a challenge for women. Although the scenario is changing gradually. To compare with other profession women are less in this profession. Although in electronic media the number of male and female are almost same. But specifically in reporting women are far behind than men. Remembering an interview of Giti Ara Nasrin`s for BBC that most of the male journalist cannot accept that women can also work in this profession. To increase the number of journalists, first of all, we`ll have to change our mentality and thinking process. And it the high time for a change. Journalism is a profession of both men and women. Every innovative person has the right to become a success in this profession. Until we break this myth that journalism is not a profession for women it's difficult to increase the number of female journalists. Very few women are in the decision-making process in media. To make a change it is important to raise a number of women in the decision-making process. Although many senior journalists think the social situation is responsible this. In media, the high ranked position people had to work till late night. But mostly women are not comfortable to work at night. It is not also true that one can`t manage the work during day time. We should increase opportunity for women as soon as possible. And women will also need to come forward and fight to move on.

Nuruzaman Labu, Senior crime reporter, banglatribune.com

The main challenge of women journalist is communication, moving one place to another. To do an assignment in any place, work in night shift and trouble more than one place for information in a single day. These are some reason women are less acceptable than men in media. Specially conflict and field work are tough for women in the context of Dhaka city. To consider the social and other situation most of the time office provides some privileges to women. This thing also effects in the recruitment process. While recruiting decision makers to choose male reporter. They think if they recruit male reporter they can properly utilize them. But still, women are coming towards this profession overcoming all the barriers. They take challenges and doing well in that field. Women journalist are working as a crime reporter and stand well in it. A noticeable number of women are working in electronic media comparing print and online media. In electronic media, they get transportation facility where print and online media hardly provide this facility. Another challenge for women journalist working in media is fear of abuse. Although we think journalism is a profession of conscience, conscious, responsibility. This senior reporter said in his experience he saw women journalist who abused by their senior colleagues and in some cases authority. When some women complain to the higher authority of this kind of unexpected things then she might have terminated because of her accused. Many times women keep their mouth shut only because of their carrier. Because media is a place where if anyone lose their job for this kind of allegation and sack from one house she hardly gets chances to work with other house. Still, media houses are unable to provide safe and secure working environment for women.

Lutfor Rahman, City Editor, Daily Manabzamin

Women journalists are victims of discrimination from the perspectives on the workplace. In our country, many people think that women do not have full knowledge and capability challenging profession like journalism. There is no fixed working area for women. For the perspective of restrictions, very few women are in top position in the media. Recently in electronic media women are making their position. The mentality of taking challenges and education are playing important role in this. To start working as a journalist women journalist had to face discrimination. Women journalist mostly assigned weak beats like women and children issue or human story to do. Women journalist gets fewer chances to work important and challenging places to work. Besides that, a big challenge to women journalists is working time. Now a day in all media extends working time. In electronic and online media provide news updates twenty-four hours. Workers also work day night and women journalist face problems for this kind of work schedule. There are many examples women journalists had to quit their job for unable to work in night shift. Family barrier and domestic disturbance stand as an obstacle for women. Many women had to leave their jobs for this reason. Although, there are many obstacles but with the time women journalists taking challenges to work. By proving their qualification and ability women are working in media. With the expansion of media, the number of women journalist are increasing. At present time in electronic media women journalist working with dominance. Many people are coming up in this profession has been studying journalism at the helm. It helps to survive in this profession and for better working. The job of journalism is like another profession. As a result, who are coming to work in journalism they have come with the mentality of survival and competition.

Issues

Struggling

Women face more resistance with comparing to man to work in this profession. Primarily resistance comes from social and family obstacles. But being a woman journalist women have to bear more impediments in the workplace. If females recruited as a reporter, then the organization assigned her soft and women based news to cover. To work in crime, diplomatic reporting and other difficult assignments female journalists had to fight sixteen years back and the scenario is still same as female reporter still fighting to work in this section. If we look in the 14-15 years back, people didn‟t discourage female journalist to work as a reporter. They made an unwritten rule that women only can do desk oriented work. But still, women are coming towards this profession overcoming all the barriers. They take challenges and doing well in that field. Women journalist are working as a crime reporter and stand well in it. A noticeable number of women are working in electronic media comparing to print and online media.

As there is no job security in this profession if one loses or terminated specially women then it‟s quite tough to get recruited in another house. Women can‟t maintain public relation like men. In media most of the recruitment get done internally so women get less chance to interact with other.

One need to be enough stronger and courageous to handle such things. If you keep quiet, then other people try to take advantage of you. It‟s not only in media or journalism it‟s in everywhere. But it doesn‟t mean women will stop coming out from home.

According to one senior journalist, the realization as a mother is that some women even get minimum from a quarter collaborative workspace from office rather organization trying to explain that women are nothing but a burden for them. Especially higher authorities do not want to make any concessions when a woman journalist is pregnant. Other male colleagues can choose convenient work shifts for them but some women had to work 3 pm to 12 am or work shifts that chosen by authority. At the time of pregnancy women were supposed to get more support from colleagues but that time most of them do extreme intolerant behaviour. In some houses, head of news or decision makers asks pregnant women to apply for leave without pay. If women journalists disagree then authority started to torture her mentally. There women become mentally week and leave their job. In journalism, they consider getting pregnant as a crime because they had to issue six month of maternity leave. For this reason, in some electronic media organization recruit less women journalist to work with them.

Social environment

From the ancient, women are being a subject of curiosity, gossip and entertainment, this practice remain same till now. And even family members and relatives also thinks that there were hardly fixed time scheduled in journalism. But social acceptance is different although now a day women are working in all sectors. When women journalist visits spot for information most of the people do not want to help only because she is a woman. But they can easily help in that situation. They think why should a girl need to out from home? Women meant to be at home. Some people come forward and appreciate women. To consider the social and other situation most of the time office provides some privileges to women. This thing also effects in the recruitment process. But we have to accept that country like Bangladesh where coming out from home is still one kind of a challenge for women. Although the scenario is gradually changing. To compare with other profession women are less in this profession. To increase the number of journalists, first of all, we`ll have to change our mentality and thinking process.

Ratio of men and women journalist

Although, in electronic media the number of male and female are almost same. But still we are far away from equality and it`s not sure whether someday the amount of male and female will be equal or not. According to the Global Media Monitoring Project, the number of women journalist doesn‟t increase in last ten years but to some extent, it decreases. If we look back the number of graduates from different universities and number of female journalists in different media the scenario will clear instant. The number of males graduated from different universities is two thousand seven hundred and fifty-two and female graduates are one thousand seven hundred and forty-four. According to Bangladesh NariSangbadhik Kendra (BNSK) 2006, the number of female journalists is increasing in Bangladesh, but this numbers is still woefully low. BNSK estimates around 6000 male journalists and only around 300 female journalists in Bangladesh. Sadly, there is fewer female at the policy-making level.

Recruitment system

When any house thinks to recruit ten reporters, they do not keep in mind to recruit one female reporter among them. Because decision makers calculate after marriage office will have to suffer as she will needs leave for a family issue, maternal leave and all these. While recruiting decision makers to choose male reporter more than female. They think if they recruit male reporter they can properly utilize them and the output will be more. In media Most of the recruiting ends with the internal recruitment process. Very few women get that internal recruitment opportunity. But still, women are coming towards this profession overcoming all the barriers. As there is no job security in this profession if one loses or terminates specially women then it‟s quite tough to get recruited another house. Women can‟t maintain public relation like men. As I mention in media most of the recruitment done internally so women get less chance to interact with other.

Discrimination

From the beginning women journalists face discrimination. Here discrimination means assigning weak beats, child and women based news, human story, feature writing, promotion, salary etc. Women journalist gets fewer chances to work important and challenging places to work. In the case of promotion, women journalist gets a fewer chance than their male colleagues. Male colleagues think women are working less than them. Women journalist are victimizing from the perspective of workplace. In newsrooms, female journalists often face disparities in news beats like energy, economic, political, parliament, crime, sports and election commission, their numbers are negligible. With poor facilities and a discouraging environment, upward mobility is a struggle. Female suffer discrimination in training, recruitment and promotion and denied decision making positions.

Abuse

Another challenge for women journalist working in media is fear of abuse. Although we think journalism is a profession of conscience, conscious, responsible people. But there are some people who abused women journalist. When some women complain to the higher authority of this kind of unexpected things then she might have terminated because of her accused. Many times women keep their mouth shut only because of their carrier. Because media is a place where if anyone loses their job for this kind of allegation and sack from one house she hardly gets chances to work with other house. Still, media houses are unable to provide safe and secure working environment for women. Many times we heard gossip about some house where women journalist may have victimized or faced some kind abuse, discrimination.

BBC Bangla published a news of reporter Ahrar Hosen titled “How far women of Bangladesh are in journalism” mentioned about Taslima Mizi, who couldn‟t survive in journalism after fighting. She said to BBC Bangla that „to work in media as a woman my problems and challenges were so much that I couldn‟t survive in journalism at last. The real scenario is in Bangladesh women who want to take the challenge and work in the field their story like Taslima Mizi are available in every house. It‟s clear that women have to face resistance working in

media. In the history of private channels, women get priority mainly in news presenting, working as a journalist and get promoted to the top level of the organization like Munni Shaha is one or two.

Senior Journalist and editor of English Daily News Today Riazuddin Ahmed said the environment of Bangladesh newsroom is not prepared yet. Where a woman editor who have to work until midnight and our social perspective is not in favour of women for this. He added I am not saying women are less eligible but they can‟t move forward because of the environment. According to the report of South Asia Media Freedom and Solidarity Project (SAMSN) In Bangladesh TV female journalists are often treated as sex objects and expected to act and dress in that manner. They are rarely seen as serious journalists. Miserably sexual harassment in the workplace is increasing. This is largely hidden and undocumented and female journalists who raise sexual harassment charges against colleagues or seniors are often at risk of losing their jobs and their charges are either not taken up seriously or dismissed as false. Violate rights of a female journalist is not a new invention but it's verified on society to society.

Challenges

A challenging profession like journalism women are also contributing side by side with men. The journalist had to face many challenges in the country to country. Sometimes they had to lose their life. For women to continue this challenging profession is not easy. In Bangladesh, women are not too many in this profession like the western county. Still very few women take journalism as their profession. Women journalist had to prove that they are not women but they are journalists. And also to prove she has the same capability in reporting as like as men. Females are trying to come to this profession proving their capabilities, using their talent and strength. But media houses are unable to provide the safe working environment, security and mental satisfaction to the female journalist. A big challenge for women journalists is working time. Now-a-days all media extends working hour. In electronic and online media provide news updates twenty-four hours. Workers also work day night and women journalist face problems for this kind of working schedule. There are many examples of women journalists who had to quit their job for unable to work in night shift. Another challenge of women journalist is communication, moving one place to another. To do an assignment in any place, work in night shift and trouble more than one place for information in a single day. These are some reasons that‟s why women are less acceptable than men in media. Specially, conflicts and field work are tough for women in the context of Dhaka city.

How the women journalist survives?

The female journalist had to prove they are not women but they are a journalist. It is necessary to prove that she has the same capability in reporting as like as men. In recent years‟ women journalists are coming up in this profession after graduation in the specific subjects. Women journalists can apply their educational knowledge in the professional field. Educational knowledge helps them to work better and build them confident to survive. The job of journalism is like another profession. women who come to work in journalism they have come with the competent mentality of survival and competition. Girls who show the confidence and prove herself from the beginning she hardly faces any kind of abuse. Women journalist who are already in the higher position they think if anyone really wants to choose this profession she must have courage and confidence and family support. In media women, the journalist had to go through a tough time while pregnant. They hardly get support and friendly work environment from colleagues and authority. Women

journalist fight for their materiality leave and sometimes they lose their previous bit. But they fight in all the way and manage to survive. For example, before pregnancy, a women journalist covers election commission beat regularly. But after pregnancy, she has been shifted in desk reporting or editing. When she goes for maternity leave authority replace another reporter in her place to cover election commission. In the mid time, the replaced reporter obviously makes the new sources for news. After coming back from leave the reporter can`t continue her work in election beat that she used to do before she got pregnant. She has to start with a new working idea and build the source for her work. Most of the times women journalists face problem while she looks for a new job in another media house. Most of the recruitments are internally in media houses. As communication and the public relation are very important in journalism. Women journalist can`t maintain public relation like their male colleagues. If any women journalist quit their job or lose their job for any reason, then it‟s really tough for her to get a new job in media organization.

Conclusion

Bangladesh by its policy provides equal status to the women and gives them the same scope to the man, though practically it‟s not working well. In Bangladesh, it is necessary to improve the environment to empower women in journalism. Improving working conditions, equal assignments, fair wages and job security are the rights of every woman but too often they are deprived of it. In the terms of policy making, women are largely ignored. Ironically, women journalists win awards, but in their own workplaces they are disregarded and often referred to in the most disparaging manner. The number of female journalists is on the rise in Bangladesh, along with the growing number of print and electronic media. Still women journalists have to go a long way to get equality. Journalism is a challenging profession for both male and female journalists. The main challenges of female journalist are being recruited in a media organization. Although at present time with the rising of electronic media some female journalist maintaining a prominent place in media.

They are very eager to work in all the sector of journalism because they are brave, courageous and adventurous, but there is little recognition of their issues and struggles. Yet their representation across all areas of the media remains inadequate. Undoubtedly, the prevailing situation of women in Bangladesh is changing and approaching towards betterment. The rate of female literacy is increasing rapidly and for these reasons attachment of women in the job, the sector is increasing day by day. More and more women are entering different professions and getting jobs and awareness about women‟s problems and right is also increasing. The role of media in affecting the change cannot be denied. Women‟s journalism in Bangladesh shares the credit for this constructive changes.

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Unveiling Stereotyped Stigmas about Menstruation and Its After Effects on Women's Reproductive Health in Bangladesh

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Abstract

We are living in a patriarchal society where we are socialized to maintain silence regarding reproductive health related issue and we are trained to maintain this silence from adolescent period. This study will explore stigmas about menstruation among male and female members of our society and its aftereffects on women's reproductive health in Bangladesh in terms of their perception, experience, practice and behavior towards adolescent girls. Here I will try to develop my sociological insight from Social Learning Theory and Cognitive Behavioral Theory. My main aim is to identify the stigma and unspeakable nature of women regarding their menstruation cycle. Our main problem is that we do not have sexual education in our board curriculum and adolescent got misinterpreted information from their friends or internet about their sexual changes which is not good enough to make them gender sensitive. From our early childhood it's necessary to reduce generation gap and provide sexual knowledge among adolescent what can reduce stigmas around menstruation and ensure a good reproductive health for women. If we want to break conservative or unspeakable nature of menstruation, we have to talk about this issue openly. If we want to ensure and contribute on SDG 3 'ensure healthy lives and promote well-being for all at all ages' and to 'achieve gender equality and empower all women and girls (SDG 5)."

Keywords: *Gendered Socialization, Menstrual Stigma, Adolescent Girls, Gender Related Curriculum.*

1. Introduction

Menstrual stigma is a common problem in our society where everyone knows it is natural but they have to play hide and seek game in front of society. It's a double standard of conservative patriarchal society where women should remain silent regarding their reproductive health related issues. Lack of reproductive health related knowledge leads them to be careless about hygiene behavior of menstruation cycle. As a result they suffer from cyst, ovaries or uterus cancer. Women's use of water differs from men in essentially one aspect: in cleansing the body of menstrual blood. The pledge of the water, sanitation and hygiene (WASH) sector to place 'women at the centre' of development has in recent years, therefore, come to focus on menstruation. International development agencies have begun to push the agenda of menstrual hygiene management (MHM), but their use of a medical approach requires critical rethinking. This study is going to unveil the gendered construction of patriarchal society, how this gendered construction influence women's menstrual behavior and men's behavior towards women regarding this issue. So we need to talk about this issue publicly if we want to ensure sustainable development and livelihood of women in our society. Moreover this study is also going to explore the problems which are associated with women's silence behavior and its aftereffects on women's reproductive health regarding this issue and lack of sexual education can make adolescent reluctant to talk about this issues. So this study will try to make people understood about the necessity of sexual and reproductive health related

knowledge. In many low-income countries, women and girls still face serious challenges when it comes to managing their periods. For 2 billion women and girls worldwide, menstruation is a monthly reality. Yet in many low-income countries, women and girls still face serious challenges when it comes to managing their periods. According to a study from the UN, one out of three girls in South Asia knew nothing about menstruation prior to getting it, while 48% of girls in Iran and 10% of girls in India believe menstruation is a disease.

In Bangladesh, monthly periods are secret and shameful things. Old menstrual cloths are buried in the ground for fear that evil spirits will be attracted to the blood. During their periods, women and girls sneak off to the tube well before dawn to wash themselves before anyone else is up. In between, they hide their cloths so that their fathers and brothers never chance to see them. As if they have done a great mistake after being grown up. This unspeakable nature of patriarchy leads to women to do hide and seek game but the fact is that they are not suffering from any diseases. Their regular menstrual period ensure that they are healthy. Sometimes the irregularity of menstrual period can have a devastating impact on their reproductive health but they always consider this issue as personal and remain silent. Young women are constantly worried about menstrual flow, and always discuss whether "blood flow is red or black, clotted or dark and clumpy", "regular" or nonexistent (Rashid, 2005). Furthermore, they believed that "if the menstrual flow is low, the blood remains trapped within the body and a woman who experiences this is unable to conceive" (Mahbub Ahmed, 1997, p.17). Fertility, particularly women is highly valued in Bangladeshi society. Not having children results in a sense of role failure with social and emotional consequences for both men and women (Papreen et al., 2000). Though it's a concerning issue for them because of our gendered socialization about this unspeakable nature of society leads them to severe diseases. There are other uncommon and even rare causes of abnormal uterine bleeding. Some of these include: cervical cancer, uterine infections, severe liver or kidney disease, rare ovarian tumors, unsuspected pregnancy, miscarriage, acute emotional stress and obesity. However this problem can easily be solved in early period if women are willing to consult with doctors regarding this matter and the support of male family members regarding this issue can solve these kinds of problem. We have seen different kinds of work which are actually focusing on contraceptives as hindrance to regular menstruation cycle. We need to be more conscious about stigmatized perception of our society regarding menstruation of an adolescent and its aftereffects on women and this area should be more focused. Without gathering reproductive health related knowledge it's not possible to prevent lifelong aftereffects on women. So my project is going to analyze the stigmatized perception of men and women regarding menstruation and specialists' suggestion to overcome this problem.

2. Objective of the study

This current study will strive to find out stigmas about menstruation among male and female members of our society and its aftereffects on women's reproductive health in Bangladesh in terms of their perception, experience, practice and behavior towards adolescent girls. More specifically the study unveiled the stereotyped stigmas about menstruation among women in our society and explored the aftereffects of menstrual stigma on women's reproductive health considering the present condition of Bangladesh.

3. Definition of Key concepts

Menstruation: Menstruation, or a menstrual cycle, is the periodic shedding of the lining of awoman's uterus. It is one of the phases of the menstrual cycle. The uterine lining breaks down into a bloody substance. It then passes down through the cervix and exits through the vagina. The process usually lasts from three to five days. The amount of menstrual blood can vary from period to period and from woman to woman. Menstruation is the natural part of the reproductive cycle in which blood from the uterus exits through the vagina. It is a natural process that first occurs in girls usually between the age of 11 and 14 years and is one of the indicators of the onset of puberty among them. Despite being a phenomenon unique to girls, this has always been surrounded by secrecy and myths in many societies. Taboos surrounding menstruation exclude women and girls from many aspects of social and cultural life. Some of these are helpful, but others have potentially harmful implications.

Menstrual Stigma: A menstrual taboo is any social taboo concerned with menstruation. Insome societies it involves menstruation being perceived as unclean or embarrassing, extending even to the mention of menstruation both in public (in the media and advertising) and in private (amongst the friends, in the household, and with men). Many traditional religions consider menstruation ritually unclean.

Different cultures view menstruation differently. Studies in the early 1980s showed that nearly all girls in the United States believed that girls should not talk about menstruation with boys, and more than one-third of girls did not believe that it was appropriate to discuss menstruation with their fathers. (Williams, L. R. (1983). The basis of many conduct norms and communication about menstruation in western industrial societies is the belief that menstruation should remain hidden. (Laws, S. (1990).

4. Menstrual stigma and it's effects on women's life in Bangladesh

Menstruation is a natural process that occurs monthly in healthy adolescent girls and premenopausal adult women. Actually menstruation starts between the ages of 9 and 12. Women need to manage menstruation on an average of 3000 days during her lifespan. Menstruation affects women's social life in various ways. A hindu woman abstains from worship and cooking during her menstruation; jewish tradition regards a women as ritually impure during menstruation; a menstruating women is not allowed to fast or have sex under Islamic law. (Ahmed,R; Yesmin,K: pp285) .A large number of female populations has to depend on old clothes to manage their menstrual bleeding. Poor menstrual monumental is a major cause of absenteeism from school. As a taboo topic in many cultures, the process and management of menstruation is often shrouded in mystery. Menstrual hygiene management directly contributes to improving maternal health. Poor menstrual hygiene and management may seriously hamper the achievement of SDG 4 on quality education and SDGs 5 on gender equality. Menstrual Hygiene Management is an issue that is totally maintained by unspeakable nature in our society. Lack of information, misconception and negative attitudes towards menstruation may lead to a negative self image among girls. Primary care physiciansare the first point of contact for diagnosis of common menstrual problems and other associated reproductive morbidities among the populations in their community. Many of the practices during

menstruation have direct implications on reproductive health. For instance, not bathing during menstruation can lead to compromise in hygiene of the girl and thus lead to the reproductive tract infections. A primary care physician is thus, required to be acquainted with common myths related to menstruation prevalent in his/her community and treat the individual holistically by addressing them also. Else, the problem may be treated for a while but it would continue to recur with increasing severity.

Consequences of unhealthy menstrual practices

Poor menstrual hygiene can cause fungal infections, Reproductive Tract Infection and Urinary Tract Infection which might lead to cervical cancer. Women who practice unhygienic practices are also vulnerable to infertility. Cervical cancer is the cancer of the mouth of the uterus caused by a virus called Human Papillomavirus (HPV). Major causes of cervical cancer are those pertaining to Early sexual debut, Multiple sexual partners, Poor Menstrual hygiene and Unprotected sex. Cervical cancer is very common among south Asian Countries. Cervical cancer kills around 72,000 women in India every year, more than 26% of the 275,000 deaths worldwide, says the report by the Cervical Cancer Free Coalition (May 2013) Cervical cancer is common among women worldwide. It kills more women in India than anywhere else in the world. Hygiene-related practices of women during menstruation are considered important because it can increase vulnerability to Reproductive Tract Infections (RTI's). Most of the adolescent girls in villages use rags and old clothes during menstruation, increasing susceptibility to RTI's. Poor menstrual hygiene is one of the major reasons for the high prevalence of RTIs in the country and contributes significantly to female morbidity. Poor menstrual hygiene in developing countries has been an insufficiently acknowledged problem. In June 2010, The Indian Government proposed a new scheme towards menstrual hygiene – provision of subsidized sanitary napkin to rural adolescent girls. But there are various other issues like – raising awareness, availability and quality of napkins, regular supply, privacy, water supply, proper disposal of napkins, reproductive health education and family support. Most gynecologists believe sanitary napkins can act as a precautionary measure to reduce the risk of cervical cancer among women/.Besides poverty and ignorance, superstition is also a discouraging factor in use of sanitary napkin. According to a survey conducted by the country-wide survey conducted by AC Nielson and voluntary organization Plan India: India has one-fourth of the world's burden of cancer of the cervix with nearly 132,000 women being diagnosed every year. Of the 355 million menstruating women in India, only 12 per cent use sanitary napkins. Nearly 12 percent of women who use sanitary napkins are at a lesser risk of cervical cancer than women who resort to unhygienic sanitary practices (cervical cancer research on menstrual practices- paree confidence). The reproductive tract infection (RTI) incidence was 70 percent more common among women with unhygienic sanitary practices. The biggest barrier to adoption of quality sanitary napkins in India turned out to be "affordability and accessibility" as nearly 70 percent of women said that their families cannot afford sanitary napkins. Over 88 percent of women resorted to shocking alternatives such as cloth, ashes and husk sand during menstruation, thereby causing severe reproductive health problems. Moreover, the scenario of Bangladesh is not so different than India. A baseline study in the slums of Dhaka city in early 2005 shows that 95% of adolescent girls use rags during menstruation, 40% of women change their rags only once a day while 75% of adolescent girls change three times, 60% of women wash the rags in unsaved water, 90% of women and 70% of adolescent wash the rags with only water, 95% of women and

80% of adolescent girls reuse the rags and the majority of women dry the rags in dirty and dark places. The main causes of unhygienic practices in Bangladesh lack of awareness, lack of safe water and sanitation facilities for washing rags, lack of drying areas due to social unacceptability, sanitary pads are too expensive, no separate toilets for women/ girls at community and school levels, toilets are not designed appropriately to change or wash the pads, no space and facility at household toilets, women and girls do not share their problems with others and this kinds of shame culture leads to serious reproductive health related problems.(Ahmed, R; Yesmin, K P 285) . The fact is that our educational institutions do not provide reproductive health related knowledge to adolescent girls. Only 6% of school provided menstrual hygiene education session for girls at school and they were mostly urban schools and secondary schools (secondary: 13%, Primary: 3%). More than 40% girls who attend the survey reported that they miss school during menstruation, poor facilities may contribute to absence during menstruation; only 45% of schools had toilets accessible for students, a quarter were clean and more than 5% of schools had separate facilities for girls that offered optimal menstrual management.(Bangladesh National Hygiene Baseline Survey ,2004)Studies have suggested that poor facilities , practices and beliefs around menstruation can have an impact on health, especially on reproductive tract infection although there is no robust evidence of this association (Sumpter et al.,2013).

Strategies to combat menstrual myths

Based on the available evidence, it is pertinent to follow a strategic approach for combating the myths and social taboos associated with menstruation in order to improve the reproductive health of adolescent girls and women. The first and foremost strategy in this regard is

- To raise the awareness among the adolescent girls related to menstrual health and hygiene. Young girls often grow up with limited knowledge of menstruation because their mothers and other women shy away from discussing the issues with them. Adult women may themselves not be aware of the biological facts or good hygienic \practices, instead passing on cultural taboos and restrictions to be observed. Community based health education campaigns could prove worthwhile in achieving this task. There is also need to spread awareness among the school teachers regarding menstruation.

- Empowerment of women through education and increasing their role in decision-making can also aid in this regard. Women and girls are often excluded from decision-making due to their lower literacy levels *per se*. Increasing the education

  status of women plays an important role in improving the health status of the community at large and overcoming the cultural taboos, in particular. Provision of sanitary napkins and adequate facilities for sanitation and washing should be made available with the gender perspective. In Delhi, there are an estimated 132 public toilets for women, only 8% the number of the 1534 for men.

- Low cost sanitary napkins can be locally made and distributed particularly in rural and slum areas as these are the areas where access to the product is difficult. Government of India has approved a scheme to improve menstrual hygiene for 1.5 Crore adolescent girls

by distributing low cost sanitary napkins in rural areas under the National Rural Health Mission since 2010. However, the scheme is in the pilot phase, and a lot more needs to achieve in this regard.

- Increasing the role of the male partner and clearing the beliefs system of the male partner is also pertinent in combating deep rooted social beliefs and cultural taboos. Men and boys typically know even less, but it is important for them to understand menstruation so they can support their wives, daughters, mothers, students, employees, and peers. Sensitization of health workers, Accredited Social Health Activists and Anganwadi workers regarding menstruation biology must also be done so that they can further disseminate this knowledge in the community and mobilize social support against busting menstruation related myths. Adolescent Friendly Health Services Clinics must also have trained manpower to address these issues.(Nurul Islam Case)

- It is necessary to promote hygiene at schools and community. Sometimes community development and community training is also necessary. Moreover courtyard open discussion can solve these kinds of problems.

- It is also necessary to build latrines to encourage better hygiene. Because unhygienic latrines in Bangladesh are mostly built of bamboo and cloth sacking and are not discrete enough for women to use in daytime.

- It is also necessary to ensure a good source of water what is the prime thing to maintain hygienic procedure. The people of Bangladesh are suffering from the scarcity of good water source.
- Incorporating more men in the gender sensitive program can reduce the possibility of unhygienic practices. Most of the time women maintain unspeakable nature with their male counterparts. So it's necessary to incorporate them in open discussion and reduce menstrual stigma.

- It is becoming clear that multi-sectoral approaches are needed. We need to link physical infrastructure and water and sanitation projects to health education and reproductive health programs and address the issue in more holistic ways. Menstruation is nothing but a very normal biological phenomenon, and adolescent girls and women should understand that they have the power of procreation only because of this virtue.

5. Conclusion

Traditional belief and unhygienic practices are the main causes of their different kinds of diseases like cyst, uterus cancer and they bear the aftereffects in their whole lifetime. Actually this is a small initiative to know how stigmatized behavior of our society leads women to bear and sustain lifelong problem related with their reproductive health. Sometimes they prefer to use old clothes to avoid requesting their male family members to bring sanitary napkins for them and buying sanitary napkins by own is beyond the imagination of maximum women. Every women of our society especially the women who possess conservative patriarchal society went through these

kinds of problem from their adolescent to young age. We can also relate our story from subjective point of view. We have also seen our sister, mother who believed that it's a personal matter and they maintain unspeakable nature regarding this issue whereas we believe personal is political. It's better to raise voice against stigmatized perception about menstruation and engagement of men is important to reduce reproductive health related problems of women. Our study will enrich the postmodern feminist knowledge and break the stereotyped patriarchal structure of our society. Lack of sexual and reproductive health related knowledge just influences us to do traditional behavior and these kinds of behavior make a devastating impact on women's reproductive health. Moreover incorporation of sexual and reproductive health related curriculum in adolescent period will break the stigma in early childhood and leads to a egalitarian society which is a little try to expand feminist knowledge in activism.

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Investigating the Effect of pH on Arsenic and Iron Removal on Sub-Surface Arsenic Removal (SAR) Performance in Narail, Bangladesh

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Abstract

Arsenic (As) contamination potentially poses an enormous threat to millions of people in the world. In most areas of Bangladesh groundwater has dangerously high levels of As contamination. Hand pumped shallow tube-wells are in widespread use in the rural areas of the country which supplies groundwater with an arsenic concentration more than 200-300 µg/L. According to World Health Organization (WHO) the standard concentration of As in safe drinking water should be below 10 µg/L, but according to Bangladesh national standard, it should be below 50 µg/L. The study in this research carried out on an existing Sub-Surface Arsenic Removal (SAR) unit built on a shallow aquifer in Boronal village in Narail, Bangladesh, was found that at elevated pH levels, SAR system was able to remove large concentration of As and iron (Fe). The experiment found that at pH 7.5-8.5 the concentration of total As came down from 100 µg/L to 10 µg/L which was measured by using As Hach EZ Arsenic test kit. It was also found that as a result of increased pH greater Fe removal also occurred. The concentration of Fe was brought down from 12 mg/L to 2 mg/L as measured by using Hach Iron test kit (model IR 18B). This experiment proved that there is an immense potential for further decreasing the total concentration of As and Fe at elevated pH.

Keywords: *shallow aquifer, arsenic removal, iron removal, pH, rural Bangladesh*

1. Introduction

Arsenic contamination potentially poses an enormous threat and even though it is not a sudden or an unexpected threat, it is a time bomb that slowly, but steadily is poisoning millions of people in the world (Bala et al. 2012). In most areas of Bangladesh groundwater has dangerously high levels of As contamination and the number of people affected by As is the largest facing any disease in the world today (WHO 2011). The use of this groundwater for drinking and irrigation purposes has created great concern for public health in this region (Chakraborti et al. 2004). According to World Health Organization (WHO) the standard concentration of As in safe drinking water should be below 10 µg/L, but according to Bangladesh national standard it should be below 50 µg/L (Bhattacharya et al. 1997, 2002; Nickson et al. 1998; Acharyya et al. 1999; BGS and DPHE 2001; McArthur et al. 2001; Ahmed et al. 2004; Ravenscroft et al. 2005).

Among the several existing methods used to treat water to make it As safe drinking water (Ahmed, 2001), this paper studies the rural household As removal system based on adsorption media called Subsurface Arsenic Removal (SAR). Other As removal household filter methods such as Sono and Alcan investigated by Sutherland et al. (2002) on their performance of As removal and other key elements such as Fe, Mn, and Al found that potential problems with these filters include sudden As breakthrough, clogging of the filter, and generation of As-rich sludge. Overall it could be

concluded that the contribution of these As removal units is insignificant in the As mitigation in the rural households of Bangladesh (JICA/DPHE 2009). The application of SAR technique for As removal has been very promising since it has many advantages over other household As removal filters. Some of the notable advantages of SAR system in a rural household of Bangladesh are that, it is residue free, low-cost technology and that does not produce any hazardous chemicals. Furthermore, to install SAR treatment unit in a rural household, no expensive filter media are required (Sarkar and Rahman 2001; Rott et al. 2002; Appelo and de Vet 2003; van Halem et al. 2009, 2010a, b; Sen Gupta et al. 2009; Rahman et al. 2014).

The SAR technology mainly uses three steps to remove As from groundwater (van Halem et al. 2009). The following steps explain the process of SAR mechanism:

- Water containing anoxic Fe and As is extracted from the aquifer and aerated.
- The aerated water is re-injected into the aquifer,
- Finally, a larger volume of water with low As concentration can be extracted.

In Bangladesh, elevated Fe and As concentrations have been found to often co-occur in groundwater (Nickson et al. 1998, 2000; McArthur et al. 2001; Dowling et al. 2002; Harvey et al. 2002; Swartz et al. 2004; Postma et al. 2007, 2010). In the SAR process when the aerated water is periodically injected into an aquifer, an oxidation zone is created in the subsurface where the Fe^{2+} is oxidized, forming adsorptive surface areas of iron hydroxides (HFO). During the extraction of the groundwater the dissolved iron, arsenic and dissolved anions and cations passing the oxidation zone are adsorbed onto HFO. In the SAR treatment, higher volume of groundwater with low concentration of Fe and As can be extracted. The objective of this study was to explore the effects of pH on As removal in SAR operation under the field conditions of rural Bangladesh. Over the course of this study it was also found that along with As, a large concentration of Fe was also removed during the experiment process. Firstly, it is important to understand that As is pH sensitive and the sorption onto HFO is more favorable at pH 7-8 and above (Kartinen and Martin 1995; Rahman et al. 2014). Secondly, it was interesting to observe that increased adsorption rate of As brought down the total concentration of Fe. Overall, it was important to understand the extent of As removal and whether the standard of 10 µg/L of As concentration according to WHO guideline could be achieved at elevated pH levels in six SAR cycles in rural field conditions of Bangladesh.

2. Materials and Methods

The study site is located in Mathabhanga-Bilduria village in Boronal-Eliasabad Union of Kalia Upazilla under the Narail District which is about 215.7 km southwest of Dhaka, Bangladesh.The SAR unit layout (Fig.1) shows SAR treatment unit built on an existing shallow tube well in the study site.

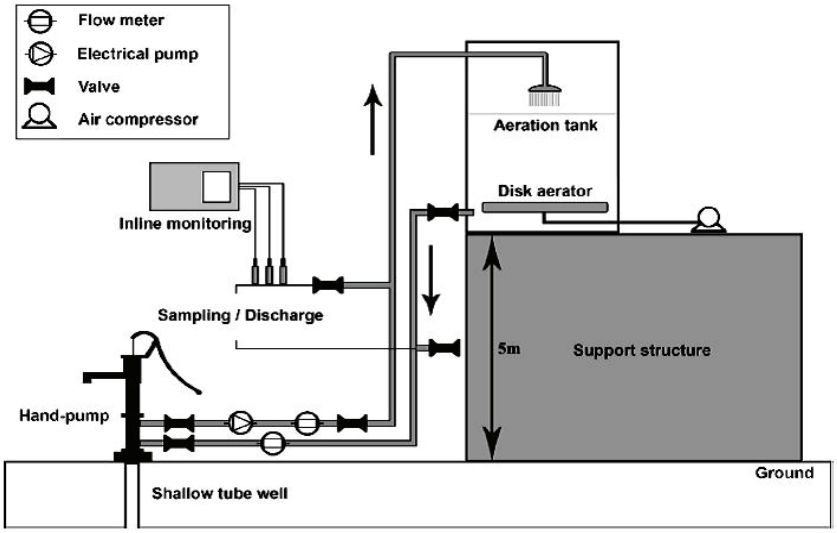


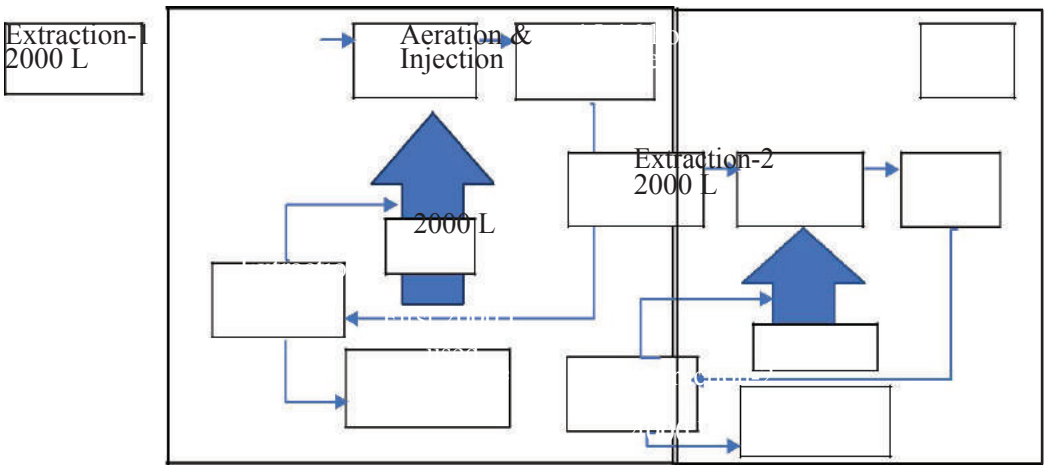
Fig. 1: Figure showing standard SAR unit at the study site; *Source: Rahman et al. 2014*

For the purpose of extraction and injection of water from the SAR well, separate pipelines with valves were used. The groundwater was extracted from the well by using electrical suction pump and the injected and extracted volumes of water were measured by fitting flow meters on to the pipes. The injection and extraction pipes were also connected to an aeration tank which was placed on the rooftop about 5 m above ground level to allow for gravity injection. The aeration tank had showerheads and disc aerators placed inside to oxygenate the anoxic groundwater before re-injecting it into the aquifer with the help of an air compressor placed inside the support structure. Sampling pipes were attached to the injection and extraction lines outside for taking samples during injection and extraction cycles.

2.1 Experimental Design

The experiment was designed to measure the various parameters of the extracted and the injected water in six SAR cycles. For every cycle, about 2000 L water was aerated in the aeration tank and injected in the aquifer to be extracted the next day. In each cycle, the groundwater samples were collected at eight specific volumes of 250 L, 500 L, 750 L, 1000 L, 1500 L, 2000 L, 3000 L and 4000 L. The purpose of this experiment was to investigate the effect of pH on As and Fe removal by adsorption onto HFO, therefore the first three cycles were conducted under regular conditions ie: the SAR system was run in normal conditions hence named 'regular SAR operation'. The last three cycles were run under a range of high pH conditions, hence named 'higher pH SAR operations'. For this experiment, in order to increase the level of pH in the injected waterNaOH pellets were added to the 4th, 5th and 6th cycle, ranging from 9, 10 and 11

respectively. In (Fig. 2), the two types of operation, used for this experiment are illustrated.



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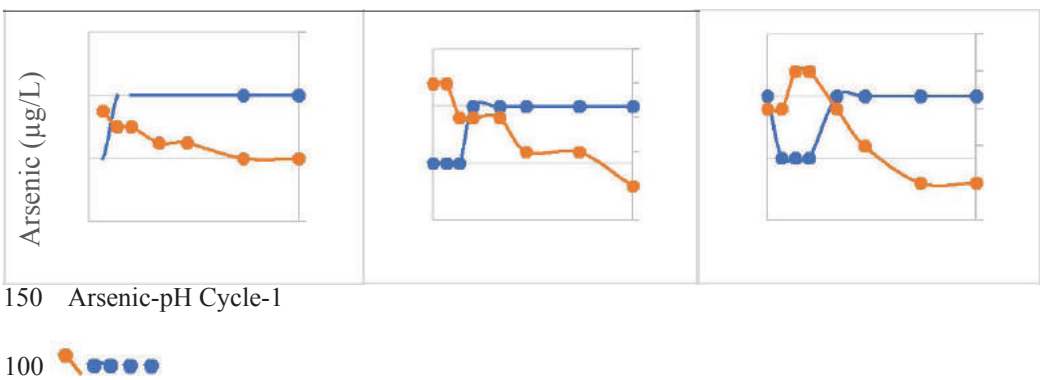
Fig. 2: Flowchart illustrating regular and high pH operation at the SAR unit

2.2 Measurement

Parameters such as pH, was measured using portable meter, a Hanna portable meter(HI9025). Standard titration was done to measure the bicarbonate concentration in the water. In field, Fe was measured using Hach Iron test kit (model IR 18B) and for As, Hach EZ Arsenic (0-500ppb) test kit was used.

3. Results of Experiment

The groundwater pH of the study site was circum-neutral. The concentration of bicarbonate in the study site was between 1127 mg/L which is very high compared to the WHO standard for bicarbonate which is between 25 to 400 mg/l (WHO, 2006).The background result of As concentration for the SAR site is around 100 µg/L and the concentration of Fe was around 12 mg/L. The Bangladesh standard for iron in drinking water is 0.3 - 1.0 mg/L. There was no health-based WHO guideline value for iron.



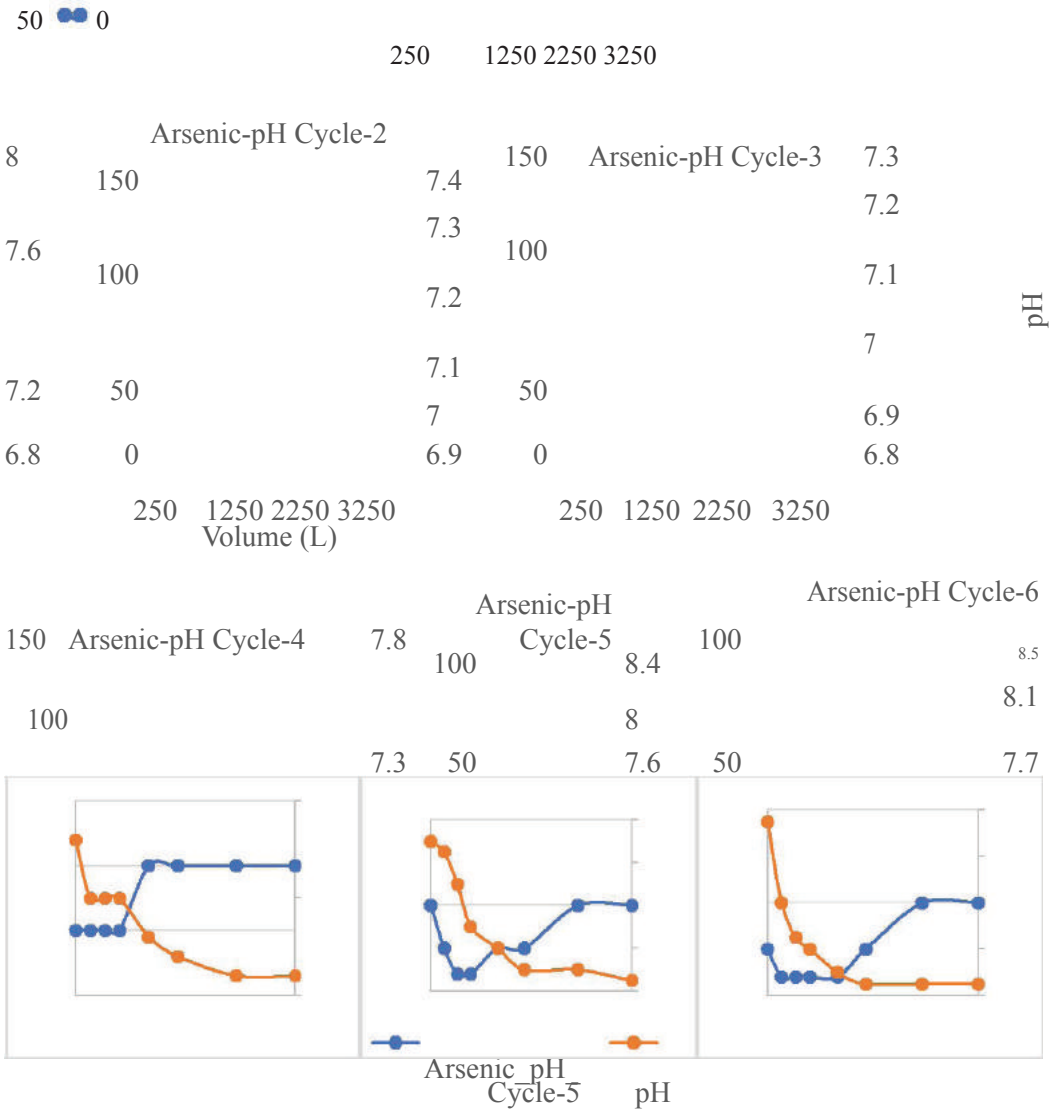
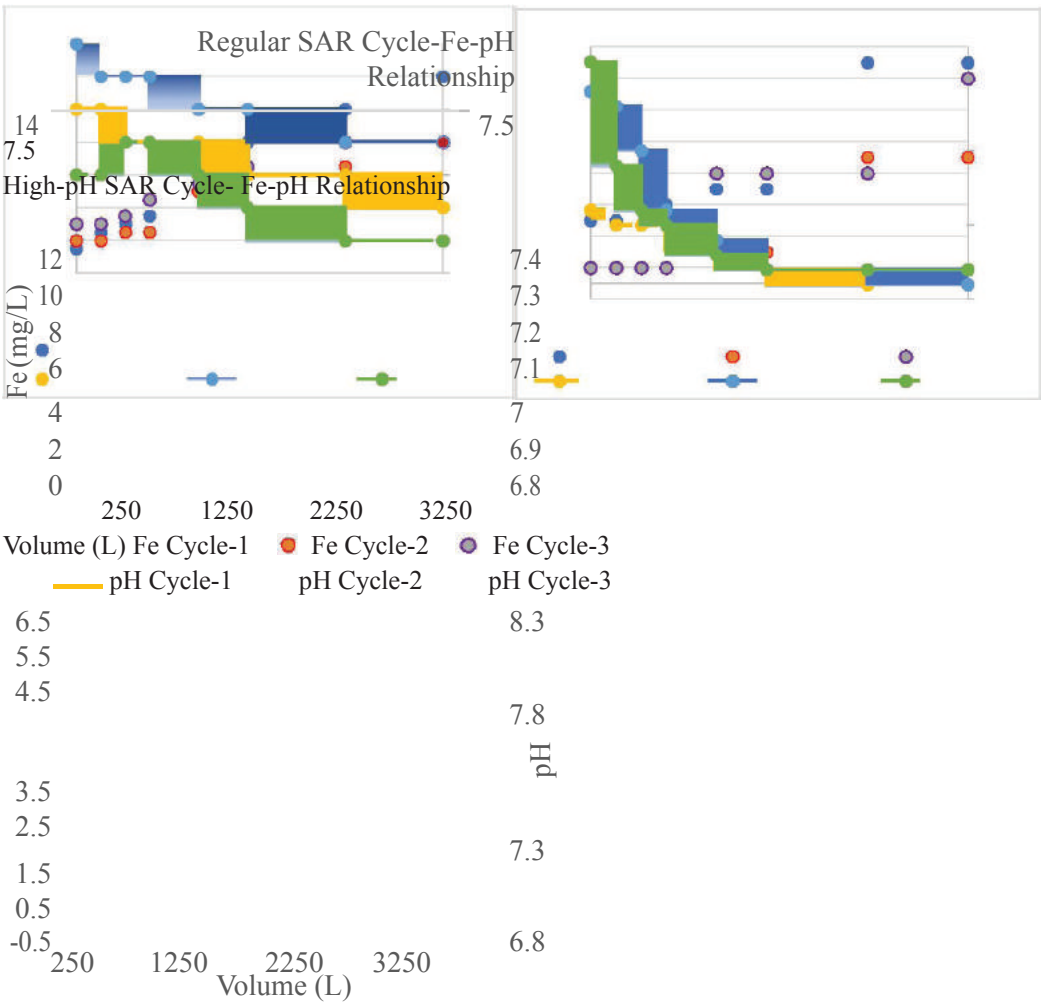


Fig. 3:Comparison of total As removal in Regualr and High-pH SAR cycles

Total As concentrations for the extracted water are shown for all six cycles in Fig. 3, it can be observed that the As removal efficiency between regular cycles (1-3) and higher pH cycle (4-6) have improved slightly. Results of this experiment show, that As removal increased significantly at cycle 5 and 6. From the graphs, it could be observed that in cycle-1 (regular SAR operation), the pH at volume 250L was 7.3 with As concentration of 50µg/L. Simultaneously, if we observe cycle-2 the initial pH was 7.5 and the As concentration was 50µg/L. In cycle-1, we observed that with a decrease in pH to 7.1 in the subsequent volumes, the concentration of As increased to 100µg/L. Note that for cycle-1, this was unusually low pH concentration for initial extraction volume and the could be the reason why the concentration of As was higher for the extracted

waterinitially. One trend that clearly stands out after observing all six graphs, at lower pH the concentration of As was higher. Especially in cycle-3 the drop in As concentration coincide with a drop of pH level.

In cycle -4, the level of pH was increased to 7.6 for the initial extraction volume by aerating the injection volume for 1 hour, hence called high pH SAR operation cycle along with cycle 5 and 6. At initial pH of 7.6, the total concentration of As was 50 µg/L from 250L to 1000L extracted volume. Comparing the results from cycle-1, 2 and 3, cycle-4 recorded the most 50µg/L volumes at the initial extraction mark. From cycle 5 to cycle at extraction pH 8.2 and 8.4 respectively, not a single concentration of 100µg/L of As was recorded. In cycle 5, 25 µg/L and around 10 µg/L of As was recorded from 250L to 2000L of extracted volume. The approximately 10 µg/L concentration of As would have been considered a break-through concentration but according to WHO guideline the concentration of As should be below 10µg/L. Also since this was measured via field kit more accurate measuring instruments were needed for this purpose. Again, in cycle-6, the 10µg/L concentration of As was measured from the volume mark of 500L to 1500L which was a great achievement of this experiment.



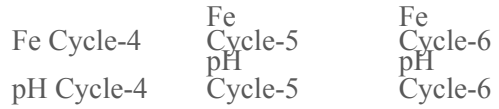


Fig. 4: Comparison of total Fe removal in Regualr and High-pH SAR cycles

Although Subsurface Arsenic Removal (SAR) is considered as a side effect of Subsurface Iron Removal (SIR), the arsenic reduction is the main objective where arsenic concentration is high (van Halem, 2010). Either way, arsenic removal depends on iron removal processes, as precipitated iron oxides form the adsorptive surface for the arsenic and this arsenic removal process is insensitive to pH but little favouring at pH 5-8. (Dixit and Hering, 2003).

From Fig. 4, the relationship between Fe and increasing pH levels are shown. In cycle-1, we can observe that the concentration of Fe is above the Bangladesh guideline of 1 mg/L but the concentration of Fe is even greater at the initial volume in cycle-2. In cycle-2 at pH= 7.4 and in the initial extraction volume at 250 L the concentration of Fe was 2.5 mg/L and as the level of pH decreases we can see the trend of Fe concentration increasing. At the end extraction volume for this cycle, Fe concentration is 8 mg/L at pH= 7.2. The same trend was observed in cycle-3 as well but the initial concentration of Fe was slightly higher than that of cycle-2 and the reason for this could be that as more volume of water was being extracted the Fe concentration increased.

From cycle-4, we see that the concentration of Fe was 2 mg/L at 250L and pH=7.4. Compared to cycle-3, the concentration of Fe at the initial extraction volume has decreased in cycle-4. As mentioned earlier, cycle-4 is a high pH SAR operation cycle, where the injection pH was 9.

In cycle-5 and 6, the concentration of Fe at the initial extraction volume was below the Bangladesh guideline of 1 mg/L. In cycle-5, from volume 500-1500L at pH 8.1-7.5, the Fe concentration was very low around 0.5 mg/L. At the end extraction volume of cycle-5, the Fe concentration at V/Vi=1.5 and pH=7 is 5.05 mg/L. Compared to cycle-2, the Fe removal efficiency was better in cycles 4, 5 and 6. At cycle-6, the concentration of Fe for the first two extraction volume were below the Bangladesh guideline, however as more background water was being extracted the Fe removal efficiency decrease slightly compare to cycle-5 with the end extraction volume at 3000 L of extracted volume and pH = 7.1, the Fe concentration was 3.5 mg/L. Overall, Fe removal improves considerably in each successive cycle. Especially, in cycle 5 and 6 from volumes 250-1000 L the concentration of Fe was below the Bangladesh guideline of 1 mg/L. It should be noted that at high pH (8-9) in the injection volume, the Fe breakthrough was achieved.

4. Discussion

4.1 Effect of pH on As and Fe removal

From the previous section, it was seen that the high pH SAR operation was able to remove As better than the regular SAR operation. This indicates that the experiment performed in field conditions in SAR unit show same trend as results found in the literature. The high levels of pH increased the absorption of some As species onto HFO, as was mention in Dixit and Herring (2003).For Fe

removal, it was a success because according to Figure: 6.4 a, b and c, the rate of Fe removal was higher in each successive high pH cycles. Evidence of such case was also seen in the Muradnagar SAR site (Rahman et al. 2014) where increase in pH levels was assumed to be because of Fe (II) oxidation in the subsurface during injection. The paper explained that more Fe (II) is oxidized with larger pH drop. This phenomenon was also observed in the Boronal SAR site, as at each successive cycle, concentration of Fe decreased.

4.2HCO_3 barrier to As removal

Bicarbonate ($HCO_{3)}$ is the most abundant constituent in groundwater from Bangladesh. As we have seen from the result section, the concentration bicarbonate at the SAR site was very high and its concentration increased further with successive cycles. According to Appelo and de Vet (2003) and Wallis et al. (2011), bicarbonate is the major driving force for As displacement from HFO. High concentrations of HCO_3 at the study site may be the principal reason for lower As removal than expected.

5. Conclusion

Subsurface arsenic removal (SAR) system is a cheap, reliable and non-waste producing As and Fe removal system, that has the potential to reduce the concentration of As below the WHO standard (10 µg/L) in Bangladesh. This study explored the effect of pH on As and Fe removal in the SAR system of a shallow aquifer in Boronal village, Narail. Throughout the course of this study, the efficiency of the SAR system at elevated pH levels increased which was able to remove large concentration of As and Fe. However, since the measurement of the As and Fe concentration was done via field kit it is necessary to measure the accurate concentration by using advanced instrument such as Atomic Absorption Spectroscopy (AAS). Even at the elevated pH level, we could not bring down the As concentration below 10 µg/L however, Fe removal breakthrough was achieved which brought Fe concentration below Bangladesh guideline of 1mg/L. Improving the performance of the SAR system by increasing pH level in the injection volume of the SAR cycle gave insight to the behaviour of As and Fe at elevated pH level. More tests are required which need to be continued for more than six cycles, unlike this experiment which would surely bring down the concentrations of As below 10 µg/L. In spite of some limitations, this research brought a huge step forward for the rural households of Bangladesh as a means for acquiring cheap and sustainable option for removing As and Fe from drinking water.

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