

# The Jahangirnagar Review

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## Statistical Association between Temperature-Rainfall and Tea Yield at Sylhet Malnicherra Tea Estate: An Empirical Analysis

**Md. Mizanur Rahman\***  
**Md. Nazrul Islam\*\***  
**Md. Rakib Hossain\*\*\***  
**Mohammad Ahmmed Ali\*\*\*\***

**Abstract:** Tea is one of the most important cash crops in Bangladesh, playing a significant role in food security, poverty alleviation, employment, and the economy. As a rain-fed crop, tea cultivation depends on micro-climatic conditions for optimal growth. Bangladesh observed extreme weather and climate events over the last couple of decades. Bangladesh is experiencing the frequency of climate variations and extreme weather events, like prolonged drought, heavy rainfall, and late winter spells. The study area was carried out at Malnicherra tea estate in Sylhet district to correlate the micro-climatic variables to tea productivity. The study also examines the trend of micro-climatic variables like maximum temperature, minimum temperature, and rainfall by using the time series data from 2012 to 2017. The simple linear regressions reveal that temperature and rainfall influence tea production. Tea production was negatively impacted by drought and excessive rainfall. Heavy rains eroded the top fertile soil and washed away soil nutrients. The yield of tea leaf was declining at the rate of 110.8 kg/ha/year. There was a high negative relationship between mean maximum temperature and yield of tea. The study recommends an integrated adaptive measure to minimize adverse effects.

**Keywords:** Rainfall, Temperature, Relationship, Adaptation, Influence, Bangladesh

### Introduction

Tea is a perennial, evergreen, woody plant that grows worldwide of wide adaptability in a range of climates and soils. Tea ecosystem is an agro-ecosystem comprising tea plant, shade tree, and other ancillary crops along with various abiotic elements. The life processes of the biotic community are critically balanced with the tea biosphere, which includes climate and soil. The leaves are processed to prepare a non-alcoholic beverage popularly known as 'tea'. Tea is the cheapest beverage and occupies the second position in the world next to water in terms of consumed liquid (Dutta, 2014; Marx et al., 2017). Tea is one of the most important cash crops in Bangladesh, playing a significant role in our economy, earning foreign currency, employment, poverty alleviation, and food security (Mamun, 2011). It is a long established plantation crop of enormous importance to Bangladesh meeting the entire domestic demand of this cheapest health beverage.

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Bangladesh obtained the 8th, 10th and 12th position in the world in terms of area, production and export of tea respectively (ITC, 2015). Now, there are 162 tea estates in Bangladesh covering about 59,018 hectares of land and producing about 85.05 million kg of finished tea per annum with an average yield of about 1,587 kg per hectare (BTB, 2017).

As a rain-fed crop, tea cultivation depends on micro-climatic conditions for optimal growth. It is reported that the weather in South Asia is becoming more stressful, more severe and less predictable: longer droughts; uneven heavier rainfall, more hail; and storms (IPCC, 2013; IPCC, 2014). Bangladesh is experiencing the frequency of climate variations and extreme weather events, such as prolonged drought, high daily precipitation, and late winter spells (Acharjee et al., 2019; Acharjee et al., 2017; Chowdhury and Ward 2004; Murumkar et al., 2013; Mojid et al., 2015). Ochieng et al., (2016) found that tea will be one of the most adverse crops affected by climate change. Tea plant in their natural environment often experiences sequential and multiple stresses, that can affect productivity (Eric et al., 2019). Both biotic and abiotic stresses reduce leaf production (Cheruiyot et al. 2010). It responds to abiotic stresses such as drought with dramatic changes in production (Niinemets, 2015). The concentrations of metabolites produced by the tea plant are highly affected by the drought (Eric et al., 2019; Kfoury et al., 2018; Han et al., 2017; Ahmed et al., 2014; Cai et al., 2013). Increasing temperatures and extreme weather events are posing a great threat to the existing production systems of tea. The pattern, distribution, and frequency of monsoonal rainfall greatly affect the quality of tea as well as the quantity of yield (Wijeratne et al., 2007). Therefore, there is a crying need to develop an integrated adaptive measure to cope with the changing climate. The study attempted to assess the impact of the change micro-climatic parameters on tea cultivation and to find out suitable technologies for adaptive measures.

### **Data Sources and Methodology**

In Bangladesh, Sylhet division is the major tea producing area, which is located in the delta of the Surma River. Sylhet district is situated between 23°59' and 25°13' North latitude and 90°54' and 92°29'50'' East longitude. Malnichara tea estate was selected purposively as the study area, which is in the north-eastern part of this district. A tea garden at Malnicherra in Sylhet district was established in 1854 for commercial purpose (Redowan and Kanan, 2013). Due to climatic condition and geographical position, North-eastern region of Sylhet district is the major tea leaves producing zones along with other agricultural crops. The time series data of 2012-2017 on the yield, rainfall, maximum temperature, and minimum temperature were collected from this tea estate. Simple linear regression was done to correlate yield, rainfall, and temperature.

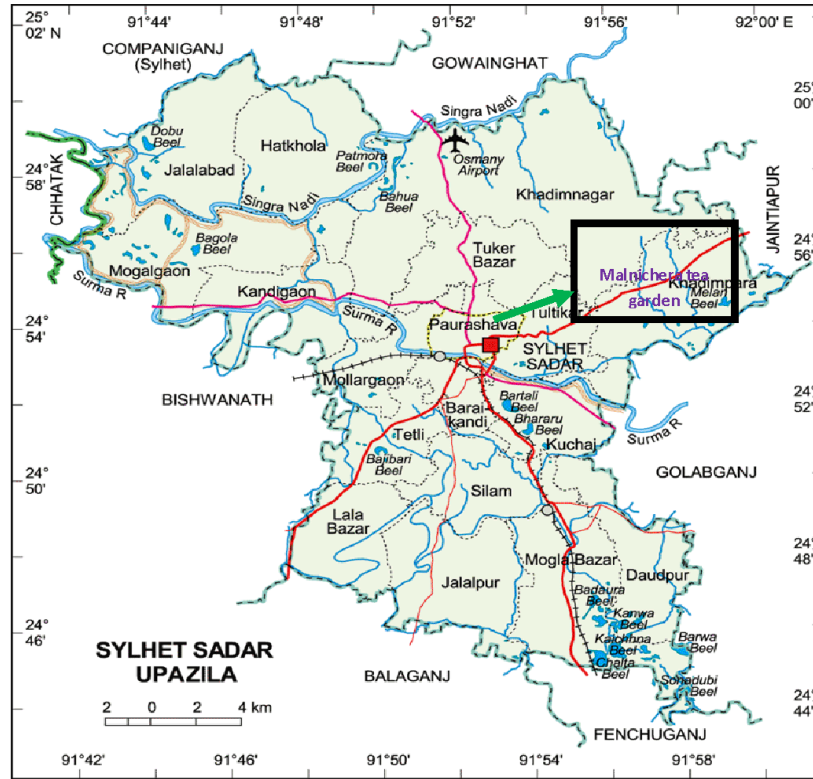
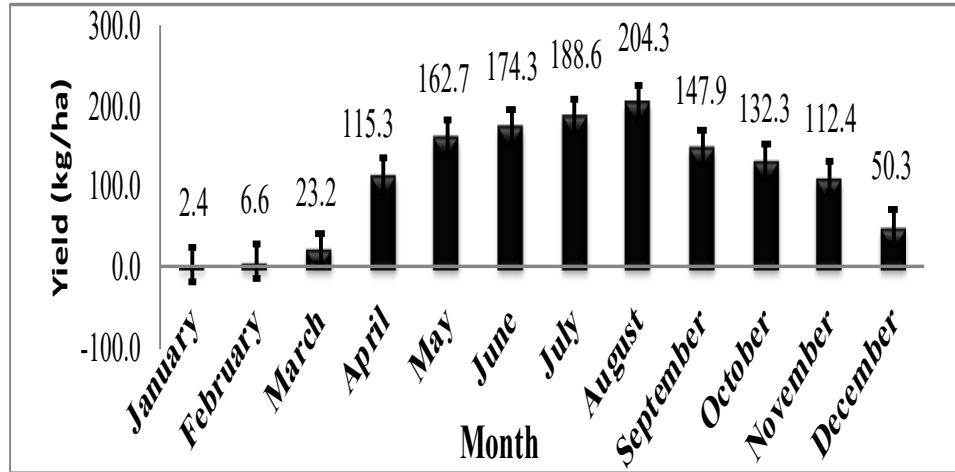


Figure 1: Location of the study area at Malnicherra Tea Estate, Sylhet

## Results and Discussion

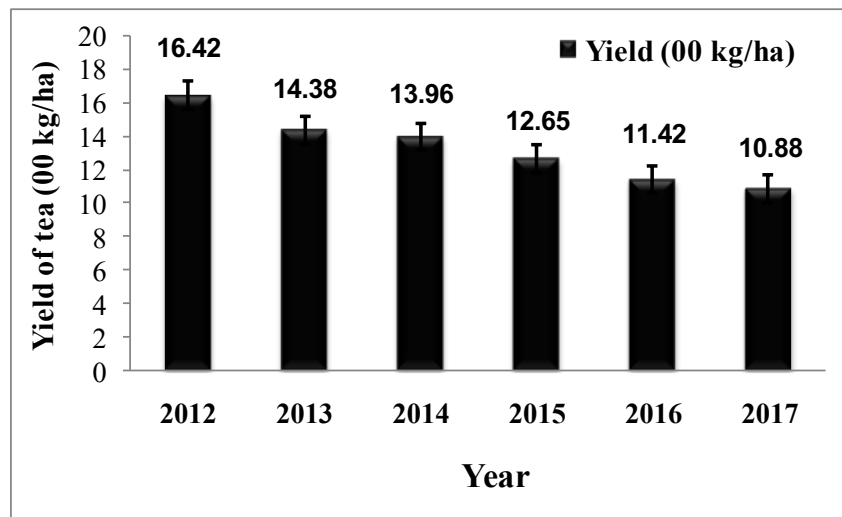
### Trend of Tea Yield from 2012 to 2017 in the Study Area

The mean yield per year from 2012-2017 of Malnicherra Tea Estate was 1320.2 kg/ha and it was declining at the rate of 110.8 kg/ha/year (Figure-1). The average yield was lower than the average national yield (1,587 kg/ hectare) of Bangladesh (BTB, 2017). Biggs et al., 2018) found the annual average yield of different gardens in Assam at <1500–2000 kg/ ha. (Patra et al., 2013) found that the productivity of green leaf in 2012 was reduced by 41.97 % and 30.90 % as compared to 1993 and 2002, respectively in Indian Assam. The average annual yield of Malnicherra tea estate from 2001-2011 was 1367.3 kg/ha (Ali et al., 2014). This indicates a clear declining trend of tea yield at Malnicherra. Hick, 2009) reported that Bangladesh was producing tea in the declining trend from 2001 to 2006.



**Figure 2:** Trend of the yield of tea at Malnicherra T.E. in Sylhet from 2012 to 2017

The highest production was observed in the monsoon (June-October) followed by the summer (March-June) and winter (October-March). The monsoon dynamics, temperature, solar radiation, and precipitation played as key drivers for the highest production in the monsoon (Boehm, 2016). The month of August produced the highest amount of leaves followed July and June. In January production was lowest followed by February and March. The year begins and ends with dry periods in Bangladesh. Tea zones experience a dry season from November to March while the rainy season continues from April to October and above 80% of annual rainfall is obtained during June – September (Paul et al., 2017). From the recent Meteorological report of Bangladesh, it is evident that in April-May the temperature reaches up to the maximum of 40°C whereas during the December or January the minimum temperature drops to the extent of 7.8°C.

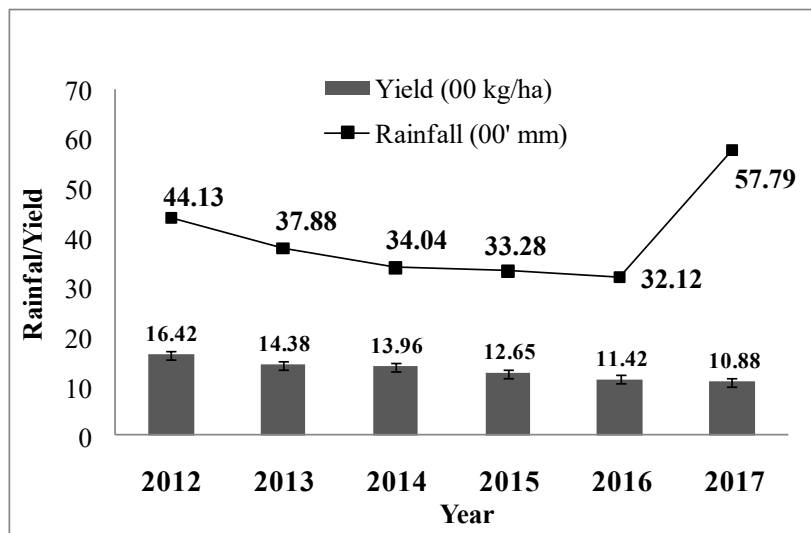


**Figure 3:** Average month-wise yield (2012-2017)

The impact of climate change is already witnessed in the declining trend of tea production. Most of the teas producing regions are characterized by a specific wet and or a combination of alternate wet and dry season interspersed by the temperature fluctuations from mild to medium. Bhagat et al., 2018) reported that tea producing countries like Sri Lanka, China, India, and Kenya have witnessed significant production loss due to climate change. It is projected that this change will be accelerated in future times.

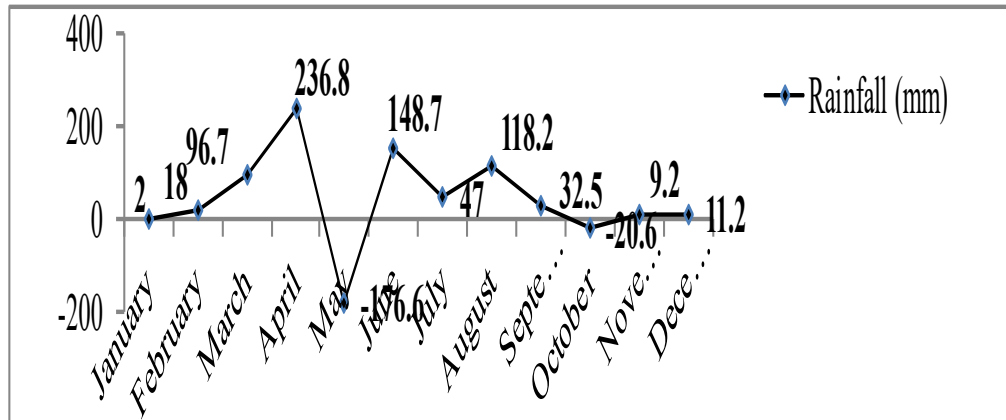
**Effect of Rainfall on Productions**

The figure-4 shows that the maximum rainfall (5779 mm) was recorded in 2017 though the yield was the lowest (1088 kg/ha). The production of tea decreases at very high rainfall due to the lack of sunshine (Wijeratne et al., 2007). Excess water may negatively influence the production of tea due to the saturation of soil, failure of absorption of water by plants. The rainfall was declining from 2012 to 2016.



**Figure 4:** The trend of yield and annual rainfall

Despite highest rainfall in 2017, the production decreased as 2457.7 mm rainfall was recorded in the summer, while 895.4 mm in the winter. A drastic change in the distribution of month-wise rainfall was observed (Figure-5). IPCC (2013) reported that South Asian rainfall is subject to greater uncertainty. The average rainfall in the month of monsoonal May reduced by 176.6 mm, where increased in the warmest April by 236.8 mm (Figure-5). Tea production is lower in long rains when compared with short rains. This is due to long rainy periods reducing the photosynthesis of the leaves with the decrease sunshine. Extreme rainfall negatively affects tea yield (Wijeratne et al., 2007, Esham and Garforth, 2013; Duncan et al., 2016).

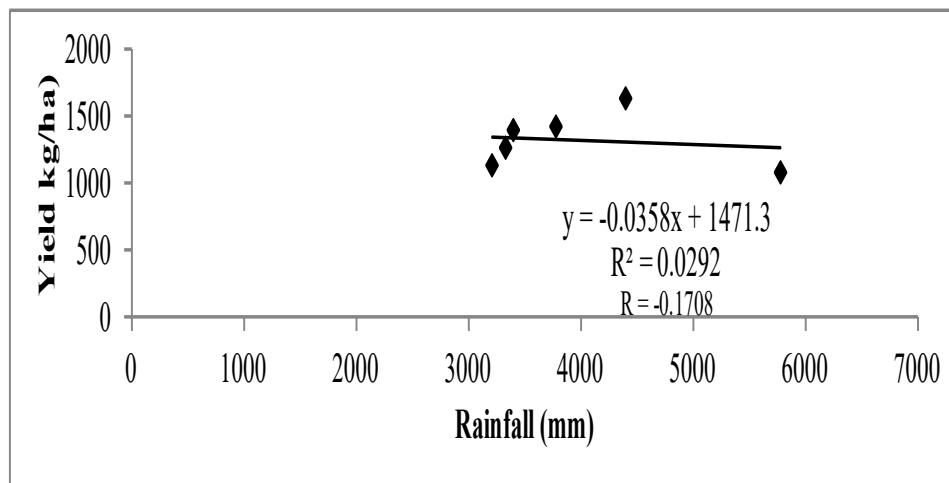


**Figure 5:** Changes in rainfall month-wise rainfall distribution pattern over 2012-2017

Therefore, the rainfall could not influence the production of tea. The tea leaf production and respectively rainfall was slightly correlated and had negatively influence each other (Figure-6). The standard annual rainfall for the highest tea leaf production per hectare in Bangladesh is 4000–4600 (Ali et al., 2014). There is a positive relationship between rainfall and tea production depending on stable temperatures and consistent rainfall patterns (Ochieng et al., 2016). Any significant change in rainfall affects production.

Boehm et al. (2016) also reported that increased rainfall affects the tea yield. Figure-6 also

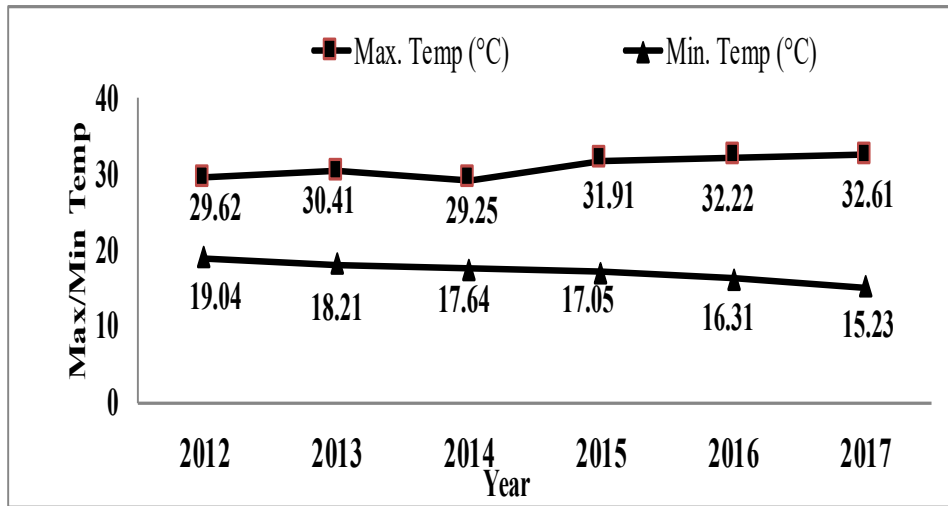
showed tea yield decreased with the increase of rainfall. The thickness and frequency of cloud coverage associated with the rainfall create obstacles in tea bush growth and difficulty arises in the harvesting time under that situation (Boehm et al., 2016).



**Figure 6:** Correlation between rainfall and yield (2012-2017)

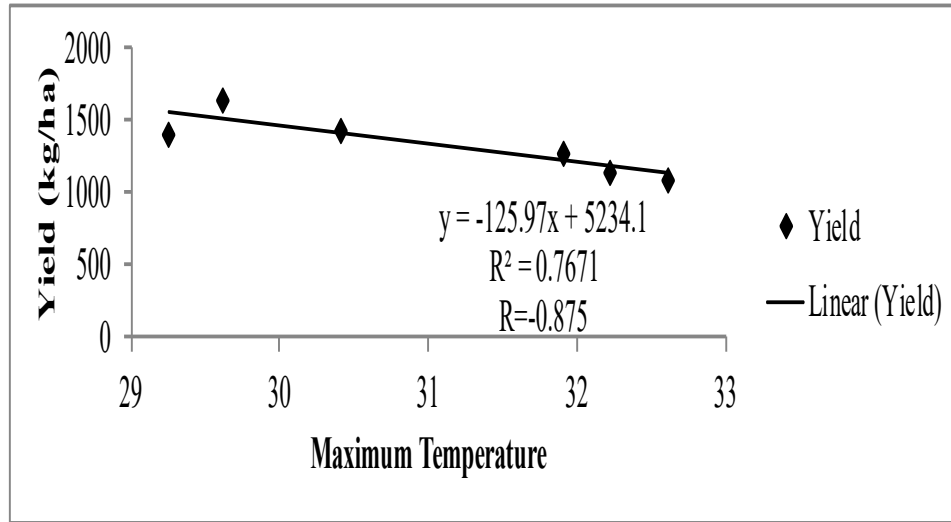
**Effect of Temperature on Tea Yield in the Study Area**

The Malnicherra Tea Estate experienced the highest yield and annual minimum temperature along with the lowest annual maximum temperature in 2012, while the contrary scenario in 2017 (Figure 4 & 7). Figure 7 shows that the maximum annual temperature was increasing from 2012 to 2017, while the annual minimum was decreasing. This is a signal of increasing temperature in the changing world under a changing climate (Hijioka et al., 2014; Mathison et. al., 2013). The annual maximum and minimum temperature influence the tea yield widely (Duncan et al., 2016). The temperature above 26.6°C affects tea yield (Duncan et al., 2016) and below 12.5 °C negatively impacts the tea production (Tanton, 1982). Wijeratne et al., 2007) reported that around 22°C temperature gave the highest yield of tea. Ali et al., 2014 found the range 23-25°C for the highest production.



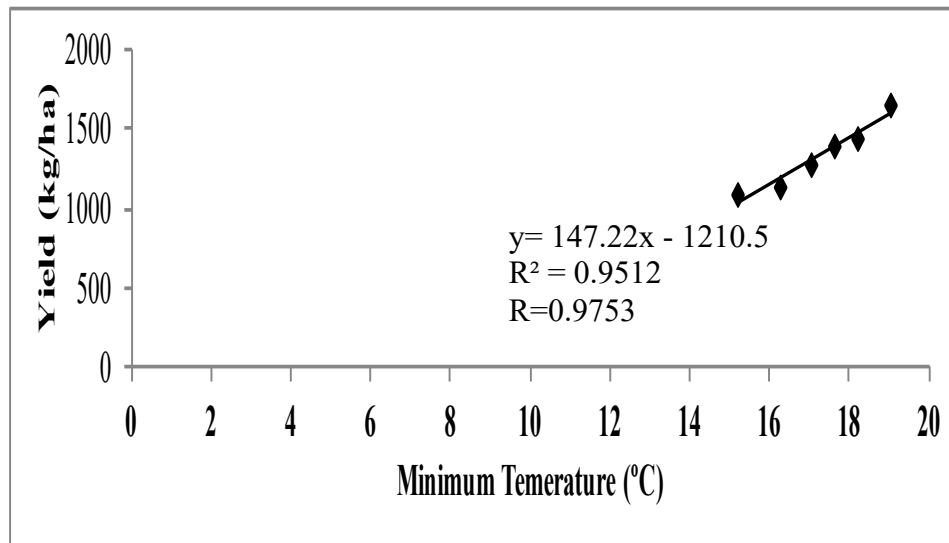
**Figure 7:** The trend of annual maximum and minimum temperature (mean)

We observed that decreasing returns at a greater pace to warming and cooling impacting negative yield (Figure 8 & 9). Figure 7 shows the highest negative correlation between tea yield and increased annual maximum temperature. On the other hand, there was a highly positive relationship between the yield and increased annual minimum temperature (Figure 9).



**Figure 8:** Correlation between yield and maximum temperature

The temperature significantly impacts the tea yields (Boehm et al., 2016). Increased maximum temperature causes changes in the leaf phenotype and consequently, it decreases the net photosynthetic rate and production (Li et al., 2015). The temperature above the optimal range reduces the productivity of tea plantations (Boehm et al., 2016; Dutta, 2014; Gunathilaka et al., 2017; Wijeratne et al., 2007). The 21st century will observe up to 40% yield loss of tea due to the increase in temperature (Adhikari et al., 2015).



**Figure 9:** Correlation between yields and annual minimum temperature

Higher temperature and rainfall has a negative effect on tea yield (Gunathilaka et al., 2017). Recent researches on climate change revealed that the micro-climatic variables are becoming unpredictable, erratic, extreme and intense accompanied by prolonged dry season; heavier uninterrupted rainfall over some days; more thunderstorms; and storms. The main tea producing regions of the world observed the change in rainfall pattern and the increase of maximum temperatures in the recent past times (Dutta, 2014). The tea productions are equally affected by both excess and shortage of rainfall, and heat stress (Marx et al., 2017). Changing climate not only affects the production but also degrades the quality of tea. The dilution of phytochemicals is the result of heavy rainfall changing the taste of tea and deteriorating the quality (Han et al., 2017). Climate change decreases not only the quality but also the quantity of tea yield through increasing soil erosion, pests' infestations, and outbreaks of diseases (Wijeratne, 1996). The authors reveal that maximum tea production depends on stable temperature and consistent rainfall distribution frequency, and anything excess will reduce the production and detriment the quality.

### Strategies of Adaptive Measures

The declining trend of tea production will negatively impact socio-economic conditions of the tea producers, workers and traders. Tea producers need to take adaptive measures to cope with existing and upcoming challenges. Most of the researchers of the world focused on taking adaptive measures to face the consequences of climate change. Some proposed adaptive measures are given below:

- a) **State policies and strategies:** Effective integrated and coordinated government policies or strategies focusing on climate adaptation are required to cope with the changing environment.
- b) **Collaboration and networking:** National networks involving multi and interdisciplinary academic, research, non-government organizations, government departments, and media can be established for assessing the negative effects of climate change.
- c) **Improved irrigation and drainage systems:** The drainage and irrigation systems should be improved to protect the plants from waterlogging and drought respectively.
- d) **Awareness building:** Public awareness about climatic stressors and their impacts ongoing and upcoming impacts on the tea should be built.
- e) **Extension of adaptive measures:** Climate change adaptation measures should be widespread immediately. Applications of indigenous knowledge and community-based management should be encouraged. The demonstration is very essential before the extension of new adaptation measures.
- f) **Capacity building:** scientists and managers should be trained in new technologies and management practices.



- g) **Crop insurance:** Small scale tea producers should be brought under the umbrella of risk insurance to transfer the loss to monetary compensations.
- h) **Introducing new varieties:** Drought and heat stress tolerant varieties should be introduced.
- i) **Integrated nutrient management:** Organic matter depletion reduces the water holding capacity of the soil. Integrated nutrient management combining minimum chemical fertilizer, maximum green manure and bio-fertilizer can be applied to the soils.
- j) **Mulching:** Mulching with soft, waxy and succulent vegetative parts should be done in the hot and dry season. Mulching conserves soil moisture through reducing evaporation losses, surface run-off, and soil erosion. Mulching minimizes the soil temperature in summers. Guatemala and Napier grass, aquatic plants, wild herbs and shrubs, and the barks of timbering plants are highly used for mulching.\
- k) **Retaining pruning litter and shade tree droppings:** As a shade-loving plant, tea plant needs optimum shade in the plantation area. During the summer in Bangladesh, most of the time-temperature prevails above the congenial temperature for tea production. Optimum shade reduced leaf temperature by 10-12°C at mid-day (Gee et al. 1982). Hence, proper shade tree establishment in the plantation area of Bangladesh can be an effective way to mitigate the effect of climate change. Preserving pruned litter on the soil is the easiest way of managing crop residues. The pruning litter and shade tree droppings add a considerable amount of organic matter to the soil.

## Conclusions

This study used a dataset of monthly yield, rainfall, maximum and minimum temperature of a single garden level. Other micro-climatic variables like humidity, average temperature, day length, sunshine and soil properties were not considered. But this dataset provides an ample opportunity to identify the impact of the fluctuations of the climatic variables on tea production. We show that tea productions are decreasing with the increase in maximum temperature and a decrease in minimum temperature. This indicates that the tea gardens will produce less under changing warmer climates. It is revealed that the high annual rainfall cannot ensure high yield, rather excessive precipitations have a negative effect on the production. Considering all aspects, effective and affordable adaptive measures have been recommended to reduce the sensitivity of tea production in the country.

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## Reconciling Conflict in the Industrial Hog Feedlot: An Integrative Conflict Analysis and Resolution Proposal

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**Abstract:** Conflicts are motors of change; they are points of collision where at least two stakeholders have competing interest and are a source of social dynamism in the ongoing process of shaping reality. Some conflicts may be tackled in time, intervened by an accepted third party who can mediate, facilitate and reconcile the disputants. Others reach a stalemate, i.e. win/lose situations that prompt considering the problem from a broader perspective to address its complexity. In this paper we discuss a conflict regarding an investment proposal by a Dutch entrepreneur of recommissioning an industrial hog feedlot of 68,000 animals in the village of Hassleben in Germany. A thorough analysis of the stakeholder's positions has revealed a complex conflict structure: on the one hand, citizens have expressed strong legitimacy, participation and value issues regarding the recommissioning of the controversial industrial hog feedlot. On the other hand, there is ample evidence of a structural problem that links Hassleben's conflict to the EU's Common Agricultural Policy (CAP) reform 2013, which has a direct repercussion on the authorization procedures that Brandenburg's administration have to incorporate in order to deal with its agricultural decision making processes; a lesson which can already be learned from the Hassleben conflict.

**Keywords:** Conflict, Recommission, Status-quo-bias, Circle of Conflict, NIMBY Phenomenon

### Introduction

Hassleben, Germany has been the stage for a conflict that has been going on for more than fourteen years. A strong civil movement named as Kontra Industrieschwein, supported by the Environmental and Animal Rights Associations (Bauernhöfe statt Agrarfabriken) in Germany, is lobbying very hard against the rehabilitation of a hog feedlot in the village. This feedlot used to be active during German Democratic Republic (GDR) times (between 1978 and 1991), and hosted an average of 136,000 pigs (Schlecht et al., 2008). After reunification of East and West Germany, the industrial farm was closed and several plans were developed and implemented to undo part of the environmental damage left in the area. Hassleben became an area of recreation for Berliners, and the tourist industry began to flourish.

In 2003, the Dutch businessman Harrie Van Gennip submitted to the regional authority of Ministry for Environment, Health and Consumer Protection (MEHC) a petition to re-open the hog feedlot facility and place 80,000 animals; an activity that would bring, according to Mr. Van Gennip, economic competence to the area, jobs and a very much needed revitalization in investments in the regional markets. The petition to rehabilitate

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the farm was rejected by the administration due to the fact that Hassleben is just starting to recover from the heavy environmental damage that the past industrial farm left behind, especially due to the excess of nitrogen and ammonia that got into the soil (causing acidification) and the water system (damaging nearby moors considered as part of a biosphere reserve) (Erjavec et al., 2008). However, in 2008 Mr. Van Gennip submitted a second petition, reducing the number of hogs to 68,000 and assuring that he would be able to comply with EU legislation about the minimum requirements considered crucial for the wellbeing of the animals and the security of the installation (Brenning and Andrade, 2011). Since then this petition is still under consideration but the civil movement group KontraIndustrieschweinand's supporters fear that this petition might be accepted by the administration.

### Aim and Objectives

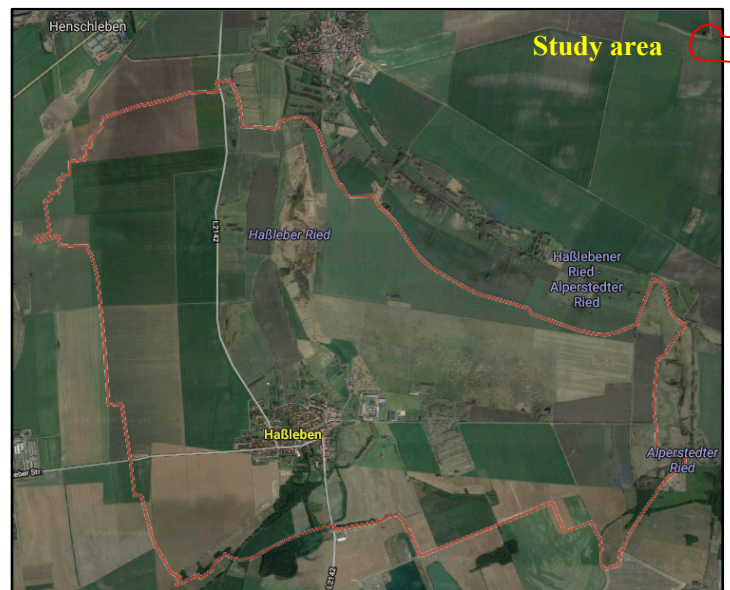
The main aim of this study is to explore the conflict arisen for the reconciling the hog feedlot and also investigate the resolution strategy. To meet the aim of this research several specific objectives are given below:

- i. To understand the nature of conflict arises from the petition for recommissioning the hog feedlot; and
- ii. To structured the types of conflict based on its characteristics and identify the conflict resolution strategy.

### Study Area

#### (a) Absolute Location

Geographically, the Hassleben lies between 51.1090° N latitude and 10.9956° E longitude.



**Figure:** The location of the study area. (Source: Google Earth image modified by author, 2018)

### **(b) Relative Location**

Hassleben, a village 90 km north of Berlin located in a hilly area surrounded by moors (Große Heide) and lakes (Kuhzer See Grenzbruch). It is located in the Thuringian basin about 18 km north of Erfurt in Germany (Statistisches Bundesamt Deutschland, 2018). The narrow Gera River (a tributary of the “Erfurt”) flows through the place.

### **Backgrounds of the Research**

Hassleben is considered the “heritage of mass animal husbandry”. In Hassleben, a pig farm for 37,000 pigs is to be built. The Dutch investor Harry van Gennip wants to set up a new business on the grounds of a pig farm already operated in the German democratic republic (GDR) and closed after the fall of the Berlin Wall.

In the past, the citizens' initiative has already succeeded in reducing the originally planned number of 87,000 pigs to 37,000. The construction project was approved in 2013 with the changed number of animals, but is not built, because the citizens' initiative had objected to the current approval.



**Figure:** Hassleben and old pig farm. (Source: Berlin/Templin, 2005)



## Data and Methods

To study the conflict for constructing the industrial hog feedlot in the study area, mainly secondary data was used. The secondary data was collected through reviewing the relevant literatures such as published and unpublished journals, magazines and newspapers, various publications of the local governments and reports and publications of multiple associations connected with business and industry, reports prepared by research scholars, universities, public records and statistics, historical documents, other sources of published information etc. To analyze the Circle of Conflict\*/Status-quo-bias\*\*/NIMBY Phenomenon\*\*\* of this research focuses on documenting the conflict through critical reading, interpreting published texts, and analyzing the backgrounds. The analysis of the rejected objection against the construction of the pig farm in the study area and the resolution rounded off the study.

\*Christopher Moore's Circle of Conflict identified five sources of conflict: values, relationships, data, interests and structure. The circle is adapted to include language as a source of conflicts and expands values conflicts to include adaptive challenges (Moore, 1996).

\*\*Status-quo-bias is an emotional preference for the current situation which can cause individuals to make seemingly non-rational decisions to stay with a sub-optimal situation (Kahneman et al., 1991; Samuelson and Zeckhauser, 1988).

\*\*\*Not in My Backyard Phenomenon (NIMBY), a colloquialism signifying one's opposition to

## Literature based Discussion Related with Industrial Agriculture Conflict

### Sources of Conflicts around Industrial Feedlots

According to Ladd et al., (2002), although one can observe a "status-quo-bias" in conflicts around farming, meaning that generally more intensive resistance will occur in the first phases of planning and before an investment in an animal feedlot is made, in cases of considerable environmental, socio-economic and negative health impacts, even long established farms can face increased resistance. Schlecht et al., (2008) have analyzed a number of studies about conflicts in the agro-industry from the perspective of this industry's opponents and have come to the conclusion that conflicts in industrial farming have various sources. They can be grouped as follows:

**(a) Loss of the authenticity of agriculture and the transformation of the social surroundings of farmers.** The recent trend of the population of cities moving to the villages has led to a significant change in the village communities. Apart from this, as agriculture is increasingly becoming an expert field, there is a change in the communication structures within villagers. Consequently, the sense of community steadily fades away.

**(b) Growing public skepticism about industrial agriculture.** The public is increasingly questioning the impacts and appropriateness of the technology employed in such facilities. Not only health concerns, but also animal rights and environmental concerns arise (pollution and damage of fragile ecosystems). Consequently, farmers or

industrialists have to deal with “representatives” of animal rights and environmental activists.

**(c) Concerns about “environmental racism”.** Industrial feedlots are concentrated around structurally weak areas and are often built by foreign investors. The local communities are agitated about their own government’s part in this.

**(d) Socio-economic distress.** Communities are worried about the devastating effects of such lots on their family farms and the consequent loss of jobs, the devaluation of their property, loss of tourism perspective and ultimately a diminishing life quality, due to the pollution of air, soil, water and increased traffic.

Schlecht et al., (2008) have tried to supplement the previous findings on conflict potentials in the field of industrial hog farming, which were focused on the opponent stakeholder’s perspectives, with their findings about the hog farmer’s perspectives on the motives and conflict potential of their businesses. They have studied six cases of animal feedlots in Germany. Their analysis shows that the farmers expect a lack of acceptance primarily from the local inhabitants that can organize in citizen initiatives. They perceive them as the strongest opponents, as the intensity of their resistance is also perceived as being high. Citizens’ initiatives are followed by environmental and animal rights movements, to a lesser degree by other farmers and consumer groups as well as local authorities and media. Interestingly, the interviewed hog farmers acknowledge the importance of acceptance in the local community and the need to tackle this issue at early stages. They perceive difficulties in coming to an understanding with their opponents, as the latter engage in a moral argumentation.

### **Stakeholder Analysis with the “Circle of Conflict” Tool**

In order to better understand the dimensions of the problem and to assess a possible intervention, we have analyzed Hassleben’s feedlot stakeholders’ vision with Moore’s “circle of conflict” tool. The circle of conflict breaks stakeholders’ perception of the conflict into five categories grouped in two sets (Moore, 1996). One set would include values, and structures, and the other one would consider data, interests and relationships. When conflicts are mainly due to value or structural differences, they become very difficult to solve: it is hard to reach compromises regarding one’s beliefs or when there is an unequal control of resources and access to power. The second set deals with characteristics that might be useful when trying to bring the different sides to communicate and arrive to some kind of common ground where decisions may become acceptable for the different disputants.

By analyzing Hassleben’s stakeholders, we are considering mainly with the value and structure conflict. The first stakeholder worth being analyzed is the civil movement known as *Kontra-Industrieschwein*. They have made their movement public through the internet ([www.kontraindustrieschwein.de](http://www.kontraindustrieschwein.de)), articles in newspapers (4/3/2011 in *UckermarkKurier* 4/3/2011 and *BILD Berlin*), through Berlin Inforadio and public demonstrations. They have also associated with a bigger lobbying group with similar values and positions that serve as a back-up to their cause: the association *Bauernhöfe statt Agrarfabriken*. Among the main values expressed by *Kontra-Industrieschwein*, we

must highlight environmental and animal protection along with heavy economic concerns. They are openly against accepting an industry in their village that will be detrimental to their life quality (noise, pollution etc.), that will lower their touristic competences, and thus are a clear example of the “Not in My Backyard Phenomenon” (NIMBY phenomenon). Their concerns are also deeply environmentally and animal rights oriented, which is why they strongly reject the project. They are in favor of protecting the economic value of their land, houses and touristic facilities and considered Mr. Van Gennip’s action a clear move of environmental racism: bringing an unpleasant industry to an economically depressed area (like in many parts of eastern Germany, Hassleben has an average 30% of unemployment). According to their values, Mr. Van Gennip’s project is completely incompatible with their tolerance threshold and goes against their interest.

With regards to the civil group’s relationships (stereotypes and history of poor communication with the other players in the conflict), the *Kontra-Industrieschwein* personifies to a very high extent the conflict *vis a vis* Mr. Van Genipp. Since it is already a very long process, the anger of the *Kontra* group has been *in crescendo*, making them organize better throughout the years, hiring lawyers and finding partners that will support their cause. Mr. Van Gennip’s industry seems to be the antagonism of what Hassleben’s civil group considers to be desirable for their village and from their perspective, a win-win solution is impossible. In one of their communications (4/3/2011), the editorial office of the *Kontra Industrieschwein* group stated their view that the project has had an enormous commotion in the whole region and that it is obvious that there will be no winners in this dispute ([www.kontraindustrieschwein.de](http://www.kontraindustrieschwein.de)). For them the solution is clear: the project must be rejected.

Complaints are also addressed to political irregularities that may have been infiltrated in the decision making process. According to the civil group, the pro *Schweinindustrie* lobby submitted scientific data in 2003 that bypassed the fact that the moors surrounding Hassleben are considered a natural protected biosphere area. At the same time, they allege political irregularities in the process, which delegitimize the project’s approval from part of the MEHC’s decision making body. Brandenburg is governed by a coalition of the Christian democratic union (CDU) and the social democratic party (SPD). One of Mr. Van Gennip’s main counselors regarding his feedlots in Germany (80,000 hogs in Mahlwinkel, Altmark) is the member of the SPD and once owner of a 10,000 animal beef farm.

The civil group *Kontra-Industrieschwein* backs up its arguments with scientific data. They appeal to studies of the University of Pottsdam by Professor Pfefer, which declare Hassleben’s nitrogen levels to be 3 times higher than the most exploited areas in Brandenburg. The movement relies on this study which assures that the 65,000 planned hog feedlot would heavily damage the forest, the lakes, the moors and the ground water. According to Greuner-Pönicke 2008, the Kuhzer Lake would be heavily damaged by the massive amount of manure that would not be able to be completely filtered, processed or carried away. Furthermore, the civil movement assures that Mr. Van Gennip will by no means be able to comply with European animal welfare legislation. The “Deutsche Tierschutzbund” (2009) reassures that an industry which will need an average of a truck

every three minutes to deal with the excessive manure and corpses of foreseeable dead masts in the 68,000 hog feedlot facility, will by no means comply with EU nor Brandenburg animal protection legislation.

### **Framing the Conflict in a Larger Political Scale**

#### **a) Value conflict leading towards structural perspectives**

As we have seen, the conflict has reached a dead end in Hassleben. There are no more win-win solutions where mediation or any kind of participatory process could bring positions closer. The circle of conflict has shown us that there is mainly a conflict of values: *Kontra Industrieschwein*'s concept of well-being for Hassleben (economical and environmental) is antithetical to the industrial farm as well as *Bauernhöfer Statt Agrarfabriken*'s understanding of how farms should operate and treat the animals is contrary to Mr. Van Gennip's proposal. From *Bauernbund Brandenburg*'s perspective, the foreign investor poses a terrible threat to local farmer's survival in market; that doesn't comply with their conservative values of community and fair market for its members. Mr. Van Gennip makes no comments on values and assures that he will be able to comply with the legislation, so stakeholders are simply talking in different languages and can't communicate. On the other hand, as we have seen especially with *Bauernbund Brandenburg* and *Bauernhöfe Statt Agrarfabriken*, the conflict is structural rather than anecdotic. What is considered as acceptable in farming systems is completely detached from the administration's behavior of subsidizing big industrial facilities where animal rights, environmental protection and consumer protection are at stake. The premise that a democratically elected organism has legitimacy in decision making seems to apply no more for the case of industrial feedlot facilities where civilian's and farmers' understanding on how agrarian industries should be conformed and operate don't match any more with government's allocation of funds and subsidies.

A level where the conflict could become manageable is one that precisely tackles the structural problem reflected in it. Our intervention recommendations will therefore be addressed to the MEHC Brandenburg administration. Hassleben's conflict surpasses a local issue: it is embedded in problems of the past (GDR use of the land and management of industrial farms, unfair handling of the situation by the administration during GDR times and after the unification, lack of legitimized processes of decision making) and it is deeply connected to present transformation movements that look towards the future (the EU's CAP reform, a legitimate process of decision making that includes stakeholders, and a vision of society that understands farming activities as necessarily respectful with the environment, with animals, with human health and with projects that correspond to human scale). The fact that the EU also plays a role in the conflict gives us the hint that a regional intervention approach will not address the issue appropriately.

#### **b) Contextualizing Hassleben's Conflict Within the EU's Common Agricultural Policy**

As pointed out by the previous analysis, it is not only a conflict of values that underlies the hog feedlot conflict in Hassleben, but also one of structural realities that need to be put into the broader political context, which is arguably the undisclosed trouble spot.

The production of pork has been steadily increasing in Germany over the past years with more pork being produced than consumed. This overproduction reached 10% in 2010 and is increasingly exported at predatory prices to third countries outside the EU, which has, together with the construction of new intensive hog operations, been subject to severe criticism in the public arena due to major social justice, public health and environmental concerns (Benning and de Andrade, 2011). The partly government-sponsored expansion of intensive hog operations by the CAP, German Federation and Länder not only undermines their own sustainability targets in terms of climate, species and water protection, but also the public demand for healthy, non-hazardous food produced with the least harmful environmental impacts (Benning and de Andrade, 2011).

### **Public Participation for Conflict Management and Conflict Prophylaxis**

#### **a) Structural perspectives of the industrial feedlot conflict in Hassleben**

On the previous sections we have argued that the conflict in Hassleben is not merely one between the citizens' initiative backed up by environmental NGO's, animal rights organizations as well as farmers' unions on the one side, and the Dutch investor on the other. We have argued that this complex conflict embodies a reaction to the framework conditions of the current agricultural policy set-up at the Federal and the EU level at large, whereas on a smaller and a more acute scale, the conflict is about decision-making practices for agricultural projects in the Land of Brandenburg. This insight is supported by statements of the BI Kontraindustrieschwein, that in the recent years have changed their line of argumentation from a very personalized opposition towards Van Gennip to the expression of dissent with decision making procedures at the level of the Land Brandenburg<sup>1</sup>.

The issue of conflicts on industrial hog feedlots in Brandenburg must therefore be viewed in the frame of a larger legitimacy crisis. This can support the assumption that conflicts, such as the one in Hassleben, that have questions of legitimacy inherent to them, will reoccur and escalate, unless the government establishes proper participatory practices that will address the question of policy effectiveness and the legitimacy of decision-making processes and will help establish a common strategic vision for the development of animal farming in the near future.

#### **b) Approaches and techniques of participation**

There are many understandings of the notion of public participation. We understand public participation as a key feature of deliberative democracy. According to Meadowcroft (2004:184), deliberative democrats argue that "the public interest cannot emerge merely by summing preexisting preferences, but can come to the fore only through a deliberative process, which generates new insights and transforms initial perspectives. In other words, deliberative interaction allows the democratic constituency

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<sup>1</sup> In a report of November 2008 on the Deutschlandradio Kultur, one of the members of this initiative, Mr. Spangenberg, stated that they had nothing against the investor nor the Hassleben villagers that were supporting his project. He stated that they [BI Kontraindustrieschwein] have understanding for their respective motives of profit and promised employment. He claims that the problem lays in the way decisions are taken, that allow for such projects to pass on the basis of arguments that do not hold truth.

to construct a collective path forward.” We believe that by understanding public participation under the principles of deliberative democracy; we approach the potentials of inclusive governance to enhance social capital and collective learning processes.

Following on Meadowcroft’s argumentation, by taking this stance, one can ensure that although participants may insist for their views and interests to be part of the deliberation process, the final outcome will be a product of the collective understanding on what a common desired outcome is. Such an interpretation reconciles with ideas of plurality of views and values, but is constructive in a sense that it seeks collectively agreed action. Thus, we believe that it fulfills both normative and instrumental arguments for participation, i.e. reflecting societies views on what is best for them whilst ensuring a democratization of decision-making processes and consequently, enhancing legitimacy (Wesselink et al., not dated:4). However, if one adds to this view a substantive rationale to public participation, that stems from a functionalist concept of inclusive governance (Renn & Schweizer, 2009: 177) and which would claim that information from non-experts can be just as enriching for policy quality as expert knowledge (Wesselink et al., not dated:4), we end up with an inclination towards Stern & Fineberg’s (1996) analytical-deliberative model of participatory processes.

We agree with Renn & Schweizer’s (2009:181) argumentation on the benefits of the analytic-deliberative process of participation as laying in the combination of the functional approach’s analytic force with the consensus reaching potential of the deliberative approach to inclusive governance, by reconciling essential expert knowledge and scientific input with moral reasoning and normative judgments of non-expert stakeholders. In the following section, we will argue on the appropriateness of an analytic-deliberative model of public participation for the conflict setting at hand.

### **An Analytic-Deliberative Model of Public Participation for Industrial Farming Conflicts in Brandenburg**

In these recent years there have been a number of conflicts related to industrial animal farming. The exacerbation of these conflicts has even led the social democratic party of Germany (SPD) fraction in the German Parliament to ask for a more rigid regulation and control of industrial animal farming. In a motion that was presented to the parliamentary Commission on Food, Agriculture and Consumer Protection in June 2011 (Antrag 17/6089), they are calling for a more detailed definition of “Industrial animal farming”. This would have consequences in the legislature on intensive feedlot construction, leading to a more rigid rule-setting and control of animal factories. Among other positions, this motion calls for a transfer of planning rights to municipalities and says that such rights should enable municipalities to engage in more transparent procedures and strengthen citizen inclusion in planning and approval processes for intensive animal feedlots.

The German Emission Control Act (§ 10) foresees is the right of the public to get informed and take part in planning discussions for intensive animal farming projects. Nevertheless, these discussions are rather designed as platforms where the public can express their doubts or objections about a project. However, if we are to understand the exacerbation of intensive animal farming conflicts, such as the one in Hassleben, as a result of process

intransparency and consequently, of lacking legitimacy, a more deliberative approach to public inclusion must be endorsed to tackle the acceptance of permission granting and subsidy management procedures. For this purpose, one has to intervene in the level of decision-making, which in our case is the MEHC at the level of the Land Brandenburg.

The Brandenburg MEHC grants permissions and manages CAP subsidies. In the last couple of years, the Ministry has been facing considerable opposition from very well organized civil and farming interest groups. These objections suggest that the current plans of the Ministry do not go in line with the expectations of the citizens, farmers and many environmental NGO's that are calling for reforms not only at the Land but also at the Federal and EU level. We propose the *Future Workshop* as an inclusive tool, that will hopefully enable the MEHC to gain the information needed for effective policy making, while at the same time including all voices that have an interest at stake, to develop a common vision on a desired future for animal farming and meat production on the Land of Brandenburg through deliberation and collective learning. We hope that such an approach to public participation will contribute to the management of already existing conflicts, but further more, will prevent potential future conflicts around animal farming in Brandenburg.

### **Proposed Conflict Resolution Methods**

Based on these conflict arenas some relevant resolution strategy is discussed below:

#### **The Future Workshop**

The future workshop is an effective method for local level planning and decision-making. It comprises of three phases that can take place within one single day. A group of up to 30 people are gathered and are presented the problem at hand. During the first phase, the stakeholders are focused on a critical analysis of the issue at hand. The criticism and concerns are written down. This analysis forms the basis for further brainstorming. In a second phase, participants are focused in creating visions about the steps ahead. Concrete suggestions and ideas are written down on large poster boards as draft action proposals. On the third phase, the draft action proposals undergo a critical evaluation by the contributors. Participants evaluate the possibility of implementation and suggest further concrete steps for enactment. The final results of such workshops have to be documented in reports and should ideally result in actions that can be followed by the stakeholders.

##### **a) Organization**

We propose that Future Workshop is called by Brandenburg's MEHC and is organized around the title "*What should animal farming and meat production look like in Brandenburg in the near future?*" It is advisable that the workshop takes place in the light of the newly received CAP subsidies and aim to create a common vision and strategy on how Brandenburg's future policies on animal farming as well as cover procedural aspects, such as issues of inclusive agenda setting, planning, decision-making, implementation and monitoring for farming policies.

**b) Management**

The Future Workshop should be managed by an independent and impartial professional project management. The project manager would be responsible for not only logistical questions, but also facilitation throughout the process and provision of technical assistance in the development of the final product.

**c) Scope**

As the Future Workshop will try to establish a process of collective learning and a common strategic vision for the whole Land of Brandenburg, it will not merely address the concrete conflict of Hassleben. Thus, the workshop should consider all interested communities and stakeholders from Brandenburg affected by industrial feedlots. Let us not forget that since we are dealing with a structural conflict, reconducting decision making process is a very complex maneuver. What the Future Workshop proposes is a first step of addressing the situation and placing the MEHC on the right track, in tune with its citizens' aspirations.

**d) Participants**

In line with the scope of the approach, the MEHC should invite representatives of the BI Kontraindustrieschwein, Bauernhöfe statt Agrarfabriken, Pro-Schwein, Bauernbund Brandenburg, representatives of the hog farming industry in Brandenburg as well as representatives of academia, environmental NGO's and policy makers of the MEHC from Brandenburg. A guiding principle should be that the participants have an interest at stake and can be part of the solution and implementation of the outcome. The representatives of the MEHC should be part of the deliberation, but it may be advisable that they retreat before the conclusions are developed, to ensure that they do not influence the final outcome in one direction.

**e) End product**

Usually, a Future Workshop is concluded with an action plan<sup>2</sup> that is ideally implementable by all the involved parties. As in this case the stakeholders will deliberate on a common vision about a desired future farming and meat production system, including also questions of process transparency and subsidy management, whilst the MEHC will be the implementing organ, we propose that the workshop's final outcome is a policy paper. This policy paper should address the MEHC and should include proposals for action that reflect the expectations of the stakeholders in a structured and comprehensive manner. The brief as such might contain more variants of desired outcomes and state arguments for each. We expect that these variants will nevertheless lead to a similar direction, as they will be results of a collective learning process through deliberation. As already clarified before, the writing of the brief will be supported by the management team of the Future Workshop. The decision on the implementation lies with the MEHC. However, in light of the current legitimacy crisis, the Future Workshop should also be used to establish mechanisms of accountability. Therefore, the MEHC should provide explanations for their subsequent decisions.

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<sup>2</sup> See Future Workshop according to The Danish Board of Technology



#### **f) Expected outcomes**

The Future Workshop with its analytic-deliberative approach towards public participation relates to all interest parties, fulfilling both functional purposes of informing the policy makers for effective and strategic decisions whilst at the same time ensuring that the stakeholders voice their cases and develop a common vision. We believe that such an approach, if properly followed up with inclusive practices, will improve the legitimacy of decisions, but furthermore, it will contribute to the development of social capital through collective learning. Ideally, such practices will lead towards more sustainable agricultural policies.

#### **Conclusion**

This paper has argued that the Hassleben industrial hog feedlot case needs to be understood as a structural and value conflict that puts the legitimacy of the current neoliberal decision-making system regarding intensive livestock feedlots into question. A conflict resolution only aimed at Hassleben would inevitably end in a deadlock, for what is needed is a structural change that legitimizes political bodies in their decision-making, linking the EU's attempt of agrarian reform in tune with the wishes of a transforming society that no longer approves of massive industrial feedlots and demands a profound reform in that area. Hassleben's long-lasting and complex conflict teaches us that participation and decision-making related to environmental problems is not only a challenge for development agencies that try to make the voices of the "oppressed" heard in countries that would be considered as "undemocratic" systems by Western standards. In Germany itself, democracy and the interplay between decision-making organs, investors and society are at stake in the Uckermark region, which has been vividly unveiled by this case. The current legal system leaves Hassleben's citizens unable of putting forth what they consider a paramount issue in their wellbeing as inhabitants of their region: a "no" to an industrial hog feedlot of 68.000 animals which goes against what they consider even minimally acceptable in terms of environmental, economical, social and ethical well-being. The fact that Mr. Van Gennip can assure on paper that he will comply with the current legislation - which is even not necessarily considered sufficient by many *Kontraindustrienschweiners* and their advocates - is not acceptable as a valid argument that would legitimize the government to make a decision that overrules the most sincere aspirations of Hassleben's citizens for their region. Parents, business managers, teachers and government officials all know that the balance between participation, efficiency, optimization and economic success is very delicate; especially when preferences of "how things should be done" shift strongly and decisively. However, if we believe in democracy as an arena of participation and decision-making, which does not always appeal to the "fastest, easiest" way, but rather encompasses world views to shape the present in consonance with the will of the majority, participation processes must be carefully implemented in decision-making procedures such as the one described in this paper.

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## **Contours and Digital Surface Model (DSM) Generation from Google Earth: A Case study on Southern Part of TSC Jahangirnagar University**

**Md. Alamgir Hossen Bhuiyan\***  
**Marzia Sultana\*\***

**Abstract:** Landscape planning is very important in integrated development. The research reveals the landscape status and creates Digital Surface Model of the study area. The data collected from Google Earth and field survey by adding path with active internet connection then Training Center XML (TCX) converter produces spot height. Geographical information systems (GIS) analyze this spot height converting vector shapefile to raster in kriging method of GIS. By raster surface analysis iso-height line are creates. A triangular irregular network (TIN) tool of ArcGIS converts this spot height into raster image digital surface model (DSM) which has elevation information. Research finds the elevation height of southern part of Teacher Student Center (TSC) of Jahangirnagar University which varies from 9 meter to 19 meter including object height. The study reveals that eastern part of the research area is comparable in high altitude where vegetation cover changes regularly in according with the altitude. Mostly herb and shrub type of vegetation cover in lower altitude where Gmelina arborea, locally gamari and woody tree are in highland. Biodiversity of the research area should maintain to keep the ecological balance of the study area.

**Keywords:** Contour line, GIS, Google Earth, DEM.

### **Introduction**

Digital Surface Models (DSM) is useful in many geoscience applications, such as topographic mapping, earth's deformation, hydrological and biological studies. The main requirement to be made a contour map is the presence of multiple data points that already have the coordinates (Easting, Northing) and altitude (elevation) than on those points.

This research aims to manufacture digital contour maps and digital surface model (DSM) with Google Earth Pro, TCX Converter, Microsoft Excel, coordinates and elevation data. The contour interval of a contour map is the difference in elevation between successive contour lines. A contour line is a function of two variables is a curve along which the function has a constant value, so that the curve joins points of equal value (Courant, et. al. 1996). A method is developed to generate the contour line from the Google Earth. Using TCX converter it is now easy to get the altitude height from Google image. Converting this contour data in ArcGIS platform it is easy to transform the contour line in to raster grid like as a DEM image.

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Google Earth is a computer program that renders a simulacrum of the Earth based on satellite imagery. It maps the Earth by the superimposition of images obtained from satellite imagery, aerial photography and geographic information system (GIS) onto a 3D globe.

### **Aim and Objectives:**

Topographic maps show the three-dimensional shape of the land. Most topographic maps make use of contour lines to depict elevations above sea level. Topographic maps are important in geology because they portray the surface of the earth in detail. The aim of the research is to generate contours and digital Surface model (DSM) from the Google Earth.

Based on this aim the following objectives are considered to achieve the goals of the research.

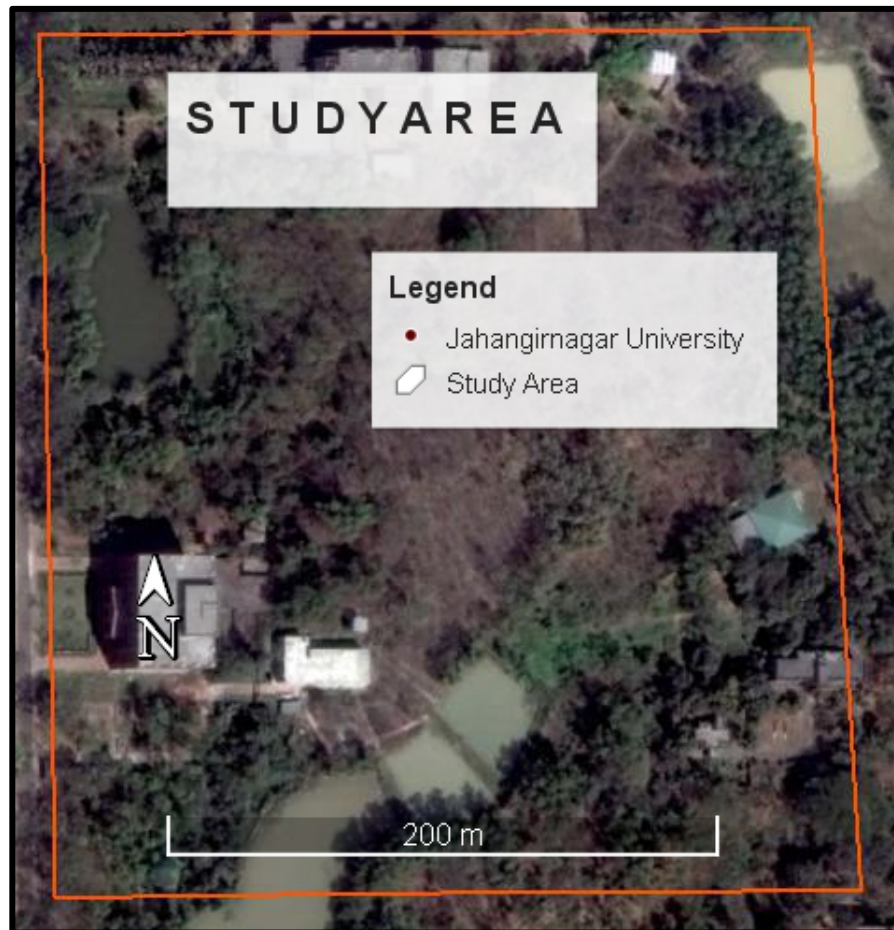
1. To generate contours from Google Earth; and
2. To create Digital Surface Model (DSM) image from the contours.

#### **1. Research necessity:**

These contour lines are an important technique of presentation the growth and drop of the land on a map. Contour lines show all the places that are the same height above sea level. They also tell us about the slope of the land. It helps to identify the water bodies of an area. In planning it assist the planner to settle the different types plan in according with the earth curvature.

### **Study Area**

Jahangirnagar University is a public university in Bangladesh, based in Savar Upazila, Dhaka. It is one of the top and only fully residential universities in Bangladesh, Popularly known as the Dhaka-Aricha Road, and is 32 kilometres away from the capital. The topography of the land with its gentle rise and plains is pleasing to the eyes.



**Figure: Location of Study Area**

### **Data and Methods**

Elevation information is very important for planning because biodiversity varies with the gradient of slope. By using ArcGIS and Google Earth the study generate the contour lines of the study area which carries elevation attribute. The following method is considered to conduct the research.

#### **Sketch points in Google Earth for Spot Height**

A spot height is an exact point on a map with an elevation recorded beside it that represents its height above a given datum. In the UK this is the Ordnance Datum. Unlike a bench-mark, which is marked by a disc or plate, there is no official indication of a spot height on the ground although, in open country (Whittow and John, 1984)



Figure\_1: Drawing points on Google Earth

### Exporting KML of Drawing points

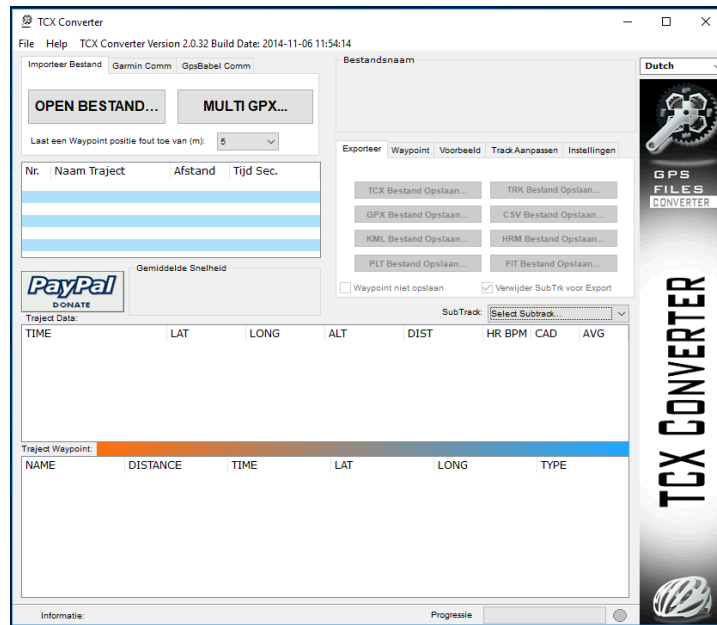
Drawing points are saved as kml format for further analysis in ArcGIS. KML is a file format used to display geographic data in an Earth browser such as Google Earth. You can create KML files to pinpoint locations, add image overlays, and expose rich data in new ways. KML is an international standard maintained by the Open Geospatial Consortium, Inc. (OGC).



Figure\_2: Drawing points are saved as a KML Format.

### Conversion of KML points in TCX convertor

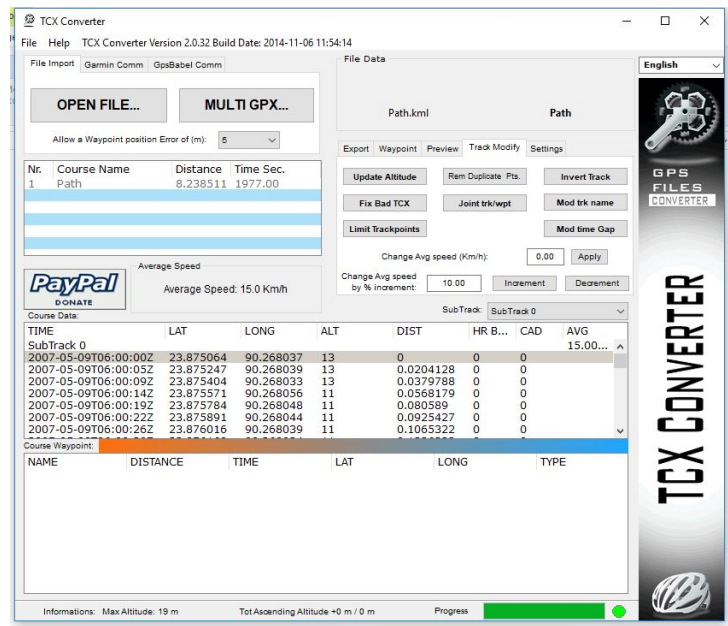
TCX Converter is the critical piece of software that convert different GPS and file and integrated that file in mapping software. With TCX Converter we can: Import TCX, GPX, FITLOG, KML, TRK (and more to come...) files. Training Center XML (TCX) is a data exchange format introduced in 2007 as part of Garmin's Training Center product. The XML is similar to GPX since it exchanges GPS tracks, but treats a track as an Activity rather than simply a series of GPS points.



Figure\_3: Interface of TCX Converter

### Altitude data generation by TCX Converter

TCX Converter generates altitude by update altitude function of the converter. Internet connection is must be needed for updating the altitude height.



Figure\_4: Elevation data generation by TCX Converter



### Exporting TCX generated elevation data as .csv format


For opening the converted data in ArcGIS its needed to data in .xlsx or .csv format. Here only three fields are considered for updating the data table in ArcGIS like Latitude, Longitude and Altitude data.

	A	B	C	D	E	F	G	H	I	J
	UNIX TIME	TIME	LAT	LONG	ALT	DIST	HR	CAD	TEMP	POWER
2	1.18E+09	2007-05-01	23.87506	90.26804	13	0	0	0	No Data	No Data
3	1.18E+09	2007-05-01	23.87525	90.26804	13	0.020413	0	0	No Data	No Data
4	1.18E+09	2007-05-01	23.8754	90.26803	13	0.037979	0	0	No Data	No Data
5	1.18E+09	2007-05-01	23.87557	90.26806	11	0.056818	0	0	No Data	No Data
6	1.18E+09	2007-05-01	23.87578	90.26805	11	0.080589	0	0	No Data	No Data
7	1.18E+09	2007-05-01	23.87589	90.26804	11	0.092543	0	0	No Data	No Data
8	1.18E+09	2007-05-01	23.87602	90.26804	11	0.106532	0	0	No Data	No Data
9	1.18E+09	2007-05-01	23.87616	90.26803	11	0.122622	0	0	No Data	No Data
10	1.18E+09	2007-05-01	23.87643	90.26804	13	0.152952	0	0	No Data	No Data
11	1.18E+09	2007-05-01	23.87659	90.26803	13	0.170336	0	0	No Data	No Data
12	1.18E+09	2007-05-01	23.87674	90.268	13	0.187961	0	0	No Data	No Data
13	1.18E+09	2007-05-01	23.87687	90.268	13	0.202419	0	0	No Data	No Data
14	1.18E+09	2007-05-01	23.87701	90.268	13	0.218006	0	0	No Data	No Data
15	1.18E+09	2007-05-01	23.87713	90.26802	15	0.231691	0	0	No Data	No Data
16	1.18E+09	2007-05-01	23.87726	90.26801	15	0.246292	0	0	No Data	No Data
17	1.18E+09	2007-05-01	23.87738	90.26801	15	0.258866	0	0	No Data	No Data
18	1.18E+09	2007-05-01	23.87753	90.26801	15	0.2758	0	0	No Data	No Data
19	1.18E+09	2007-05-01	23.87778	90.26801	15	0.304402	0	0	No Data	No Data
20	1.18E+09	2007-05-01	23.87797	90.26801	15	0.324794	0	0	No Data	No Data
21	1.18E+09	2007-05-01	23.87822	90.26801	15	0.352771	0	0	No Data	No Data
22	1.18E+09	2007-05-01	23.87839	90.268	15	0.372323	0	0	No Data	No Data
23	1.18E+09	2007-05-01	23.87846	90.2681	15	0.385115	0	0	No Data	No Data
24	1.18E+09	2007-05-01	23.87837	90.26819	15	0.398132	0	0	No Data	No Data
25	1.18E+09	2007-05-01	23.87826	90.2682	15	0.411226	0	0	No Data	No Data

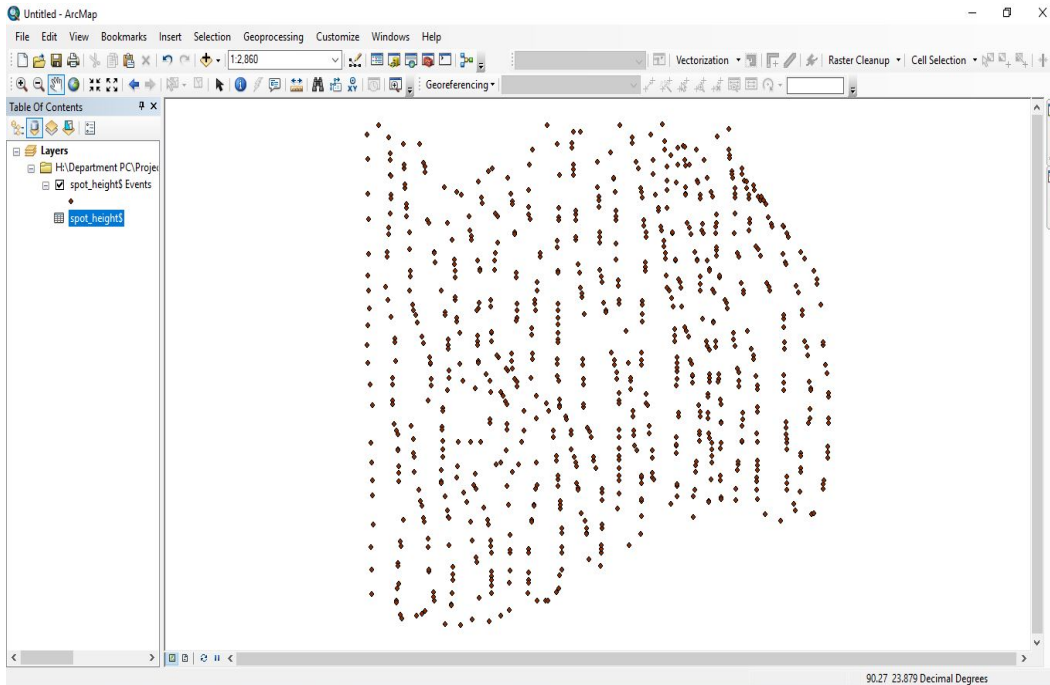
Figure\_5: Converted TCX generated altitude data in .xlsx format.

### Importing Excel data in ArcGIS

Excel files are added to ArcMap like other data, through the Add Data dialog box. When you browse to an Excel file, you will need to choose which table you want to open. For example, if you have an Excel workbook called Sales\_Figures.xlsx that contains three worksheets—Sales, Month, and Year to Date—each worksheet is a separate table in ArcGIS. Any name references to cells or ranges defined in Excel are preserved in ArcGIS.

1. Click the Add Data button .
2. Click the Look in arrow and navigate to the Excel workbook file (.xls).
3. Double-click the Excel workbook file.
4. Click the table you want to add to ArcMap.
5. Click Add.

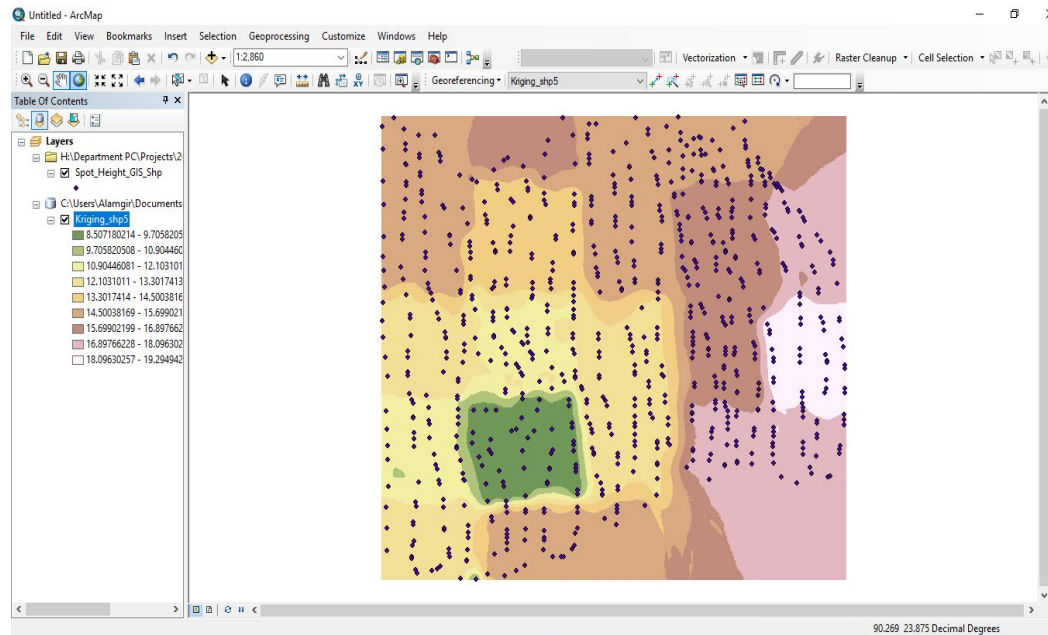
Excel tables, like other non-spatial tables (without associated features), are shown only in the List by Source view of the ArcMap table of contents.



Figure\_6: Importing .xlsx data in ArcGIS

### Converting XY co-ordinate to Raster by Kriging method

Generate input files in the point format provide an easy method to create surfaces and two-dimensional coverages from ascii files containing x,y coordinates and z-values. The x,y coordinates and z-values can be expressed as integers or single- or double-precision floating-point values. The x,y coordinates for the output raster are stored in double precision. The z-values are stored in single precision. Generate files in the point format contain the feature id, x,y coordinate, and z-values for point features. The id values are not used by the kriging function. The format for generate files containing points is id, x,y,z.



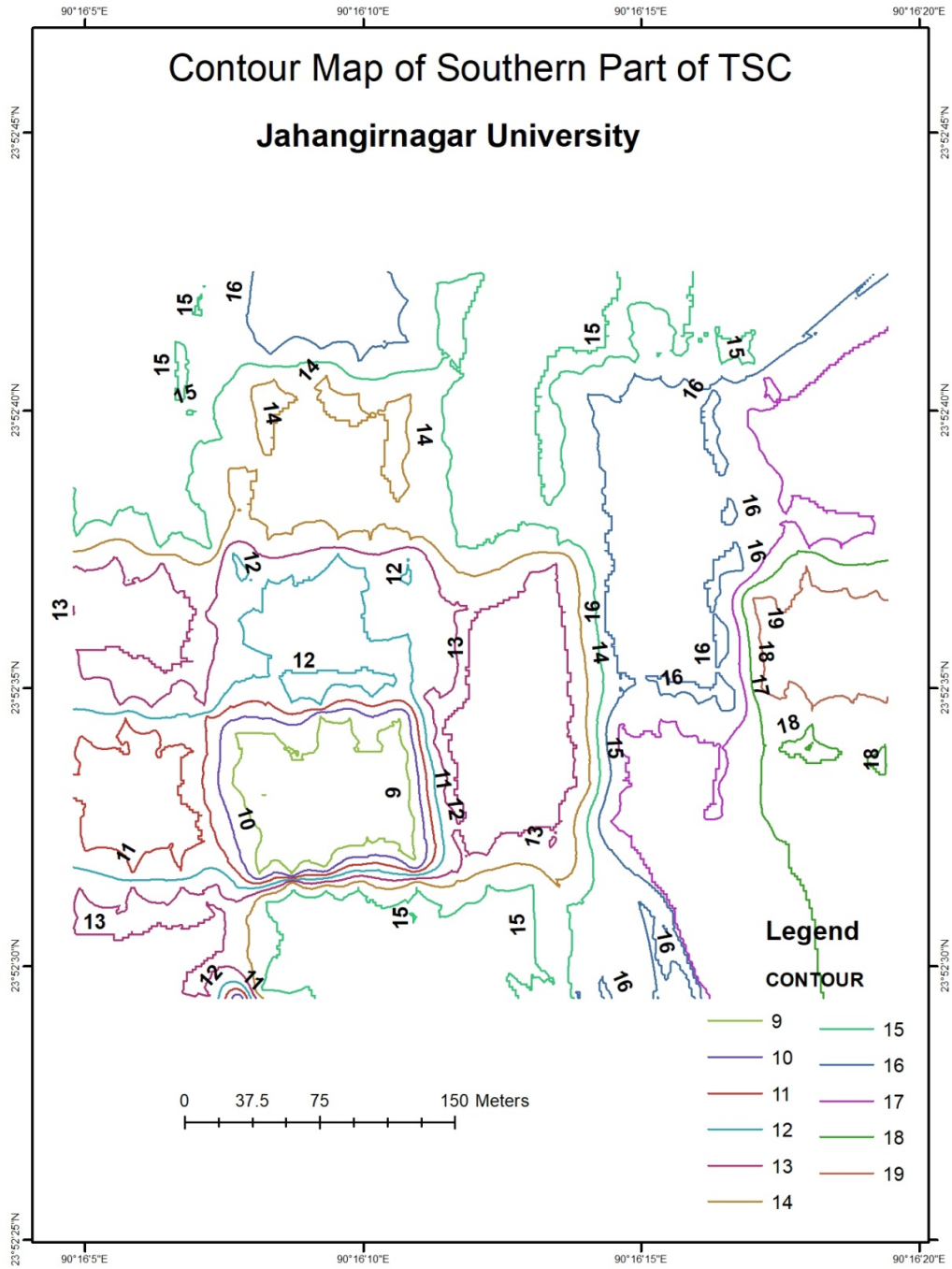
Figure\_7: Converting XY co-ordinate to Raster by Kriging method

### Develop contour lines from the kriging generated raster

Contours were originally the most common method for storage and presentation of elevation information. Unfortunately, this method is also the most difficult to properly utilize with general interpolation techniques. The disadvantage lies in the under sampling of information between contours, especially in areas of low relief.

At the beginning of the interpolation process, Topo to Raster uses information inherent in the contours to build an initial generalized drainage model. This is done by identifying the points of local maximum curvature in each contour. A network of curvilinear streams and ridges intersecting these points is then derived using the initial elevation grid (Hutchinson, 1988). The locations of these lines are iteratively updated as the DEM elevations are iteratively updated. This information is used to ensure proper hydro geomorphic properties of the output DEM and may also be used to verify accuracy of the output DEM (Grohmann, 2004 ).

The contour data points are also used in the interpolation of elevation values at each cell. All contour data are read and generalized. A maximum of 100 data points are read from the contours within each cell, with the average elevation value used as the unique elevation data point for each cell intersecting the contour line data ( Javed et.al 2009). At each DEM resolution, only one critical point is used for each cell. For this reason, having a contour density with several contours crossing output cells is redundant. From the Digital Elevation Model image catchment and drainage density can be easily identified by ArcGIS hydrology tools (Korkalainen et. Al 2007).



Figure\_8: Contour map of southern part of TSC in Jahangirnagar University.

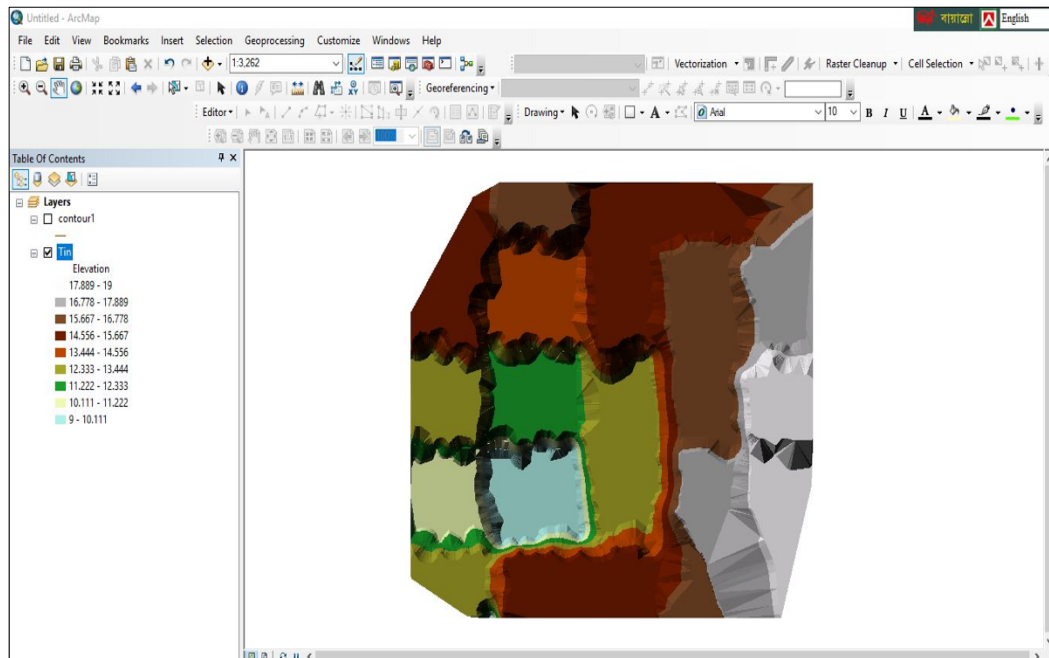
When the contour data is used to interpolate elevation information, all contour data is read and generalized. A maximum of 50 data points are read from these contours within each cell (Maathuis, 2006). At the final resolution, only one critical point is used for each cell. For this reason, having a contour density with several contours crossing output cells is redundant (Moore et. al 1991).

### **Developing Digital Elevation Model (DSM) from the contour line**

A Detailed geo-referenced data of the altitude of the surface (including terrain and off-terrain objects).

#### **Create Triangular Irregular Network (TIN) from the contour lines**

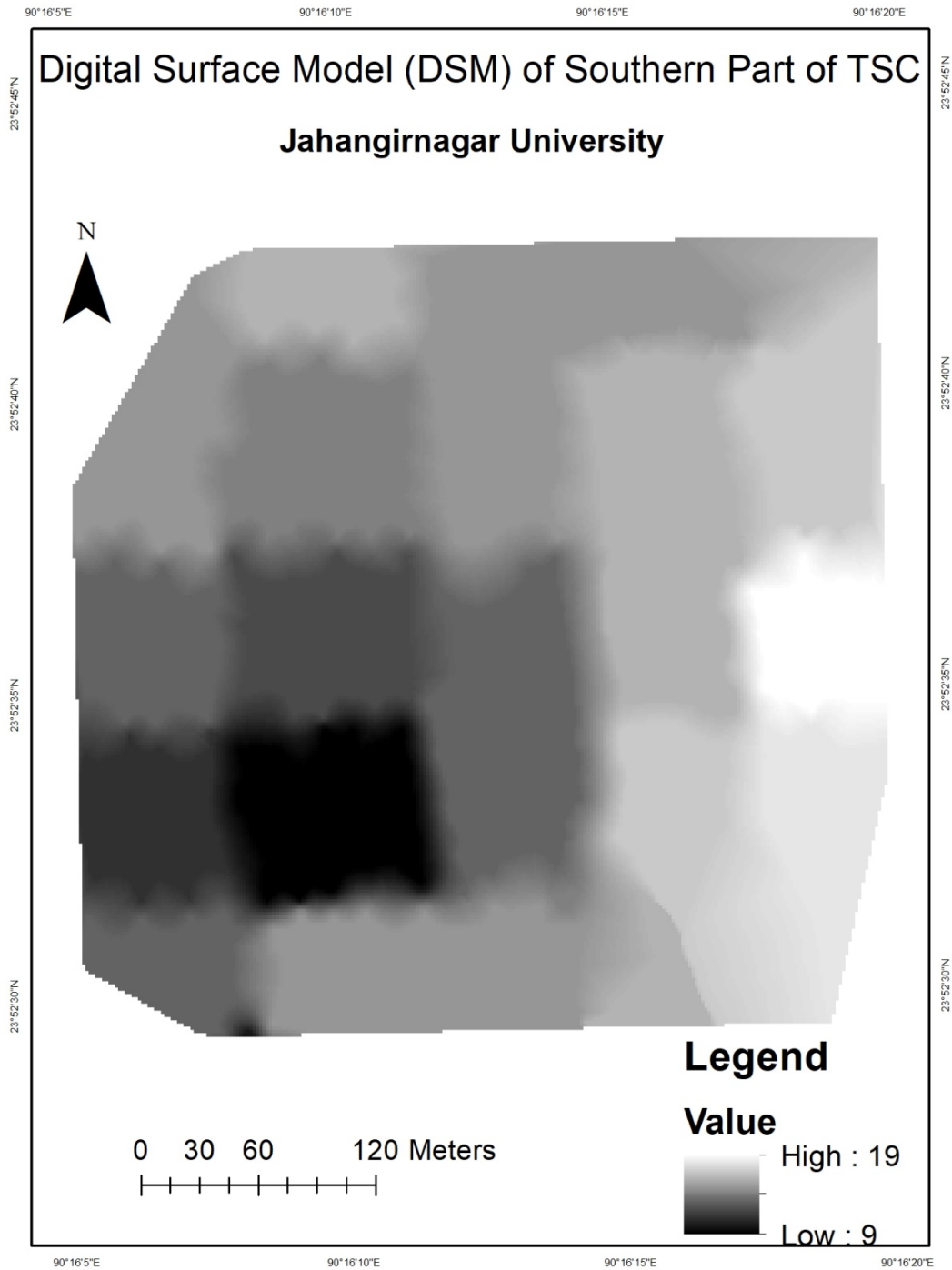
TINs should be constructed using projected coordinate systems. Geographic coordinate systems are not recommended because Delaunay triangulation cannot be definite when the XY coordinates are articulated in angular units, and distance-based calculations.



Figure\_9: Triangular Irregular Network (TIN) image of the study area

#### **1.1.1. Create Digital Surface Model (DSM) from TIN image of the research area**

The illustration of constant elevation values over a topographic surface, including vegetation and man-made features, by a regular array of z-values, referenced to a common datum. The DSM is also known as the "First Return Surface."



Figure\_10: Digital Surface Model (DSM) of the Study Area

## Result and discussions

The research depicts the variation of contour lines in 9m to 19 meter where 11 types of contour lines are exists. According to the nature of contours there is gentle slope in this area. The lowest part of the research area is 9m and the highest point is 19 m with object height. Vegetation cover differs along with the contour in the research area. There is small contour interval shows that the area is a flat. The Horizontal line of the contour reveals there is gentle slope. Digital Surface Model (DSM) reveals the differences of elevation information of the study area which will help in planning purposes. DSM gives us the information in 3D view which is useful in telecommunications, urban planning and aviation.

## Conclusion and Recommendation

Digital Surface Model (DSM) generates various types of geospatial data that are used in different hydrological and ecological phenomenon which are required in preserving our environment. The research finds out the way to generate earth curvature and digital surface Model (DSM) through drawing contour line from the Google Earth pro. Contour lines expression all the places that are the same height above sea level and here vary from 9m to 19m including object height. This place has lots of variation in vegetation cover and should be reserve as a forest land to keep the biological diversity and ecology.

## Acknowledgement

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## **Microclimate of Sundarbans Reserve Forest: A Case Study on the Selected Points of the Sundarbans**

**Bibi Hafsa**<sup>\*</sup>  
**Ehsan Reza**<sup>\*\*</sup>  
**Raju Ahmed**<sup>\*\*</sup>

**Abstract:** Microclimate is the suite of climatic conditions measured in localized areas near the earth's surface and act as a determinant of ecological patterns in both plant and animal communities and a driver of such processes as growth and mortality of organisms. Primary data of different microclimatic variables like temperature, relative humidity, barometric pressure has been measured in different selected places and in different dates over the day. Different environmental survey instruments were used to collect those data. The collected data were then synthesized and analyzed in both spatial and temporal dimension. The research finds that (1) Temperature is the foremost factor influencing RH, with the effect of specific humidity and direct contribution of air pollutant; (2) RH shows a prominent ups and down trend in the Sundarbans Reserved Forest, due to temperature variations in winter season; (3) Decreasing RH was responsible for the reduction of fog days, as the data is collected in winter; (4) Increasing RH responsible for the decreasing of temperature because of holding less water vapor in air and (5) Barometric pressure is responsible for temperature variation and wind directions which directly make the difference of relative humidity.

### **Introduction**

Micro-climates are atmospheric zones pertaining to a limited geographical area, and constitute an essential part of climate science (Robert, Brown, and Gillespie, 1995). Effective management of micro-climates can help create a buffer against the larger threat of climate change and help the geographical region to cope with and adapt to climate change (ADB, 2008; Aziz and Paul, 2015). The significance of micro-climate can be judged from the fact that mismanagement of micro climatic conditions can amplify the effects of climate change in the form of temperature peaks, droughts, irregular rains or delayed rainfall (Karim, 1988; Rahman et. al., 2015). Currently, the threat perception for the environment is analyzed and gauged from the perspective of macro-climate related predictions and seldom correlated with local climatic conditions (Robert, Brown, and Gillespie, 1995). In fact, the subject area of climate science currently focuses on regional weather and larger climate trends and dwells less on the inter relations between macro- and micro-climate conditions. This hinders the understanding of micro-climates and the potential role they can play in stalling climate change (Dimoudi and Nikolopoulou, 2003).

Micro-climates are the amazing local interplays between factors such as soil temperature, air temperature, wind directions, soil moisture and air humidity-affected by day night

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effects and seasonal effects. They are determined by the particular landscape, soil conditions, vegetation, land use and water retention. Microclimate is generated by different factors and these factors affected microclimate as well and drives it through another state of climatic condition by the change of these factors (Gültekin and Alparsl, 2010; Dipu and Ahmed, 2013). Defining factors of microclimate are temperature, relative humidity and barometric pressure in a broad scale. Change of these climatic factors create pocket climate which is also known as microclimate (Dimoudi and Nikolopoulou, 2003; Kamal, 2013). Microclimate study in Sundarbans Reserve Forest is essential to understand the climatic condition of several spots and know about the ecosystem and habitats depend on this microclimate (Biswas, et. al., 2007). There are several types of microclimatic study in urban area, coastal area, forest area but based on field survey and spot data collection of microclimate study Sundarbans Reserve Forest as a mangrove forest is chosen for the first time. Winter season is selected for the easy access and the date 05-06 February 2018 is the most suitable time for the field survey. Microclimate study of Sundarbans Reserve Forest helps to manage the better environment for the habitats and plays a vital role to understand the characteristics of microclimate of the world's largest mangrove forest (Said, 1999).

Strategic intervention with the micro-climate conditions can help tackle climate change at the grass root level. Retaining water at the landscape level with water harvesting, water spreading, controlling erosion and drainage are effective forms of strategic intervention at local level that can improve soil moisture in the landscape. Better moisture levels help in controlling the fluctuating soil temperature and enable the soil bacteria to fixate nitrogen and add to the overall fertility of the landscape (Gültekin and Alparsl, 2010). Yet another intervention can be in the form of increasing the local vegetation levels, which can help in heat absorption and reduce heat radiation. Moreover, better vegetation helps create local winds that effectively circulate air and maintain ambient temperatures at ideal levels (Dipu and Ahmed, 2013). Micro-climate conditions assume even more significance in an urban scenario. The urban setting comprises of concrete structures and reflective surfaces that do not absorb heat but radiate it into the immediate atmosphere creating a heat island effect. The dividends of a successful micro-climate management manifest themselves in the form of improved groundwater table; vegetation levels and better agricultural productivity due to secured moisture, gentler microclimates and higher soil nitrogen availability. Though less understood and largely under-utilized, the management of micro-climate is a powerful tool to smoothen out the impacts of climate change and develop resilience against the same (Dimoudi and Nikolopoulou, 2003)

The Sundarbans Reserve Forest, one of the largest mangrove forests in the world (1,40,000 ha), lies on the delta of the Ganges, Brahmaputra and Meghna rivers on the Bay of Bengal. It is adjacent by a complex network of India's Sundarban's World Heritage Site inscribed in 1987. The site is interested by a complex network of tidal waterways, mudflats and small islands of salt-tolerant mangrove forest and presents an excellent example of ongoing ecological process (Nishat, 2019). The Sundarbans Reserve Forest (SRF), located in the south-west of Bangladesh between the river Balewar in the east and the Harinbanga in the west, adjoining to the Bay of Bengal, is the largest contiguous mangrove forest in the world. Lying between latitude 21°27'30'' and

22°30'00'' north and longitude 89°02'00'' and 90°00'00'' east and with a total area of 10,000 km<sup>2</sup>, 60% of the property lies in Bangladesh and the rest in India. The land area, including exposed sandbars, occupies 414,259 ha (70%) with water bodies covering 187,413 ha (30%) (Minitry of Environment and Forest, 2010).

A microclimate is a local set of atmospheric conditions that differ from those in the surrounding areas, often with a slight difference but sometimes with a substantial one (Garcia, 2006; Schröder, 2014). The term may refer to areas as small as a few square feet or as large as many square kilometers or square miles. Because climate is statistical, which implies spatial and temporal variation of the mean values of the describing parameters within a region these can occur and persist over time sets of statistically distinct conditions, that is, microclimates (Rahman, 2011; Sarker, et. al., 2017).

### **Aim and Objective**

The main aim of this research is to assess microclimate study at several spots of Sundarbans Reserve Forest. To fulfill these aim researchers selected these objectives:

1. To collect temperature, relative humidity and barometric pressure through the duration of an hour and make an analysis.
2. To show microclimatic data in Graph and describe the causes of variations.
3. To find out the cause and effect of the microclimatic factors on specific habitats.

### **Study Area**

According to the objectives for microclimatic study of four spots of Sundarban Reserve Forest were selected. The study spots were Kotka Ghat, Kotka Sea Beach, Hiron Point and Karamjal (Map-1). Kotka Ghat is one of the well-arranged water vehicle stations surrounded by various species of trees. Kotka sea beach is almost damaged by several cyclonic storms but the variety of species of trees is still remarable. Both of the Hiron point and Karamjal spots are carrying huge variety of trees and wild animals.

**Map-1:** Study area of the Sundarbans Reserve Forest

Sources: Compiled by the authors, 2019

The Sundarbans Reserve Forest is one of the most significant mangrove forests in Asia, covering 6000 km<sup>2</sup> in Bangladesh is internationally recognized heritage site for many years could be the easy gateway for the economic development of the country (Das and Bandyopadhyay; 2013). Likewise, other reserve forests in the world, it provides a variety of ecosystem services including a huge number of flora and fauna and a great diversity of their species. This flora and the other abiotic factors of the ecosystem affect the microclimate of the area.

### Data sources and Methodology

This study incorporates primary and secondary sources of data, Primary data was key to this research. The primary data sources method was field Survey, observation, photograph taking. The location data collected with GPS (Global Positioning System). Temperature, moisture and air pressure data were collected using different environmental survey instruments such as Thermometer, Hygrometer, and Barometer. Literature review also conducted to review the findings of the data. The study also maintained a systematically arranged methodology to achieve successful completion of the research

work. The goodness of a research depends upon three aspects are: - Finding out problems, Surveying for evidence and Conclusion with recommendations.

**Table-1: Log frame of this research**

Objectives	Required data	Data sources	Tools/techniques	Output
To collect the Temperature, Relative Humidity with Barometric pressure	Temperature, Humidity and Barometric pressure	Primary data	GPS, Hygrometer, Barometer, Thermometer	Values of the parameters
To show microclimatic data in Graph and describe the causes of variations.	Output of Obj 1	Primary and Secondary data	Microsoft Excel, Literature review	Representation of the microclimatic data
To find out the cause and effect of the microclimatic factors on specific habitats.	Microclimatic status and Habitats natural environment	Secondary data	Literature review	Review of the environmental effect and concern

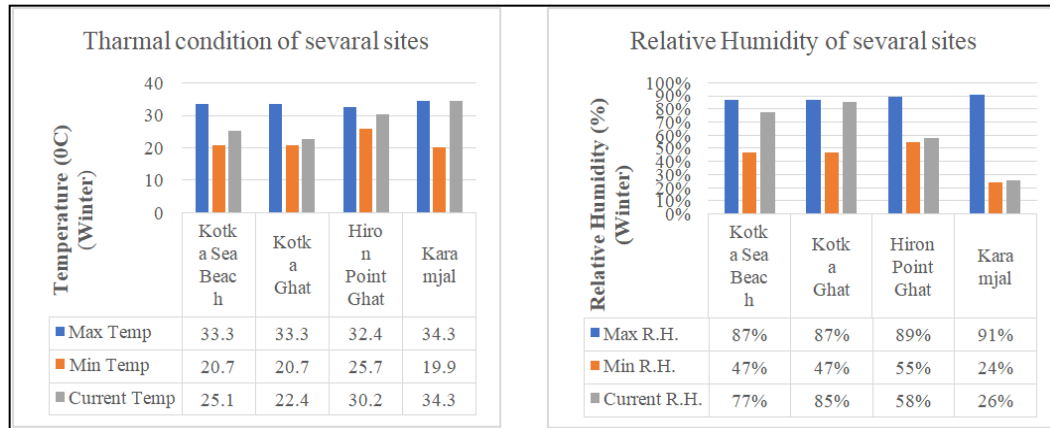
**Table-2: Collected field data at different location**

Location		Kotka Sea Beach	Kotka Ghat	Hiron Point Ghat	Karamjal
<b>Latitude/Longitude</b>		21.85403 N 89.877371 E	21.85403 N 89.877371 E	21.81761 N 89.46361 E	21.42907 N 89.59202 E
<b>Temperature (Winter)</b>	Max.	33.3 <sup>0</sup> C	33.3 <sup>0</sup> C	32.4 <sup>0</sup> C	34.3 <sup>0</sup> C
	Min.	20.7 <sup>0</sup> C	20.7 <sup>0</sup> C	25.7 <sup>0</sup> C	19.9 <sup>0</sup> C
	Avg.	25.1 <sup>0</sup> C	22.4 <sup>0</sup> C	30.2 <sup>0</sup> C	34.3 <sup>0</sup> C
<b>Humidity (Winter)</b>	Max.	87%	87%	89%	91%
	Min.	47%	47%	55%	24%
	Avg.	77%	85%	58%	26%
<b>Barometric Pressure</b>		1024.2 Pa	1011.3 Pa	1008.6 Pa	1008.3 Pa

Sources: Field Survey, 2018

### **Thermal Condition and relative humidity of different spatial units of Sundarbans**

Thermal condition of the several spots a Sundarbans Reserve Forest at several time and the relative humidity is measured by thermometer and barometer and the impact on vegetation and species are defined by the analysis after the graphical presentation of the collected data.



Sources: Field Survey, 2018.

**Figure-1:** Thermal condition and relative humidity

This graphical presentation helps to understand the ups and downs of temperature of these four sites in the winter season. Here the highest maximum temperature is recorded in Karamjal which is 34.3°C in the meantime the lowest temperature is recorded in Karamjal which is 19.9°C. On the other hand, the highest and lowest maximum and minimum relative humidity is recorded in Karamjal which is 91% and 24%.

### Standard Deviation of temperature and relative humidity

Here is a graphical presentation of maximum, current and minimum temperature and relative humidity of the study area and standard deviation of each spot. From the data we come to know that the maximum temperature of Karamjal is higher than other spots. And its higher than other data so that the standard deviation is large in area. The range of relative humidity of Karamjal is larger than others and the current relative humidity is.

This graphical presentation helps to understand the deviations of temperature and relative humidity of several spots of Sundarbans Reserve Forest. The highest deviation is observed in maximum temperature and the lowest deviation is observed in minimum temperature. That means the ups and downs in highly occurred in maximum and minimum temperature graphs. And the same level deviations is observed in relative humidity of these four spots in Sundarbans Reserve Forest.



Sources: Field Survey, 2018.

**Figure-2:** Maximum, average and minimum temperature and relative humidity variation

### Sea Level Temperature

The standard "mean sea level" around the world is usually based on 19 years of data that average out hourly readings of the sea level around the world. Because mean sea level is averaged around the world, using a GPS even near the ocean can result in confusing elevation data. Again, the height of the local ocean can vary from the global average (Akbari, 2001). Here is the data table collected this specific three days in several spots of Sundarbans reserved forest.

**Table-3:** Sea level temperature

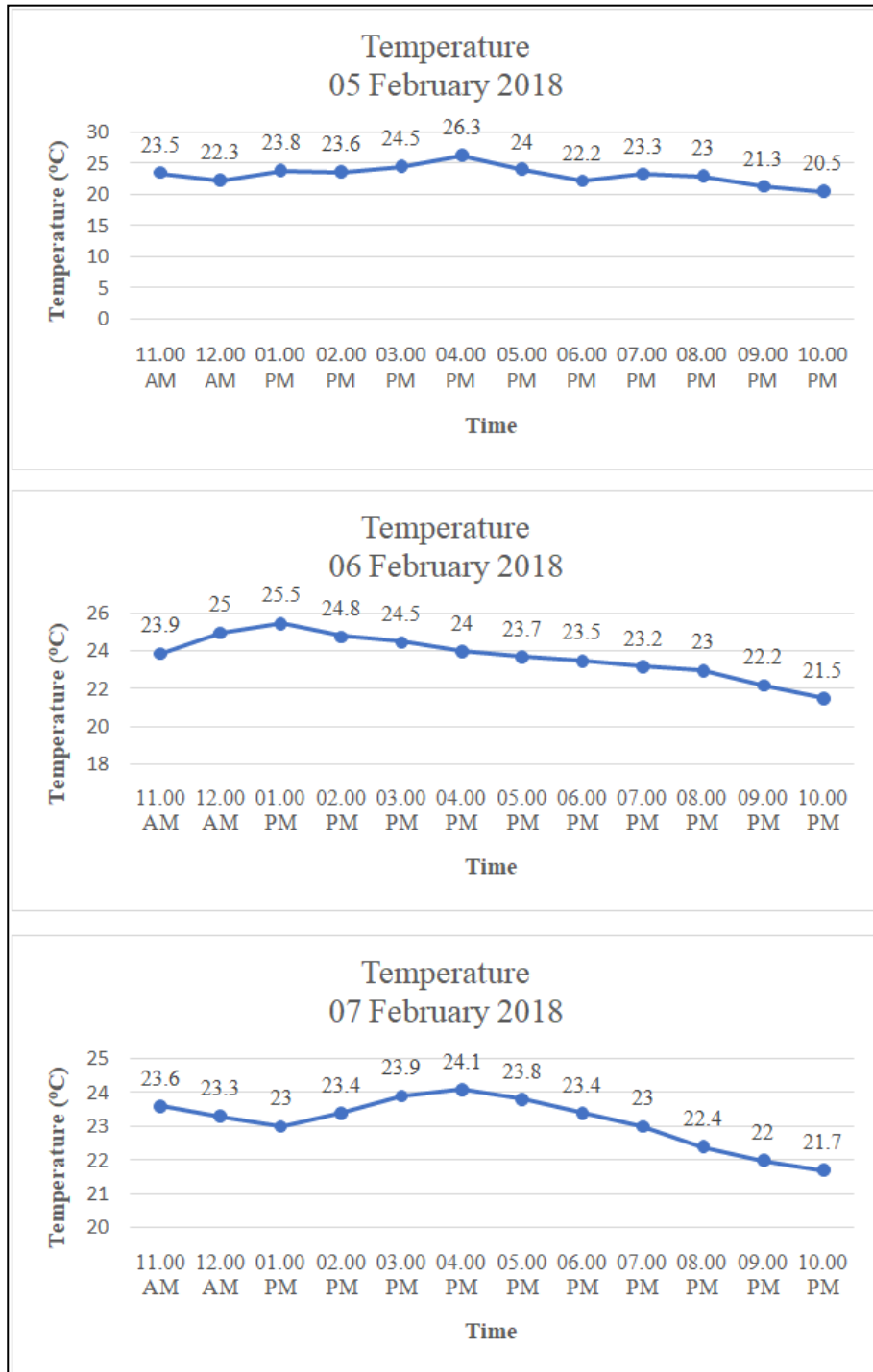
05 February 2018		06 February 2018		07 February 2018	
Time	Time	Time	Temperature	Time	Temperature
11.00 AM	11.00 AM	11.00 AM	23.9 <sup>0</sup> C	11.00 AM	23.6 <sup>0</sup> C
12.00 AM	12.00 AM	12.00 AM	25 <sup>0</sup> C	12.00 AM	23.3 <sup>0</sup> C
01.00 PM	01.00 PM	01.00 PM	25.5 <sup>0</sup> C	01.00 PM	23 <sup>0</sup> C
02.00 PM	02.00 PM	02.00 PM	24.8 <sup>0</sup> C	02.00 PM	23.4 <sup>0</sup> C
03.00 PM	03.00 PM	03.00 PM	24.5 <sup>0</sup> C	03.00 PM	23.9 <sup>0</sup> C
04.00 PM	04.00 PM	04.00 PM	24 <sup>0</sup> C	04.00 PM	24.1 <sup>0</sup> C
05.00 PM	05.00 PM	05.00 PM	23.7 <sup>0</sup> C	05.00 PM	23.8 <sup>0</sup> C
06.00 PM	06.00 PM	06.00 PM	23.5 <sup>0</sup> C	06.00 PM	23.4 <sup>0</sup> C
07.00 PM	07.00 PM	07.00 PM	23.2 <sup>0</sup> C	07.00 PM	23 <sup>0</sup> C
08.00 PM	08.00 PM	08.00 PM	23 <sup>0</sup> C	08.00 PM	22.4 <sup>0</sup> C
09.00 PM	09.00 PM	09.00 PM	22.2 <sup>0</sup> C	09.00 PM	22 <sup>0</sup> C
10.00 PM	10.00 PM	10.00 PM	21.5 <sup>0</sup> C	10.00 PM	21.7 <sup>0</sup> C

Sources: Field Survey, 2018

From the data above, it is notified that the sea level temperature of 05 February is close to each other. The data collection is started from 11 AM and the sun shines enough so that the temperature of sea water is a little high and when the sun goes to the horizon the temperature is gradually goes down.

From the data 06 February we see that highest temperature is at 01 PM because the sun and at night the temperature goes down enough.

These three graphs represent the sea level temperature variations of the selected three day in several spots of Sundarbans Reserve Forest and the highest temperature is 26.3<sup>0</sup>C which is recorded in 05 February 2018 at 04.00 PM and the lowest temperature is 20.5<sup>0</sup>C recorded which is recorded in 05 February 2018 at 10.00 PM



Sources: Field Survey, 2018

**Figure-3:** Sea level temperature variation



### Barometric Pressure

Barometric pressure, sometimes are called atmospheric pressure, is the pressure within the atmosphere of earth. In most circumstances atmospheric mass, so that atmospheric pressure decreases with increasing elevation. Pressure measures force per unit area, with SI units of Pascal's. Sea Level standard atmospheric pressure is 101.325 K. Pa. (Akbari, 2012). Atmospheric pressure varies widely on earth, and these changes are important in studying weather and climate.

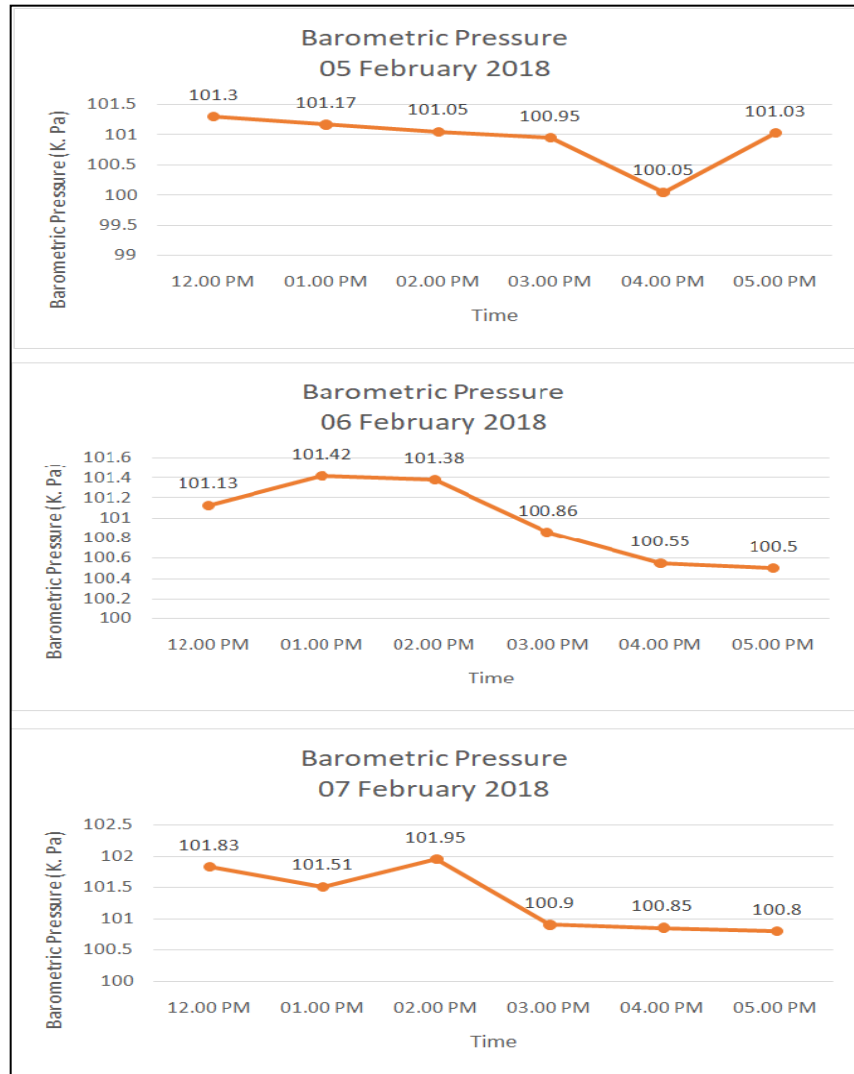
**Table-4:** Barometric pressure

Date	Time	Barometric Pressure (K. Pa)	Place	Surface
05 February 2018	12.00 PM	101.30	Dongamari	Land
	01.00 PM	101.17	Dongamari Ghat	Water
	02.00 PM	101.05	Harbaria	Land
	03.00 PM	100.95	Harbaria	Land
	04.00 PM	100.05	Harbaria Ghat	Water
	05.00 PM	101.03	Harbaria Ghat	Water
06 February 2018	12.00 PM	101.13	Kotka	Land
	01.00 PM	101.42	Kotka Sea Beach	Land
	02.00 PM	101.38	Kotka Sea Beach	Land
	03.00 PM	100.86	Hiron Point	Land
	04.00 PM	100.55	Hiron Point Ghat	Water
	05.00 PM	100.50	Hiron Point Ghat	Water
07 February 2018	12.00 PM	101.83	Karamjal	Land
	01.00 PM	101.51	Karamjal Wildlife Rescue Center	Land
	02.00 PM	101.95	Karamjal Watch Tower	Land
	03.00 PM	100.90	Karamjal Ghat	Water
	04.00 PM	100.85	Karamjal Ghat	Water
	05.00 PM	100.80	Karamjal Ghat	Water

Sources: Field Survey, 2018.

Here is the graphical presentation of the barometric data of several spots with an hour interval in land and water surface which helps to visualize the ups and downs of the pressure in the perspective of time.

The barometric pressure is related to altitude. The pressure will be high when anyone closes enough at ground or sea. But it will reduce when anyone stay with a distance from ground. The data is collected from the ship and the ship is minimum 15-20 feet in its height so that the pressure is not like the ground. But the data of 02.30 PM of 05 February and 06 AM and 03 PM of 06 February is collected from the ground level. Though there is variation, the data is collected various spot and it represent the microclimatic condition.



Sources: Field Survey, 2018.

**Figure-4:** Barometric pressure variation

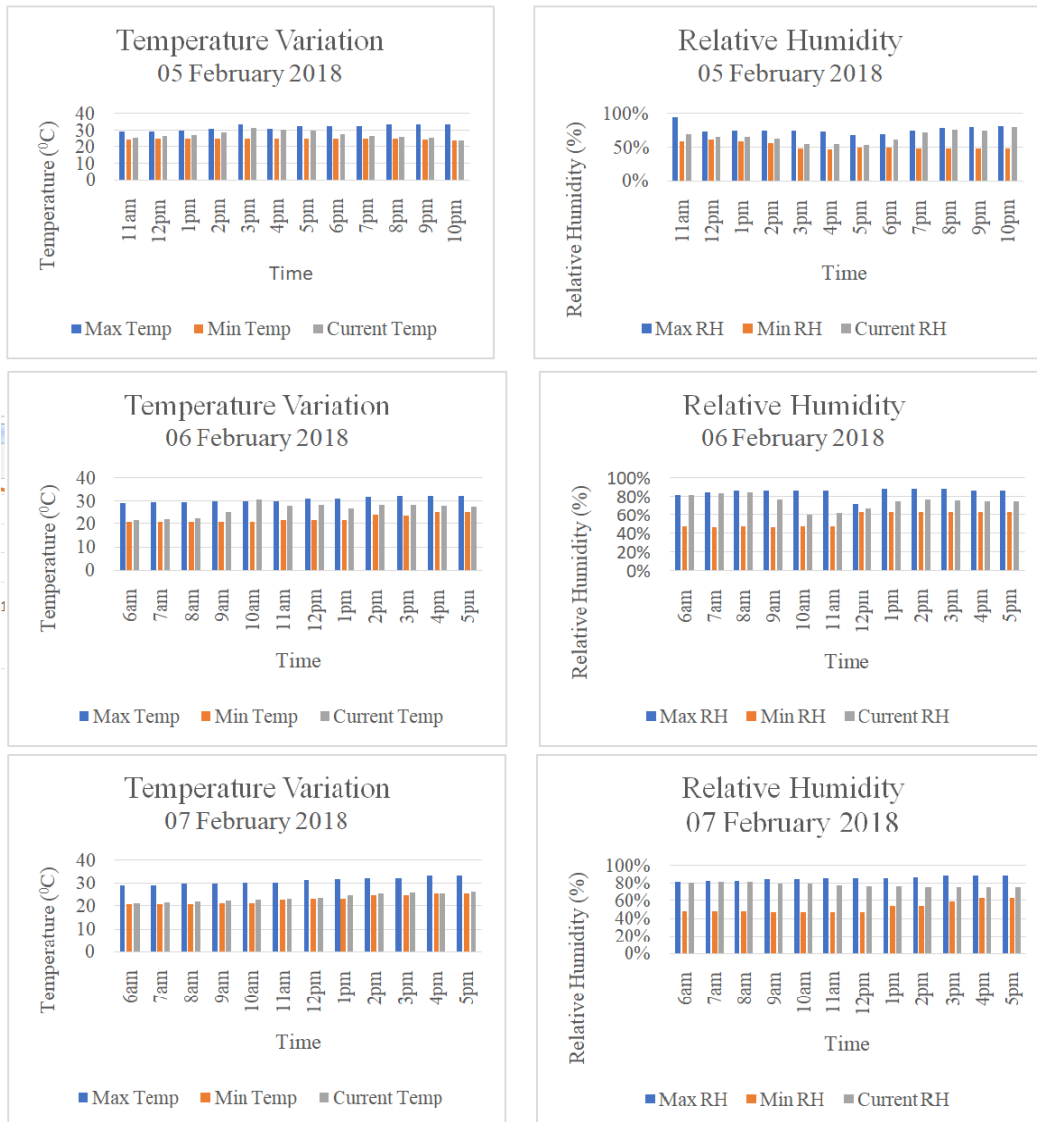
**Frequent Temperature and Relative Humidity**

Relative humidity is the amount of water vapor (vapor pressure) that is in the air. It is a percentage of how much moisture the air could possibly hold. Relative humidity is a combination function of the actual moisture content of the air, the temperature, and the barometric pressure. The amount of vapor that can be contained in the air increases with temperature (Vinet, 2000). The higher the percentage of relative humidity, the more humid (moist) the air feels, while a lower percentage usually feels drier. Saturation occurs when air is holding the maximum amount of water vapor possible at the existing pressure and temperature. Saturation is equal to 100% relative humidity, resulting in precipitation (Escourrou, 1981).

**Table-5:** Frequent temperature and relative humidity

05 February 2018							
Time	Maximum Temperature	Minimum Temperature	Current Temperature	Time	Maximum Relative Humidity	Minimum Relative Humidity	Current Relative Humidity
11am	29.3 <sup>0</sup> C	24.5 <sup>0</sup> C	25.4 <sup>0</sup> C	11am	95%	59%	69%
12pm	29.2 <sup>0</sup> C	24.7 <sup>0</sup> C	26.7 <sup>0</sup> C	12pm	73%	61%	66%
1pm	29.7 <sup>0</sup> C	24.7 <sup>0</sup> C	27 <sup>0</sup> C	1pm	74%	59%	65%
2pm	30.8 <sup>0</sup> C	24.7 <sup>0</sup> C	28.8 <sup>0</sup> C	2pm	75%	56%	63%
3pm	33.3 <sup>0</sup> C	24.7 <sup>0</sup> C	31.4 <sup>0</sup> C	3pm	75%	48%	54%
4pm	31 <sup>0</sup> C	24.7 <sup>0</sup> C	30.2 <sup>0</sup> C	4pm	73%	47%	55%
5pm	32.5 <sup>0</sup> C	25 <sup>0</sup> C	29.5 <sup>0</sup> C	5pm	68%	50%	53%
6pm	32.5 <sup>0</sup> C	25 <sup>0</sup> C	27.8 <sup>0</sup> C	6pm	70%	49%	61%
7pm	32.5 <sup>0</sup> C	24.8 <sup>0</sup> C	26.7 <sup>0</sup> C	7pm	75%	48%	72%
8pm	33.3 <sup>0</sup> C	24.7 <sup>0</sup> C	25.8 <sup>0</sup> C	8pm	79%	48%	76%
9pm	33.3 <sup>0</sup> C	24.1 <sup>0</sup> C	25.4 <sup>0</sup> C	9pm	80%	48%	75%
10pm	33.3 <sup>0</sup> C	23.8 <sup>0</sup> C	23.9 <sup>0</sup> C	10pm	81%	48%	80%
06 February 2018							
6am	29.2 <sup>0</sup> C	20.7 <sup>0</sup> C	21.6 <sup>0</sup> C	6am	82%	48%	82%
7am	29.6 <sup>0</sup> C	20.7 <sup>0</sup> C	22 <sup>0</sup> C	7am	85%	47%	84%
8am	29.6 <sup>0</sup> C	20.7 <sup>0</sup> C	22.44 <sup>0</sup> C	8am	87%	48%	85%
9am	30.1 <sup>0</sup> C	20.7 <sup>0</sup> C	25.1 <sup>0</sup> C	9am	87%	47%	77%
10am	30.1 <sup>0</sup> C	20.7 <sup>0</sup> C	30.9 <sup>0</sup> C	10am	87%	48%	60%
11am	30.1 <sup>0</sup> C	21.5 <sup>0</sup> C	28.2 <sup>0</sup> C	11am	87%	48%	62%
12pm	31.3 <sup>0</sup> C	21.5 <sup>0</sup> C	28.3 <sup>0</sup> C	12pm	72%	64%	68%
1pm	31.3 <sup>0</sup> C	21.5 <sup>0</sup> C	27.1 <sup>0</sup> C	1pm	89%	64%	75%
2pm	31.8 <sup>0</sup> C	23.7 <sup>0</sup> C	28.4 <sup>0</sup> C	2pm	89%	64%	77%
3pm	32.2 <sup>0</sup> C	23.6 <sup>0</sup> C	28.4 <sup>0</sup> C	3pm	89%	64%	76%
4pm	32.5 <sup>0</sup> C	25.5 <sup>0</sup> C	28 <sup>0</sup> C	4pm	87%	64%	75%
5pm	32.5 <sup>0</sup> C	25.5 <sup>0</sup> C	27.8 <sup>0</sup> C	5pm	87%	64%	75%
07 February 2018							
6am	29.3 <sup>0</sup> C	20.7 <sup>0</sup> C	21 <sup>0</sup> C	6am	82%	48%	81%
7am	29.3 <sup>0</sup> C	20.7 <sup>0</sup> C	21.5 <sup>0</sup> C	7am	83%	48%	82%
8am	29.9 <sup>0</sup> C	20.9 <sup>0</sup> C	21.8 <sup>0</sup> C	8am	83%	48%	82%
9am	29.9 <sup>0</sup> C	21 <sup>0</sup> C	22.2 <sup>0</sup> C	9am	85%	47%	80%
10am	30.2 <sup>0</sup> C	21 <sup>0</sup> C	22.6 <sup>0</sup> C	10am	85%	47%	80%
11am	30.2 <sup>0</sup> C	22.8 <sup>0</sup> C	23.1 <sup>0</sup> C	11am	86%	47%	78%
12pm	31.5 <sup>0</sup> C	23.2 <sup>0</sup> C	23.5 <sup>0</sup> C	12pm	86%	47%	77%
1pm	31.8 <sup>0</sup> C	23.2 <sup>0</sup> C	24.5 <sup>0</sup> C	1pm	86%	54%	77%
2pm	32.5 <sup>0</sup> C	24.5 <sup>0</sup> C	25.3 <sup>0</sup> C	2pm	87%	54%	75%
3pm	32.5 <sup>0</sup> C	24.5 <sup>0</sup> C	25.6 <sup>0</sup> C	3pm	89%	59%	75%
4pm	33.3 <sup>0</sup> C	25.3 <sup>0</sup> C	25.5 <sup>0</sup> C	4pm	89%	63%	75%
5pm	33.3 <sup>0</sup> C	25.3 <sup>0</sup> C	26 <sup>0</sup> C	5pm	89%	63%	75%

Sources: Researchers, 2019.



**Figure-5:** Frequent temperature and relative humidity

From the data table, it comes to know that the maximum temperature is gradually goes down with the time duration and the minimum temperature goes high. On the other hand, maximum and minimum relative humidity is going down and rises with the duration of time. Current temperature has ups and down though there is a pattern but the current relative humidity is going down by the flow of time.

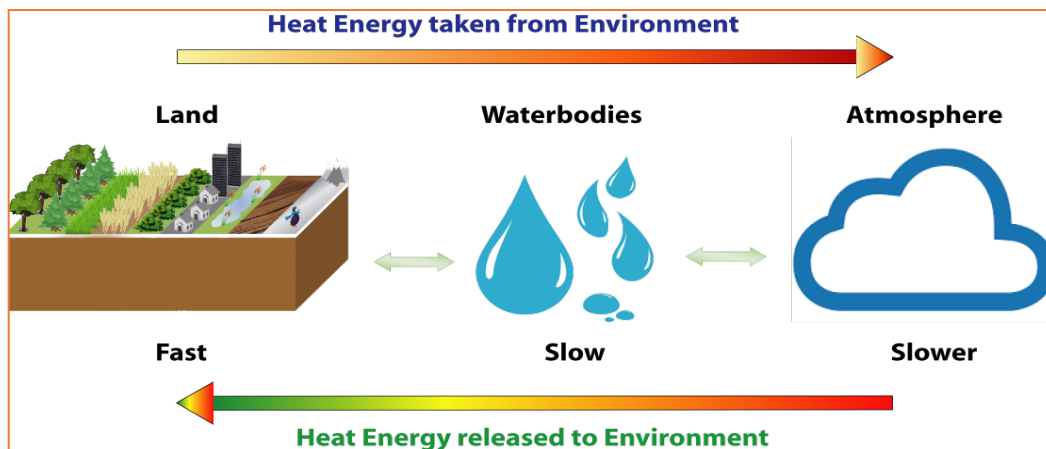
The graphs represent the maximum minimum and current temperature and relative humidity of an hour difference of three selected date in winter season. This climatic factors are responsible for the microclimate of this specific area of Sundarbans Reserve Forest.

## Findings

From the data which is collected from the field survey has a great variation but a pattern. There are some findings of these types of variations.

### 1. Temperature variation of land and water surface due to thermal conductivity:

The data collecting spots are Kotka beach, Kotka ghat, Hiron point and Karamjal . Some data are collected beside the river and some are collected inside the forest where there is no effect of river. There are also some data which are collected from the front and back part of the ship and this data varies from the temperature variation of waterbodies. Thermal conductivity of water is less than land because solid things transfer heat energy rapidly than liquid.



Sources: Researcher, 2019

**Figure-6:** Thermal conductivity of three different phases of matter.

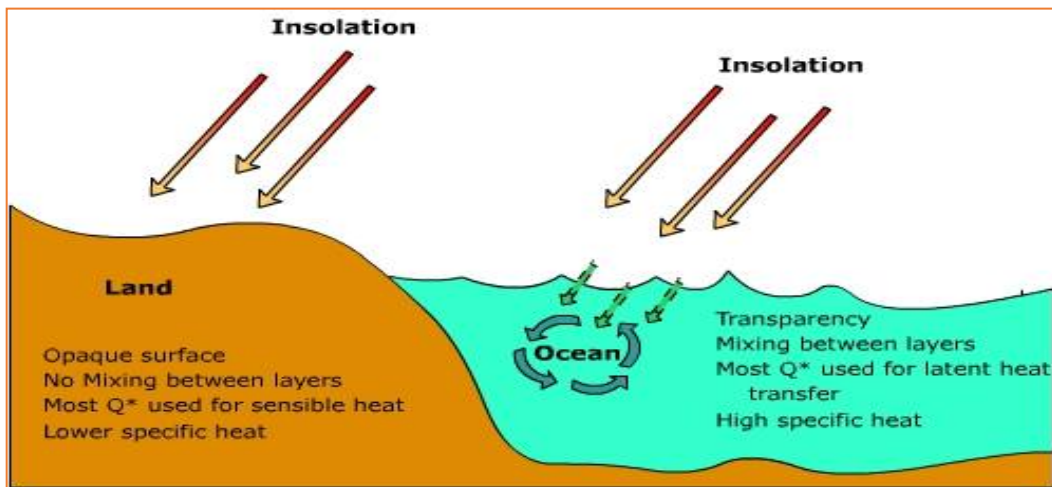
The figure represents the thermal conductivity of three different phases of matter and the heat transfer rate of them atmosphere is slower, waterbody is slow and land is faster of all. And this heat transfer rate is highly related to temperature because when a matter takes heat from environment the matter itself remains heated and the environment becomes cool and opposite happens when it releases heat to the environment (Gültekin and Alparsl, 2010).

From the figure-4 the curve of maximum temperature stay vertical when it shows the value of Kotka beach and Kotka ghat where it is connected with the waterbodies and the curve goes down to show the value of Hiron point ghat as it surrounded with vegetations which is an another point of view and finally the value rapidly upraises to represent the value of Karamjal as the data is collected from the land and no connection of waterbodies. And similarly, the average temperature curve and the minimum temperature curve shows the same pattern. So, the data which is collected from the land has a pattern different from the pattern of the data collected from the river or river bank. This is all about the reason of variation of thermal conductivity of liquid and solid particle and having this type of pattern variations.

2. **Sea and Land surface temperature variation due to surface adjacent:** The sea level temperature collected over an hour period has also some little variation because the thermal conductivity of liquid is slower than solid. But there are still some variation and has a pattern because of angle of sun shine which also indicate the rate of heating though as the data is collected in winter season. There is also another reason of this kind of variation that is related to the heat transfer from land to waterbodies and waterbodies to land and inter their state (Dimoudi and Nikolopoulou, 2003).

Air temperature is greatly affected by the location of a place relative to a large body of water. Air temperature near or over bodies of water is much different from that over land due to differences in the way water and land heat and cool. Properties that affect water temperature are:

- Transparency
- Allocation of Q (Where, Q=Heat energy)
- Ability to circulate
- Specific heat



Source: Jean, 2000.

**Figure-7: Land - Sea Contrasts**

Water is a transparent medium and land is opaque. Water allows light to penetrate to depth, leaving the surface layers cooler than they would be if the surface was opaque. A cooler water surface results in cooler air temperatures above. When solar radiation strikes land, the energy is absorbed in a thin layer that heats relatively rapidly. Likewise, it readily gives up its heat to the atmosphere (Dimoudi and Nikolopoulou, 2003).

When radiant energy is absorbed by land, most of the net radiation is used for sensible heat transfer or ground heat transfer, only small amounts are used for latent heat transfer. As sensible heat transfer into the air is the dominant heat transfer, air temperatures increase over the land. Over water, much of the net radiation is used for evaporation. With little energy used for sensible heat transfer, air over water remains cooler than that over land (Dimoudi and Nikolopoulou, 2003).

Being a fluid, water is able to freely circulate. Surface water that has been warmed by the sun can mix with cooler water at depth, thus keeping the body of water cool. Land cannot circulate warmer surface layers with cooler ones below, resulting in high surface temperatures and higher air temperatures than these over water (Gültekin and Alparsl, 2010).

Finally, the specific heat of water is higher than that of land. Water has a specific heat that is five times greater than land. This means that it takes five times more energy to heat one gram of water than one gram of land. So, if adjacent land and water receive the same amount of insolation, the water will warm much slower than land, and give up its heat much more slowly than land.

Combining the above differences between the heating of land and water, an important observation can be made. That is, air temperatures are usually lower over a water surface than over adjacent land. As this cooler maritime air comes ashore, air temperatures over land will be reduced. Because the water's temperature doesn't fluctuate as much as that of land, temperature ranges are smaller over water and coastal locations than those in the interior.

3. **Barometric pressure differences:** Barometric pressure does not vary a lot in these several spots. First of all, a microclimate study is happened in a small area and barometric pressure or air pressure varies from altitude and temperature, and it works very slowly. Here the data is collected from the land and sea surface where the action of altitude is not worked but the variation of temperature was there that's why a little bit difference of air pressure is noticed. Air pressure is all about the gravitational pull of atmosphere on earth and where the density of air is high the air pressure remains high. And temperature defines air pressure as high temperature makes air lighter and it turns move on upward that's why this place become low air pressure zone and create a vacuum (Aziz and Paul, 2015). The high dense air from high pressure zone rapidly comes and fills up the vacuum. That is so, without variation in atmospheric pressure at different locations, there would be no wind. The day time air pressure of land surface like Dongamari, Harbaria, Kotka and several spots are higher than sea surface temperature because of the temperature variations of sea surface and land surface and the opposite action is happed at night time.
4. **Relative Humidity variation:** The relative humidity is the amount of water vapor the air is holding right now as a percentage of what it would be holding if it were saturated. If relative humidity is 20 percent, for example, the air contains 20 percent of the water vapor that it could potentially hold at that temperature. If the temperature is increased, however, the amount of water vapors the air can hold increases, so the relative humidity decreases (Gültekin and Alparsl, 2010). Relative humidity (RH) is one of the most important parameters in the micro climate study. This study first collects the field data and figure out the variations of relative humidity among the spots and then investigates the relationships of RH with temperature and barometric pressure. The main conclusions are as follows. (1) Temperature is the foremost factor influencing RH, with the effect of specific humidity and direct contribution of air pollutant. (2) RH shows a prominent ups and down trend in the Sundarbans Reserved

Forest, due to temperature variations in winter season. (3) Decreasing RH was responsible for the reduction of fog days, as the data is collected in winter. (4) Increasing RH responsible for the decreasing of temperature because of holding less water vapor in air. (5) Barometric pressure is responsible for temperature variation and wind directions which directly make the difference of relative humidity.

This study provides a scientific basis for understanding the influence of climatic factors on several spots in Sundarbans Reserve Forest and draws out the variations of Temperature, Barometric Pressure and Relative Humidity and find out the reasons of following the patterns.

## Conclusion

The immense tidal mangrove forests of Bangladesh's Sundarbans Reserve Forest, is in reality a mosaic of islands of different shapes and sizes, perennially washed by brackish water shrilling in and around the endless and mind-boggling labyrinths of water channels. The site supports exceptional biodiversity in its terrestrial, aquatic and marine habitats, ranging from micro to macro flora and fauna (Ministry of Environment and Forest, 2010). It is clear that microclimates are closely tied to habitats and are important to organisms at a fine scale. As such microclimatic monitoring at taxon-specific resolutions is vital to the routine monitoring of the environment, ecosystems, and species, and how these will be affected in a changing world. While it is important to consider the potential influence of microclimates when considering climatic interactions with ecology, and conservation efforts such as the protection of microrefugia, it is a complex topic with many different potential methods available. There are a variety of questions that need to be asked at the very beginning of research planning, and which need to continue to be checked through the design process. Microclimate plays a critical role in plant regeneration, growth, and distribution in upland situations, and it is strongly expected that the same is true for riparian zones (Rahman et. al., 2015). Upland researchers have found strong relationships between the distribution of some vegetation associations and various microclimatic factors such as soil moisture, air temperature, and humidity. Others have proposed that internal water budgets, which result from rates of both absorption of water from the soil and transpiration (controlled by local temperature, light, and wind), are probably more important to plant growth than absorption alone. Others have postulated that the high productivity and diversity of plants near streams might be partially accounted for by the ideal combination of microclimate and moisture conditions. Overall, the ecological consequences of many of these fundamentally important microclimatic gradients and processes remain to be discovered and quantified for riparian environments.

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## **Error calculation of the selected maps used in the Great Voyage of Christopher Columbus**

**Khairunnahar\***  
**Khandakar Hasan Mahmud\*\***  
**Md. Ariful Islam\*\*\***

**Abstract:** The famous discovery of Christopher Columbus is ended up with a massive accident but fortunately find a successful joy. The coincident of Columbus's voyage can be explained in the view of a geographer as he miscalculated the measurement of scale and did the wrong interpretation of contemporary maps. Columbus tried to find a western route as he thought it could be a shorter distance according to his miscalculation. In this research paper, the reason behind Columbus's miscalculation procedure and his thoughts about the geographic orientation is discussed. To find the knowledge gap and difference between the two scale – Arabic scale and Roman scale; the reproduction of some ancient maps have done and the contemporary geographic knowledge gap is discussed. Ancient maps have reproduced using ArcGIS and sometimes manually to compare with real world. The comparative view of the real world and Columbus's assumed world is presented with the two scales that he got confused. A sufficient amount of literature review has done to get a clear concept about those two scales, their difference and uses. Columbus actually measured the smaller scale and thus he measured the smaller circumference of the earth which is actually similar to Ptolemy's perception. He voyaged more than he thought and reached America which he assumed as Asia. Though there is enough geographic knowledge gap during the time of Columbus; he would still got confused as he measured the smaller scale as correct if he knew the real geographic location.

### **Introduction**

Christopher Columbus is one of the famous navigators who discover America instead of Asia. And the reason behind this is – miscalculation of the circumference of the earth because different types of scale create different sizes of Earth. So it is clear that Columbus thought about Earth size in different way than the actual size (Dr. Becker, 2015).

Columbus had indeed underestimated the earth circumference following Ptolemy (Allen, 1997) and overestimated the size of the Oecumene e.g. the landmass of Africa, Europe and Asia (Sawyer, 2013). He believed that most of the world consisted of land rather than water (Petrie, 2004). This mistake led him to conclude that Asia extended much farther east than it actually did (Principe, 2011).

Both the misunderstanding (different scale and overestimation of the Oecumene) convinced Columbus enough to make a voyage to Asia towards west. Though he

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calculated a wrong measurement of scale; fortunately he found a land which he thought as Asia.

Interestingly, this small perception of the earth was adopted by many scholars as well as navigators like Columbus (Tucker, 2002). Columbus might not start his voyage if he followed the larger circumference of Eratosthenes than Ptolemy. Other geographical knowledge gaps like the undiscovered America, over estimation of land mass, extension of Asia continent etc. convinced Christopher Columbus to make his voyage. During his measurement he made his significant mistake about the measurement scale. He measured the earth circumference according to Arabic scale but when calculated the distance he mistakenly followed the Roman scale (McCormick, 2012).

Either this smaller distance made Columbus believe to adopt the Ptolemy's perception or both the statement supported each other which make him confident enough to make the voyage. Whatever it was; Columbus started his voyage believing upon his measurement and perception of the world given by Ptolemy.

The expedition of Christopher Columbus and his exploration of America was a miracle to geographers because the circumference of the earth does not support his idea to voyage toward west and the technological support was not so advanced in the time of 15<sup>th</sup> century.

The research work aimed to find out the way of thinking of Columbus on the basis of which he took the risk to navigate. To achieve the objective of the research work, two broad categories of research methods were considered.

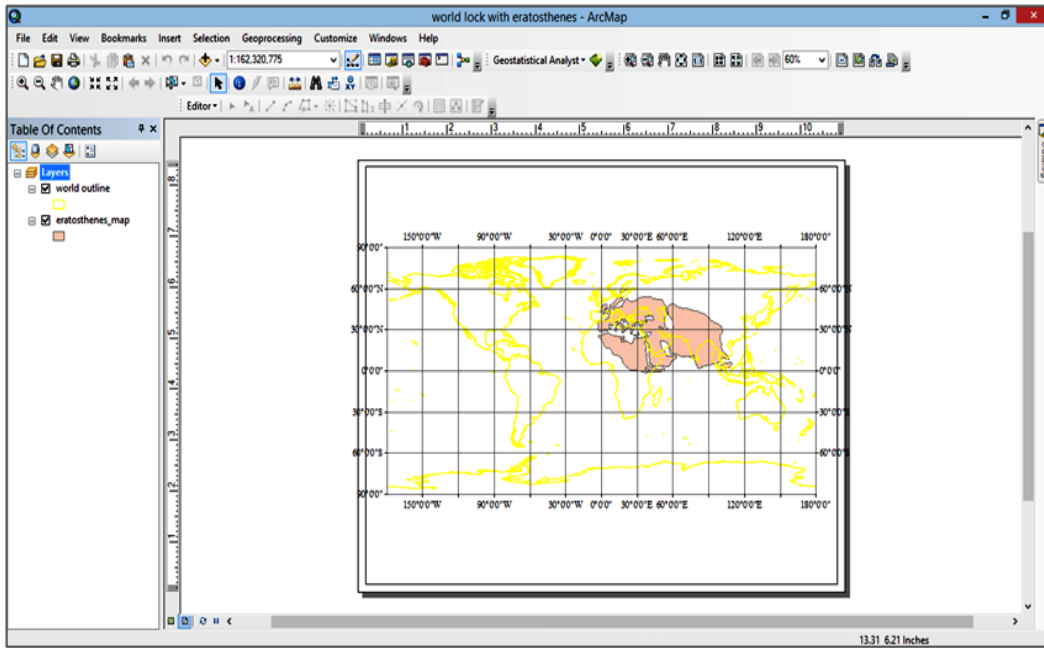
- a) In first phase, the calculation procedure of his voyage will reveal by examine the evidence from his time.
- b) And finally the importance of scale will examined by historical and present maps.

### **Data and methods**

For the purpose of the research work both qualitative and quantitative data were required. Both of the types were required for understanding the calculation procedure and contemporary geographic knowledge. By examining those data; more reliable picture of navigation idea of Columbus is expected. And these data made the methodology strong for the research goal.

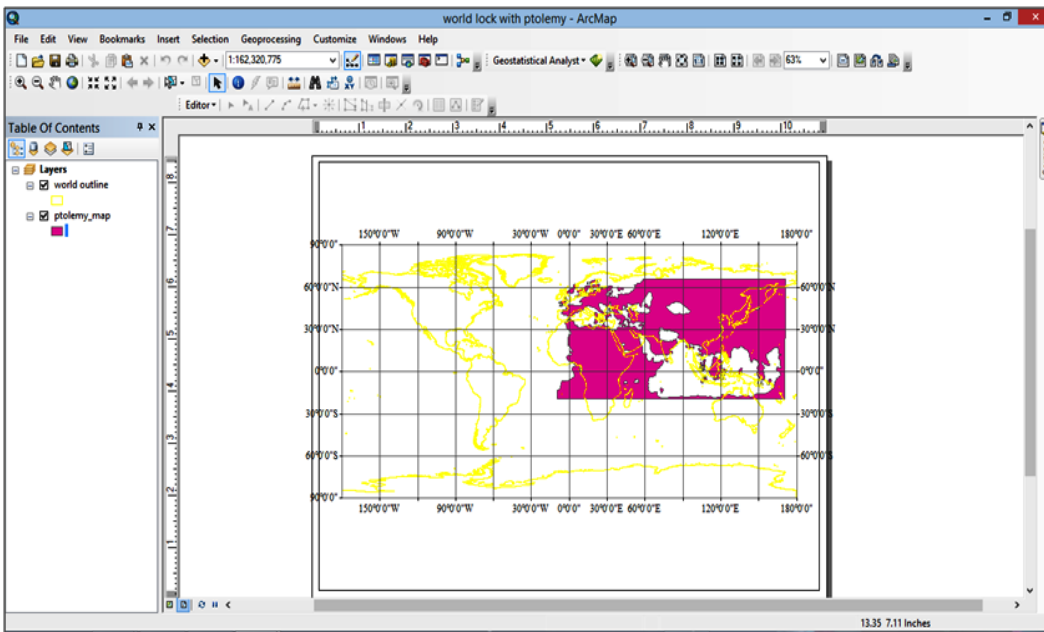
Four ancient maps has been selected, which were used for the great voyage of Columbus – these maps were, Eratosthenes's Map, Ptolemy's Map, Troscanelli's Map, and Martellus's Map. These four maps were georeferenced and digitized in simple cylindrical projection with appropriate scale.

Figure - 1: Reproduced Eratosthenes's map and world map in same view frame

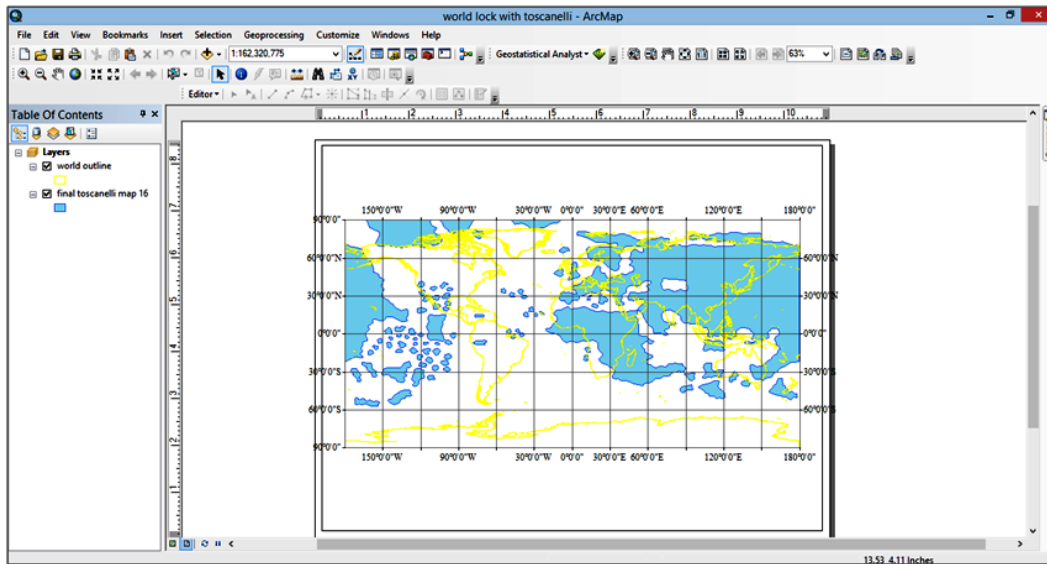


Source: Compiled by Author, 2015

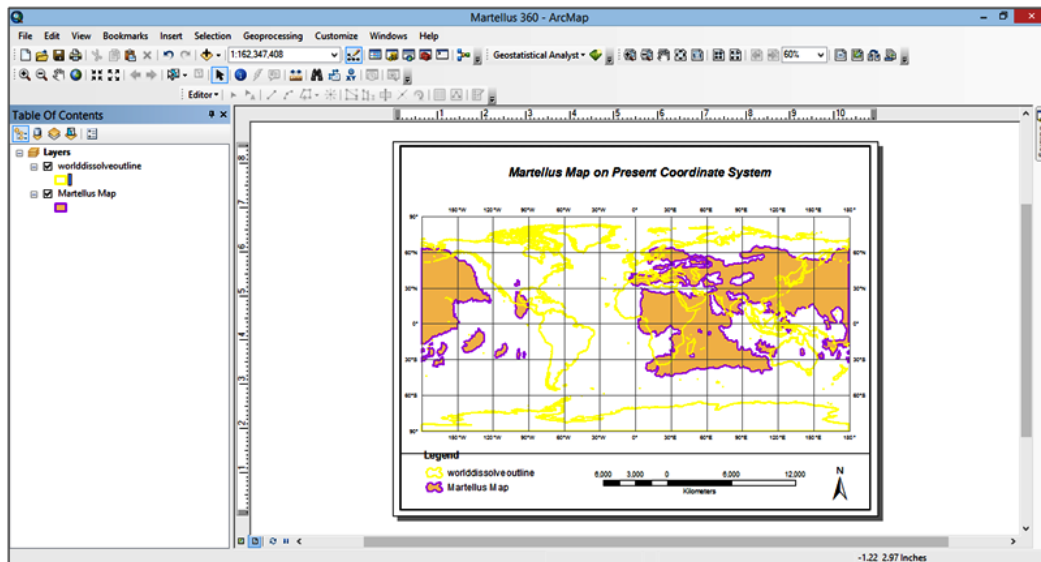
Figure - 2: Reproduced Ptolemy's map and world map in same view frame



Source: Compiled by Author, 2015

**Figure - 3:** Reproduced Toscanelli's map and world map in same view frame

Source: Compiled by Author, 2015

**Figure - 4:** Reproduced Martellus's map and world map in same view frame

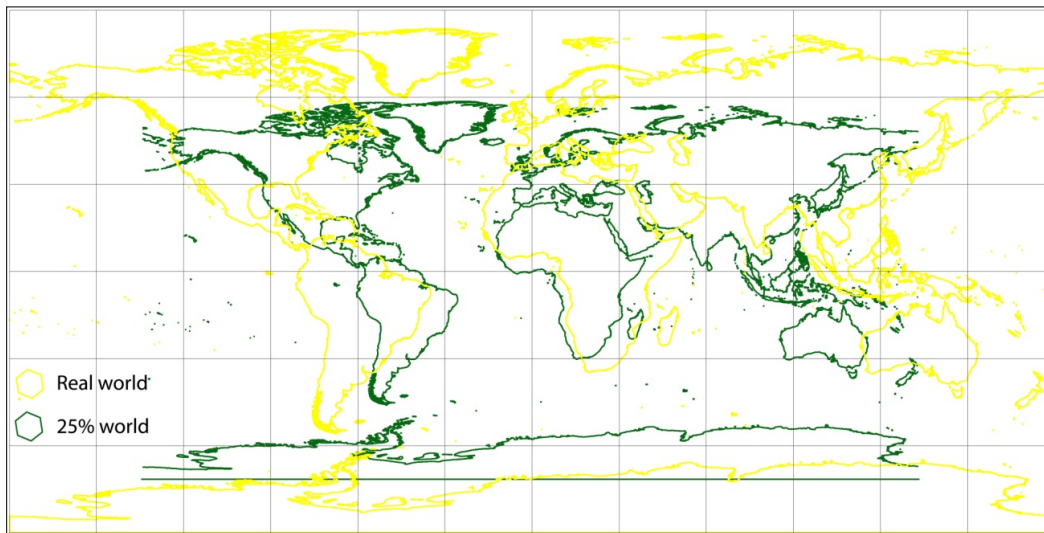
Source: Compiled by Author, 2015

It can be said that Columbus was highly inspired by those scholars and cartographers that are discussed above. It is easily understandable that they had a great knowledge gap in the terms of orientation of geographical locations. These knowledge gaps led him to take such a decision. He didn't make any decision about western route by Eratosthenes rather he was influenced by Ptolemy in many points of view from the ancient time. Again, the

geographical position of different places in the maps of Toscanelli and Martellus influenced Columbus enough to navigate from his time.

The fundamental basis of Columbus came from Ptolemy and that is reduced earth circumference. As Ptolemy calculated the circumference wrong and Columbus followed that it helped to construct the basis of navigation route. If Columbus knew about the original distance between Europe to Asia towards westward he might not navigate in western route. This knowledge gap helped Columbus to measure a shorter distance to navigate. A graphical illustration of these two circumferences of the earth is given below:

**Figure – 5:** Graphical Illustration of Present world and 25% reduced world



Source: Compiled by author, 2015

Ptolemy exaggerated the length of the Mediterranean by about 30% and thus also that of Asia which reduced the distance between the western tip of Spain and the east coast of Asia. Columbus also had no idea about America continent. So, his calculation supported the idea of extended landmass.

Columbus's hypothesis about reduced earth circumference, a world without America continent and exaggerated Asia continent gave him a base to make a plan about western route. The positions of different geographical location by different cartographers helped him to calculate about the distance of his destination. By addition of miscalculation confirm him to do according to his plan.

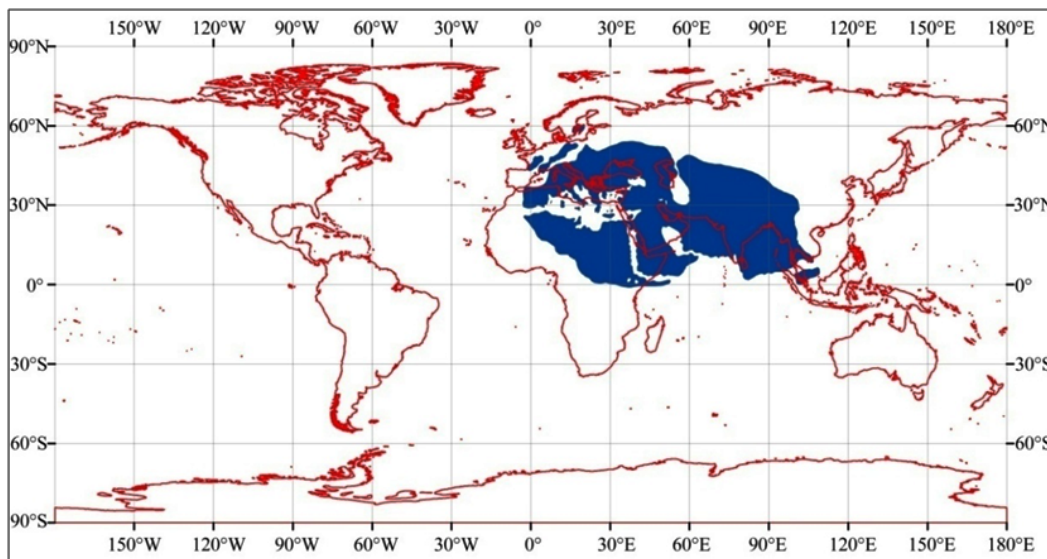
### **Data analysis and presentation**

There are two types of error that Columbus had done. One of them was lack of knowledge about the real world. Cartographers from past didn't know much. That is why their maps showed only their known world. And another error was miscalculation which he had done by his own due to misunderstanding.

### (a) Eratosthenes's world and present world

A graphical illustration of comparative location may easily understandable to comprehend the knowledge gap. The real world is much bigger and way more habitable than Eratosthenes thought (Figure-6. Though Eratosthenes calculated the earth's circumference with a negligible error, he didn't believe the world as habitable as today. Here, Eratosthenes world map is placed as it is. The prime meridian of Eratosthenes's world is gone through the Alexandria which is today's 30° E. The present prime meridian is gone through Greenwich. So, it can be said that his map location displaced every 30°. If Eratosthenes map reproduced into present prime meridian every place will be located with a difference of 30°.

**Figure – 6:** Presentation of Eratosthenes's world on present prime meridian



Source: Compiled by author, 2015

By standardized the world map of Eratosthenes it is shown that not only his circumference was nearly accurate but his knowledge of the orientation of the world is also clear considering his period.

It is shown that he didn't extend the landmass of Africa because it is used to think that no one can live below Torrid Zone. His landmass of Africa didn't cross 0° of latitude. Again, after placing his world in present prime meridian it is also noticed that his extension of Asia is not extended as Ptolemy or his following cartographers.

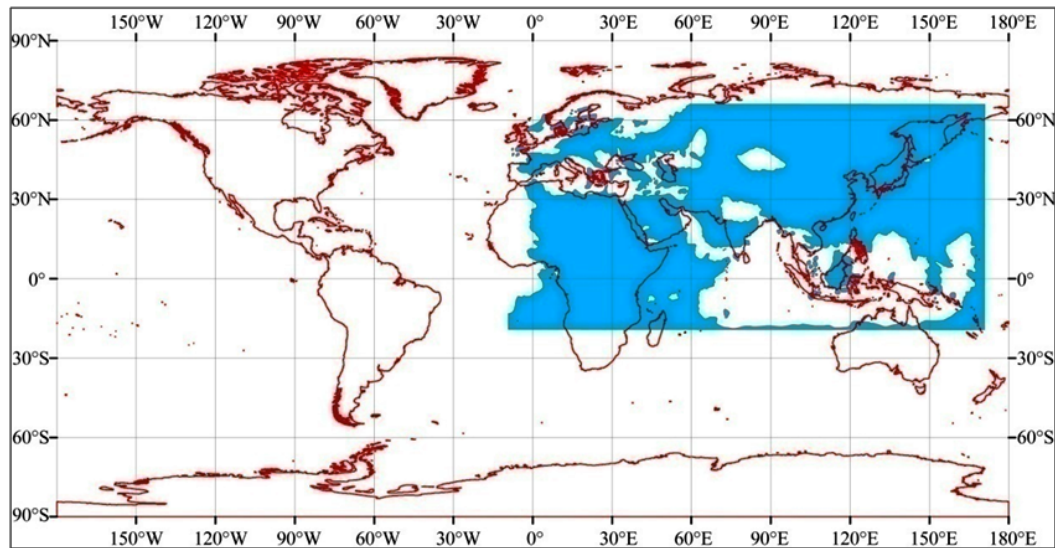
### (b) Ptolemy's world and present world

Ptolemy influenced Columbus the most in many ways. His concept of extended landmass influenced cartographers until Columbus discovered new landmass. Cartographers after Ptolemy followed the idea of extended landmass in different forms. But Ptolemy imagined the world with other unrealistic feature. He believed on continues landmass which join the Africa and Asia to keep the balance of total landmass. Ptolemy put his

prime meridian in Canary Island. After that Canary Island was considered as prime meridian. Canary Island is today's 15° W.

It is seen that Ptolemy considered the African continent extended as it is. But he also thought the Asian continent as extended as it covered up to 180°E. He considered the length of Mediterranean exaggerated about 30% that it cross 60°E. He put his Middle East in present South Asia. Beside that he put his prime meridian in present 15°W. So, every location in his map displaced with a difference of 15°.

**Figure – 7:** Presentation of Ptolemy's world in present prime meridian



Source: Compiled by author, 2015

It is seen that Ptolemy presumed about the extension of Asia that cover the Oceanic part of the world. As he put his prime meridian 15° W, the replacement of prime meridian displace the location from previous position. His extended Asian continent reduced the distance from distance between the western tip of Spain and the east coast of Asia. Ptolemy not only extended the landmass, he also dominant the circumference of the earth which make the distance navigable.

### (c) Toscanelli's world and present world

Toscanelli produced his world map in 1474. Cartographers from his time was greatly influenced by Ptolemy that they drew the world map with extended Asia continent. From the result of tremendous voyages; they got a shape and idea about Africa continent. The navigators also discovered many oceanic island and islands of Asia continent including Japan (Chipangu). Toscanelli drew all of those in his map; putting the prime meridian in Canary Island by following Ptolemy. Bu by comparing the real world and Toscanelli's world; their knowledge gap may clearly identify.

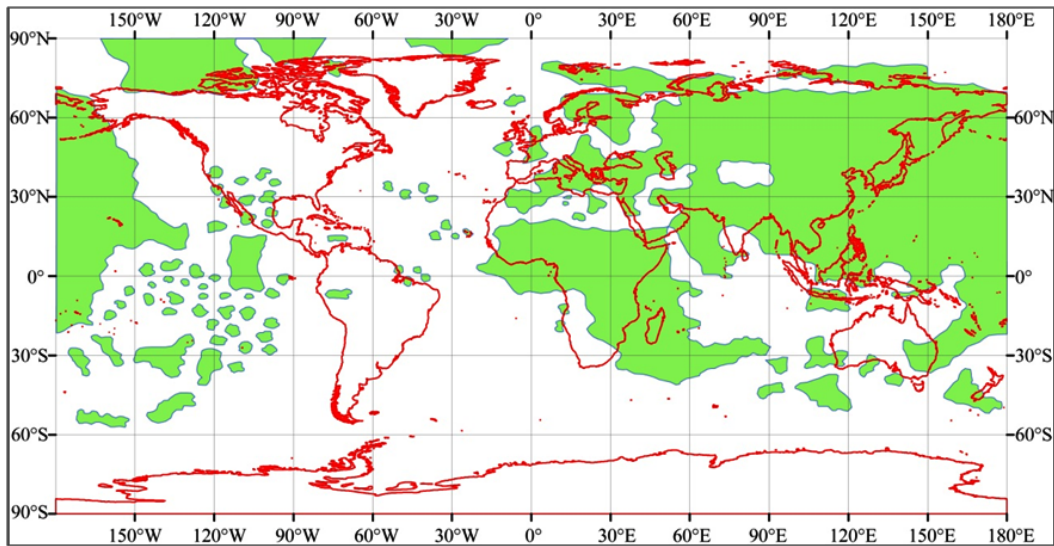
Here it is seen that Canary Island is went through prime meridian. He considered that the habituated landmass covered 360° with a little percentage of Ocean. Like Ptolemy, Asia continent is extended enough to nearly touch the Atlantic islands. Actually, he drew a



landmass over the Ocean and put some islands in the continent of America. Africa continent also displaced enough from real.

If current prime meridian represent as the same prime meridian in Toscanelli's world, the figure would be represented as below:

**Figure – 8:** Presentation of Toscanelli's world in present prime meridian



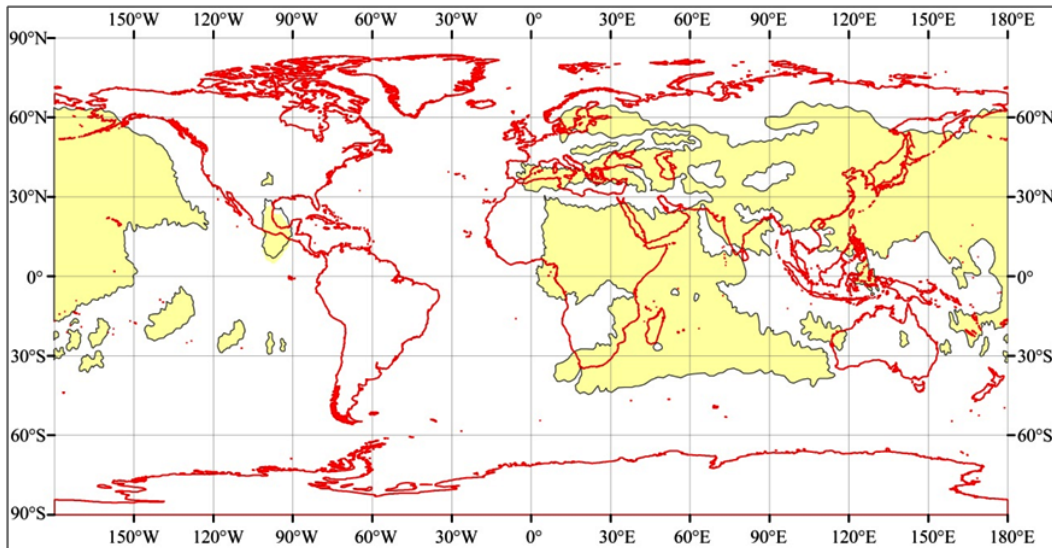
Source: Compiled by author, 2015

Toscanelli's world in present graticules system represent that he didn't imagine any landmass in the area of America continent except some of islands. Asia continent is still extended more than 240°. The calculation of oceanic distance influenced Columbus from Toscanelli's map.

#### **(d) Martellus's world and present world**

Martellus's map is one of the significant maps in the history of Columbus's discovery. In Martellus's map he showed or indicated some of the important feature that helped Columbus to assemble the total plan to navigate. He extended the Africa continent up to 45° S. His location of Japan (Cipangu) is significant and important which is clearly identified.

Martellus's map is also influenced by Ptolemy that he also exaggerated the Asia and Africa continent. By comparing his world with present world show us how different they think from today.

**Figure – 9: Presentation of Martellus world and present world**

Source: Compiled by author, 2015

Martellus Africa continent is much bigger and more displaced than today. Asia continent also extended much that it shows Middle East in the location of today's South Asia. It seems that Martellus considered his prime meridian as today. Because he didn't draw Canary Island in his map rather put his prime meridian like today's place. He ignored the Atlantic islands except the islands of Asia. It is clearly seen that Japan exactly drew where Columbus intended to land. Martellus left 90° space as Ocean.

From the above discussion and interpretation of two world view indicate that the knowledge gap of contemporary time influence Columbus much. But not only these made him confident enough to navigate but also he made miscalculation of his own.

### Miscalculation of Columbus

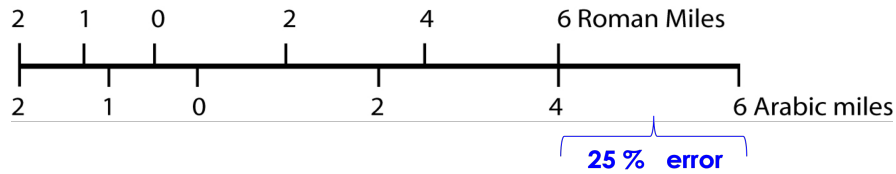
In the terms of calculation, Columbus followed the values of degree which was given by the medieval Persian geographer, Abu al Abbas Ahmad ibn Muhammad ibn Kathir al-Farghani; popularly known as Alfraganus in western. Columbus assumed  $1^\circ = 56.67$  mile at the equator (McCormick, 2012). Here is Columbus's first error or miscalculation that it is actually  $1^\circ = 69$  mile in present (Danson, 2006). He considered around 18% smaller mile than actual.

$$1^\circ = 56.67 \text{ mile}$$

$$\text{So, } 360^\circ = 20401.2 \text{ mile}$$

But when he calculated for his voyage, he mistakenly followed the Roman scale. As the Roman scale is smaller than Arabic scale, he actually measured the smaller distance (McCormick, 2012).

He used the **4856-foot Roman mile** instead of the **7091-foot Arabic mile**.



1 Roman mile = 0.92 mile (present unit)

1 Arabic mile = 1.22 mile (present unit)

1 Roman mile = 0.75 Arabic mile

According to Arabic scale,

$$1^{\circ} = 56.67 \text{ mile}$$

As, in present unit 1 Arabic mile = 1.22 mile

$$\text{So, } 56.67 \text{ mile} = 56.67 \times 1.22 \text{ mile} = 69.1374 \text{ mile}$$

So, in the terms of  $360^{\circ}$  it would be  $(360 \times 69.1374) = 24889.5$  mile which is much nearer to present circumference of 24901 mile.

According to Roman scale,

$$1^{\circ} = 56.67 \text{ mile}$$

As, in present unit 1 Roman mile = 0.92 mile

$$\text{So, } 56.67 \text{ mile} = 56.67 \times 0.92 \text{ mile} = 52.1364 \text{ mile}$$

So, in the terms of  $360^{\circ}$  it would be  $(360 \times 52.1364) = 18769.1$  mile which is Columbus actually measured and this measurement is 25% reduced than the real circumference of the earth.

Ptolemy used the circumference of the earth 18,000 mile in his book "Geographia" (Morritt, 2010). As Columbus read Ptolemy's "Geographia" (Adhikari, 1992); it can be said that he may be convinced with such a measurement.

Now, it may conclude that Columbus made some mistakes in both the terms of theory and mathematics.

- He ignored the earth circumference calculated by Eratosthenes and followed the smaller perception of the earth circumference given by Ptolemy.
- He considered  $1^{\circ} = 56.67$  mile rather than 69 mile which is 18% smaller.
- He miscalculated the Arabic scale and used Roman scale for his voyage which is 25% smaller.

As he considered a scale which is smaller than the actual, the oceanic distance that he gathered from previous navigators or contemporary maps would be smaller or with wrong measurement.

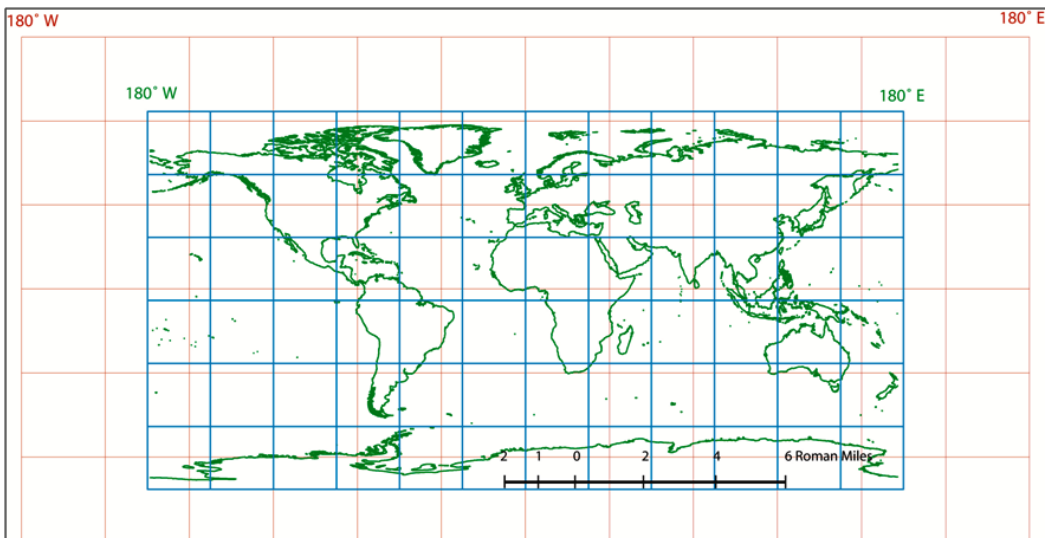
### **Change of the size of world map according to change of scale**

The famous mistake Columbus had done is that he measured the scale which is 25% less than it supposed to be. Columbus considered the world  $360^{\circ}$ , believed the circumference of the earth as smaller as Ptolemy and additionally miscalculated the measurement of scale which got match with all of his idea.

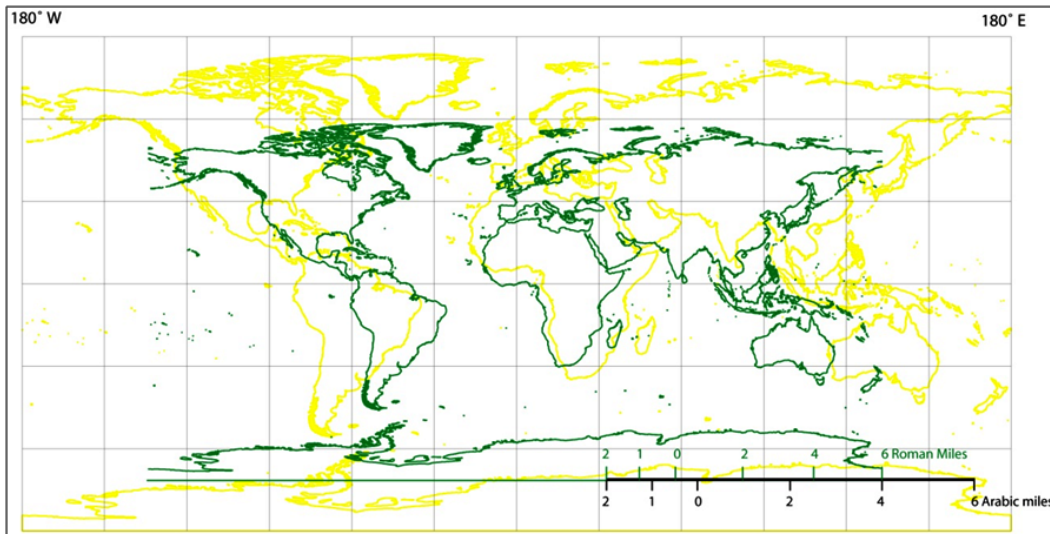
Here, outer grid line shows the real graticules interval which is compared with Columbus's 25% reduced world. The scale according to roman scale is showed by which it can be compared that the difference of measurement of scale can change the size of real world. This could make a massive mistake in the terms of calculation of measuring distance. Columbus also divided the world into 360° but as he measured with a smaller scale; he actually voyage a shorter distance than he thought. And this shorter distance kept the balance with Ptolemy's perception.

According to Arabic scale, the size of the world should be different than Columbus's assumption. If Columbus did the correct measurement; the distance from one place to another would be different than Columbus's thought or the circumference gave by Ptolemy.

**Figure – 10:** Columbus's world according to Roman scale



Source: Compiled by author, 2015

**Figure – 11:** World view according to Arabic scale and Roman scale

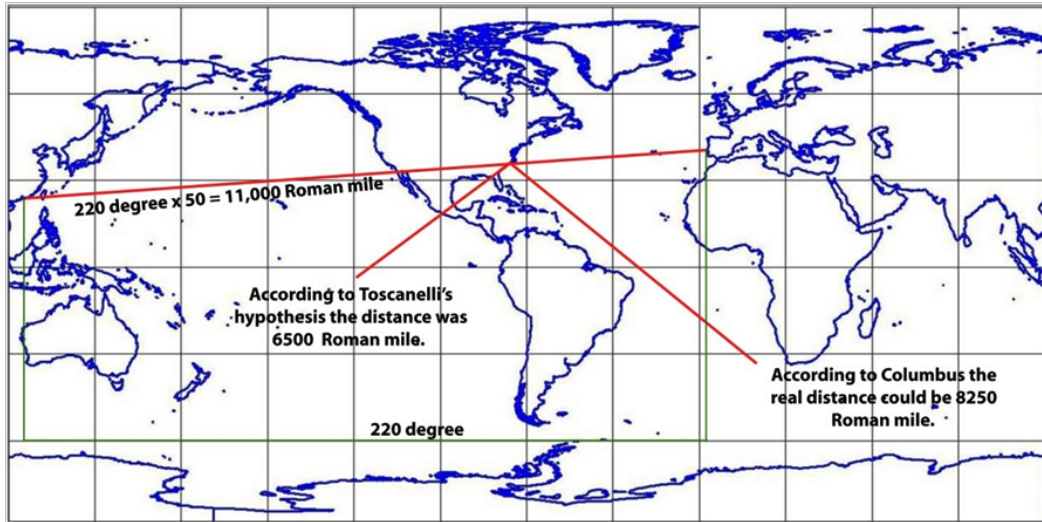
Source: Compiled by author, 2015

The comparison between these two world maps gives a clear view about the significance of measurement of scale about how geographical size can be changed with the changing of scale.

### **Significance of scale in Columbus's voyage**

To understand the significance of scale; other error that Columbus did should consider as correct as present day. If there is no other error except the miscalculation of measurement of scale; what would Columbus do?

In Toscanelli's map, the distance between Lisbon and China is about 220°. Toscanelli calculated the distance 6500 Roman mile because he believed that the distance between these two was 130°.

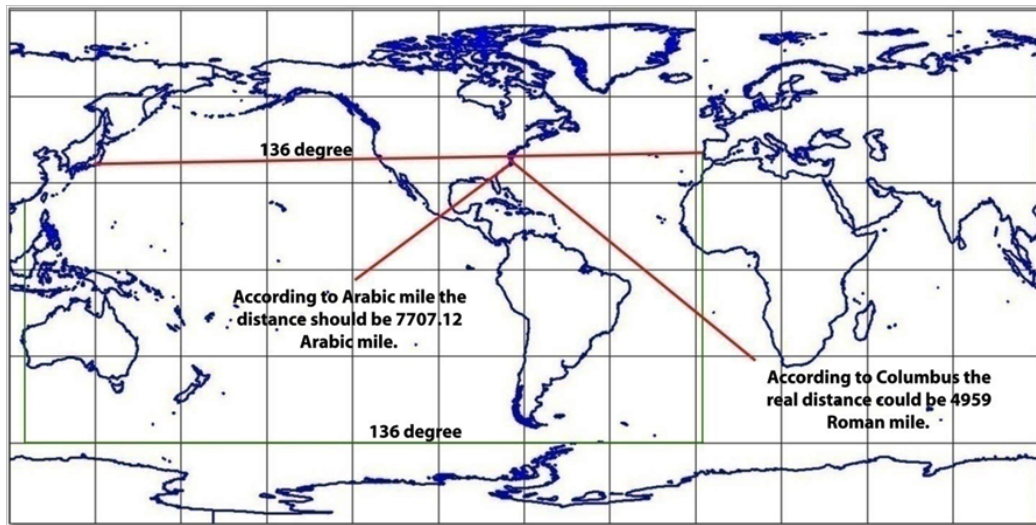
**Figure – 12:** Real distance from Lisbon to China according to Toscanelli's concept

Source: Compiled by author, 2015

In reality the distance is around  $220^\circ \times 50 = 11,000$  mile according to Toscanelli's map. If Columbus knew that the real distance between two is actually  $220^\circ$ , the same problem of smaller scale would be happened. If Toscanelli didn't make the mistake; Columbus himself would have made it because he calculated the distance 25% less. So, Columbus would assume the distance as 8250 Roman mile.

In Martellus's map it is shown that the difference between Lisbon and Japan is  $85^\circ$ . As, Columbus considered that  $1^\circ = 56.67$  mile, so the distance between these two would be 4816.95. But Columbus calculated the distance 25% less so he calculated the distance as 3612.7125 mile.

**Figure – 13:** Real distance from Lisbon to China according to Martellus's concept



Z

Source: Compiled by author, 2015

Actually the difference between Spain and Japan is  $136^\circ$  and the distance between them is 6612 mile. If Columbus knew the true distance he would have calculate the distance 25% smaller. As, he calculated  $1^\circ = 56.67$  mile, so  $136^\circ$  will be 7707.12 mile which Columbus would be calculated 4959 mile.

So it can be easily understand that if Columbus didn't have the knowledge about the geographical orientation of the world; he would not reach or ever start a voyage by the western route to Asia due to having the miscalculation of scale.

## Conclusion

So the concluding remark of this research paper is that the significance of scale is not a matter of negligence. Because from the ancient time, the knowledge of geography have grown day by day and to measure this big world a unique unit is needed.

But it took a long time to come to an end about this unit of measurement which is called map scale. Different country used different unit of measurement and made some misunderstanding like Columbus.

Columbus is considered as the luckiest navigator who would have faced any kind of trouble if there is actually no continent. The geographical position of America Continent and the miscalculation of Columbus did pretty match which coincidence made Columbus successful.

Though he successfully landed on a landmass that he considered as Asia but the calculation also has done that the conception of smaller scale would not appropriate if he knew the actual distance of real world. If Columbus knew the real geographical position

or didn't made the miscalculation between Arabic scale and Roman scale; he would not start his journey.

Now every country of this world follow a unique scale that  $1^\circ = 69$  miles and the representation of map scale is clear and easier than the previous. To present a map scale on a map there are several ways by which no one get confused about that.

Columbus did his significance mistake not only due to smaller scale but also he had a limited idea about the orientation of geographical location. But the measurement of scale have got extra emphasis because if Columbus knew the real orientation of geographical location; he would do the same kind of mistake if he keep the concept of smaller scale.

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## Geographical Assessment of the Vulnerability of Natural Resources in St. Martin's Island

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**Abstract:** This paper investigates the vulnerabilities of key natural resources in St. Martin's island using participatory approach. Though the St. Martine Island- the only coral island in Bangladesh was declared Ecologically Critical Area (ECA) in 1999, both natural and mass anthropogenic interventions along with unregulated tourism has become detrimental for the health of this unique ecosystem. As participatory approach incorporates local participation thus provides a means of engaging local resource users and stakeholders in natural resource management, therefore, based on different participatory methods this research performed three interlinked objectives. At first, it identifies the key natural resources in the island that the community people revealed most valuable to them. Secondly, it examines the spatial extent of the identified key resources in relation with the general land use of the island. Finally, it assesses the vulnerability of the resources of the study area in relation to the extent of their exploitation including the possible causes of different level of vulnerabilities of the key resources as the community people perceived. The present research also puts forward some recommendations on how to limit the over exploitation of the resources and valuable ecosystem services as an integrated as well as sustainable way.

**Keywords:** Saint Martin's Island, coral island, resource inventory, resource vulnerability, participatory approach.

### Introduction

The St. Martin's Island is the only coral Island in Bangladesh. Located at the south most corner of the country and the northeastern part of the Bay of Bengal, this unique island is a natural treasure that attracts thousands of tourists every year. The island's unique land and marine resources having a significance of global biodiversity (Hoque et al., 1979). Endowed with a variety of physiographic features such as rocky platform, sandy beach, sand dune, lagoon and marshes as well as the biological organisms like corals, sea turtle, sea algae and fish make the Island ecologically significant (Hossain et al., 2007). The St. Martin's Island is not only significant for its biodiversity value, but also important for Bangladesh in defining its Exclusive Economic Zone and delineating its sea boundary in accordance with the United Nations Convention on the Law of the Sea (UNDP, 2010).

However, the island was fully environmentally alive before the commencement of mass anthropogenic intervention such as unsustainable resource use, degradation and loss of key habitats, overexploitation, pollution and biodiversity loss which are now-a-days in their highest forms in the island (Haque et al., 2015). Along with, unregulated tourism has

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become detrimental for the health of this unique ecosystem (ibid). Though the island was declared Ecologically Critical Area (ECA) in 1999 (Hasan, 2009), in recent statistics showed that in four months peak tourist season from November to February in every year, at least 10,000 to 20,000 tourists visit St. Martins Island daily and stay there overnight, posing a big threat to the country's only coral island (The Daily Independent, 2018). Several studies have found that already some negative impacts have emerged. Khan (1985) noticed that Saint Martin's coral resources were started to vanish. Islam and Islam (2008) also supported such finding and stated that though commercial coral collection began in the 1960s, it is now the professional activity of a few families. Similar findings also found in Tomascik's (1997) research. Feeroz (2009) showed that a number of fish species are being over-fished, resulted alarming reduction of the fish and fisheries diversity in the present days. Ansari et al. (2006) showed sever environmental impact of tourism both in natural and social environment of the island. Haque et al. (2015) pointed that pollution are undermining long-term sustainability of marine ecosystems and livelihoods in this island. Ahmed (2011) major cause of recent deforestation in this island is the clearing of vegetation including mangroves to make claims on land by local people. Research also showed that the effects of global climate change pose significant threats to the biodiversity of St. Martin's Island, in particularly the most noticeable damage caused by high sea temperature is coral bleaching. Rahman (2009) showed that when the sea temperature rises above 28 °C, the coral expels the algae and consequently it starves. On the other hand, considering the socio-economic condition, Touhiduzzaman<sup>1</sup> and Rahman (2017) examined that the incidence of poverty and migration rate are rising in the island. As the rate of overexploitation is gaining momentum, natural resources were degrading and in the near future, the community will suffer from a livelihood crisis. They recommended that unless tourists visiting St. Martin's Island quickly adopt ecologically responsible behavior, the unique flora and fauna of the Island that has experienced tragic changes over the last two decades would continue to be degraded. Upal (2015) added that other supplementary issues such as over population, poor agricultural custom, water pollution, construction activities, and harmful boat anchoring practices are demanding strict conservation practices inevitable to protect the marine and land resources of the island.

In such context, this research argues that for the sustainable utilization of the island's resources, a community based update inventory regarding the vulnerability of key resources along with their condition is highly needed. As the management of marine and coastal ecosystems is an inherently place-based process (Koehn, Reineman, & Kittinger, 2013), place-based approaches are seen as critical to addressing many of the challenges inherent in managing these complex social-ecological systems (Young et al. 2007). Elsewhere, social data is increasingly recognized as an important component of marine ecosystem planning and management (Kittinger et al. 2014). In such perspective, participatory approach, which incorporates local participation to identify and develop spatial information, provides a means of engaging local resource users and stakeholders in data gathering and natural resource management (Craig, Harris, & Weiner, 2002; Dunn, 2007). Participatory approach can also improve community trust and local buy-in regarding both the validity of the data created and of management actions, integrating local and 'indigenous' knowledge with scientific or 'expert' data (Dunn, 2007). Keeping this view, this paper geographically attempt to examine the vulnerabilities of the key natural

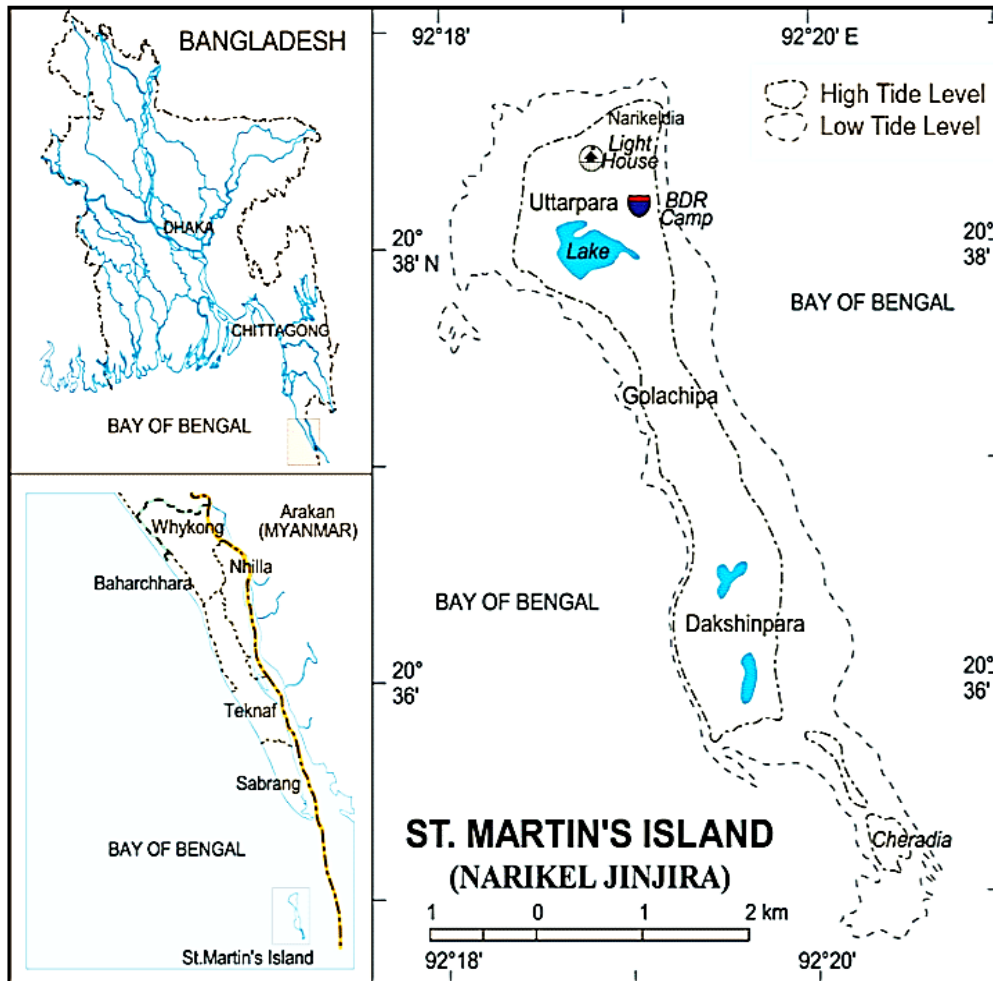
resources of St. Martin's island through well-adopted Participatory approach. The inventory may help to increase the community awareness about resource exploitation and can build the potentiality of the community to judge any activity that is harmful to the island, recognizing that people and human behavior comprise an important, but often under-examined, component of these complex systems (De Young, Charles, & Hjort, 2008).

### **Objectives**

This paper investigates the vulnerabilities of available key natural resources in St. Martin's island using participatory approach. Therefore, the first objectives of the study is to identify the key natural resources in the island that the community people revealed most valuable to them. It also examine why they are key resources to the people of this island. The second objective of the study examines the spatial extent of the identified key resources in relation with the general land use of the island. The focus thereby gives to prepare land use map, land type map and then locates the hotspots of key resources in terms of their existing abundances. Finally, in third objective this research assesses the vulnerability of the resources of the study area in relation to the condition and extent of their exploitation. Such examination also includes the possible causes of creating different level of vulnerabilities of the key resources as the community people perceived. The present research also puts forward some of the issues as form of recommendation in order to reduce the vulnerability of the key resources of the island an integrated as well as sustainable way, thus limiting the over exploitation of the resources and valuable ecosystem services that support all sorts of human welfare.

### **Geography of the St. Martin's Island: A brief overview**

The St. Martin's Island is located at 20034' N to 20039' N and 92018'E to 92021'E (Map 1) and is situated about 10 km south of the southern tilt of Teknaf peninsula and 34 km from Teknaf mainland in Cox's Bazar district (Islam, 2002). This small island is separated from the mainland by about a 9 km wide channel. The island is a dumbbell-shaped island having 7.8 km length and 1 km width. The surface area of the island is about 8 km<sup>2</sup> during low tide and 5 km<sup>2</sup> during high tide (Tomascik, 1997).



Map 1: Geographical Location of the St. Martin's Island.

Source: Banglapedia, 2010.

There is a shallow continental shelf in the island having a maximum depth of 25m whereas the maximum depth of coast is only 10m (Haider, 2008). The St. Martin's Island is locally known as *Narikel Jinjira* (Coconut Island) as the beaches are fringed with coconut palm (Hasan, 2009).

The Island is sedimentary continental in nature with continental base rocks and submerged coral associations. The 100-500 m wide coastline of the island is fringed by a rocky intertidal habitat consisting of small and large boulders and relatively rare coral boulders. The presence of relatively well preserved dead coral colonies in the upper and middle intertidal zones denotes that the island has been uplifted in relatively recent times (Tomascik, 1997). The island is accessible only by boat/ship from the town of Teknaf (Haque et al., 2015). The island is divided into three broader sections: the Northern Uttarpara, the Southern Dakshinpara, and the Southernmost tip Cheradia. Uttarpara is

connected to the southern part of the island by a narrow neck of land called Golachipa. The area just after South of Golachipa is Madhyapara, followed by Dakkhinpara. An intertidal rocky reef extends about 1.8 km South from Dakkhinpara, locally known as Cheradia which supports three vegetated sand islands and is connected to the Southern part of the island at low tide. A narrow sand belt consisting of alluvial sands and littoral carbonates, accumulated on top of the rocky intertidal reef, connects Cheradia with the main Island.

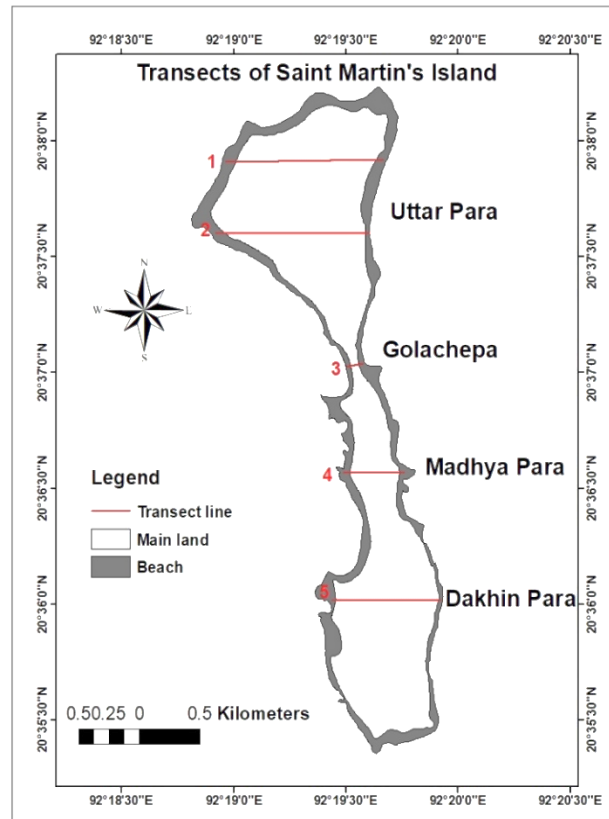
The island enjoys the subtropical monsoon climate that prevails over Bangladesh but is much influenced by the sea. Cyclone and storm surges are very common natural disaster occurred between April and May and sometimes in October which cause severe damage (Ansari et al., 2006). Currently, the island has a total population of 7000 inhabitants (BBS, 2010). People largely inhabit Uttarpara. The primary livelihood activities are fishing, agriculture, seaweed collection, coral harvesting, coconut selling, mollusc shell collection and associated businesses. Of whom about 90% are fishermen (Haider, 2008), and the mostly populated part in Uttarpara. Planted trees particularly coconut tree, have replaced the original vegetation. Some timber yielding plants are also there. Anthropogenic activity is mainly concentrated on this part of the island.

## **Methodology**

This research adopted people-oriented participatory approaches all through from data collection, data rectifying and finalizing the result. An in-depth assessment of the dependency on the valuable natural resources of local stakeholders with livelihood groups e.g., fishermen, farmers, resource collectors, businessmen, hotel/motel owners, local NGO/CBO representatives and local government officials, educated and elderly people (both terrestrial and marine were performed using the dominated methods such as transect mapping, pile sorting with focus groups, and social resource vulnerability mapping. Total 20 community people from different folks and 6 institutional representative were participated in this research. Two field survey were performed in two different seasons i.e. non-tourism season (March, 2018) and tourism season (December, 2018) because in non-tourism season resources can be found in their natural condition while in the tourism season they became vulnerable due to excessive tourist.

The authors made detailed observation of the distribution and state of natural resources of the island including the intertidal and subtidal zones. All observations were geo-located, using hand-held GPS and topographic map so that they could subsequently be related. To produce useable outputs, observations were recorded as drawings and notes. An important way of learning about local conditions and resources is to ask local communities what they know (Pelto and Pelto, 1978). Direct observation prevents rapid appraisal from being misled by myth (Chambers, 1980) and it often provides more valid and less costly information than other research methods (KKU, 1987). Detailed land cover and land use patterns were obtained from two field visits covering the surrounding of the whole island. The elevation data of the island was also collected by using Google Earth Pro and justified through GPS readings during the fieldwork. Digital Elevation Map (DEM) was the prepared through ArcGIS (10.5 version).

Participatory Resource mapping with different stakeholder groups was then used to gather primary information following Pido (1995), Pido et al., (1996), Townsley (1996), IIRR (1998), Hossain et al., (2004; 2006). The stakeholders first identify the key resources of the island and then ranked based on three aspect like environmental importance, ecologically important and socially importance. Pile sorting method was used in this regards. Participants were asked to sort interventions for key resource identification based on their likelihood of using those resources and subsequently describe their reasoning. Thus, the resource map reflects how people view their own locality in terms of natural resources. The islanders were prepared maps of the location and extent of different resources, resource use patterns and to provide the authors with any other relevant information about the way the resource was used and the way this use had changed over the past 20-30 years.



Map 2: Location of Transect walks.

Five transect walk were done (Map 2) in the island from North to South for determining the natural resources. Transects provided detailed and rigorous estimates of resource structure. The first transect was taken at approximately 500 m far from the north most point as the hotel motel zone and dense settlement were mostly located in the northern part within this area from shore line. The transect walk started each line from west to east direction with 100 m interval except Golachepa as the total length along that line (see Transect line 3 on map 2) was less than 100 meter. The information was gathered from direct observation while walking a straight line; when any settlement and water bodies found, we bypass that object and then started walking again along the line with the assistance of compass and GPS. A group of local people was always with researchers during the transect walk and helped then to identify objects. For identifying object's characteristics and its association, this research used two criteria for each object in each point like resources and associated vulnerabilities of them. The information's were noted and diagrams had drawn on the notebook. The discussion were done, and the probing questions were asked during the walk.

Finally, all the findings were also discussed with the community people and other stakeholder at the end of the exercise in order to cross verification for once more time and to create a deeper understanding of the entire area arrived at, including site-specific problems and the treatments or solutions recommended for these problems. It is noteworthy to mention that though the research was primarily based on field data, secondary data and information from different journals, newspapers and published reports on Saint Martin's Island were used subsequently. All the data gathered from the field and secondary sources analyzed through maps, tables and figures and presented in standard geographical format.

## **Result and Discussions**

### **Community perceived key resources**

Saint Martin's is endowed with vast terrestrial as well as marine natural resources having a global biodiversity outlook. The natural resources of this island are primarily experiencing an increasing over-exploitation by means of unsustainable utilization and unrestricted coastal development. Since all the coastal resources provide invaluable support to islanders, it is urgent to maintain a balance so that, as a minimum, resources should be extracted to allow the resources to continue to support human needs (Thompson and Islam, 2010). Lubbert (2001) stated that local people have their own sets of issues and priorities, which need to receive due weight in the planning and decision-making process. Thus, effective community participation in resource management requires a learning and action process. As a first objective, this study identified the key resources as the community revealed. This resource assessment helps to learn about the community and its resource base. The primary concern was to develop useful information about local perceptions of resources. The participants developed the content according to what is important to them. A list of key resources was then produced along with the explanation of why these resources are considered as key resource of the island is given in Table 1. Community people also ranked the resources based on ecological, social and economic importance of each resource. The list provides a strong foundation for exploring the spatial extent and investigating the condition of those resources.



**Table 1:** Community adopted ranking of key resources based on the ecological, economic and social perspective.

Key resources	Community Ranking based on Importance	Why are they key resources to the Community?
Rocky shore	EI = 2 EcI = 5 SI = 1	Biologically rich environment includes many attachable species like green mussel, oyster, sponges, sea cucumbers. It protect the island from the high wave. It is used as construction material for building, house, roads and walkways.
Sandy shore	EI = 9 EcI = 7 SI = 4	It is used as a natural walkway for the islanders and the beach is used for fish drying, net drying & repairing, boat construction & maintenance, local trading and other household activities. Ecologically it is important for seashell and turtle nesting. As an intertidal zone, the shore serves as a buffer zone that protect the main land of the island from the direct wave action.
Plain land	EI = 12 EcI = 6 SI = 2	The entire island is almost plain land used for agriculture, human settlement, hotel, resort and other infrastructure development. Plain land is the place where the islanders live so it has been ranked top whereas it got the 6th position as it has been used for agriculture. Ecologically it got the lower importance than many other resources of the island.
Ground water	EI = 10 EcI = 8 SI = 3	The ground water is the only source of pure drinking water in the island. The water table depth is about 12-20 feet. After this depth the water is very salty, made the pure drinking water very limited. The water table recharge during the rainy season and people use the water till the spring sometimes summer.
Wetland	EI = 14 EcI = 12 SI = 7	The wetland of the island is one of the most important resource for the islanders. The island has two creeks of which one is located in the northwestern coast and another in the east coast. Surface water is used for irrigation. Wetlands associated with mangrove are probably providing important habitats for birds.
Sand dune	EI = 11 EcI = 11 SI = 9	Sand dune locally called <i>Balir deil</i> are usually found behind the beach. The largest sand dune is situated in the Dakkhinpara and the second largest one is found near the grave yard of Saint Martin's and then the dune of Marine Park at Golachepa is the third largest and their elevation is high than the other sand dunes. The dunes and especially the beach are a vital part of the natural character of the Island. The continued health of the sand dunes and beach is very important for the protection of local people from predicted sea level rises (which are likely to have a major impact on the Island). The dunes act as a filter for rainwater as it recharges the groundwater. They also prevent sand being blown inland by winds.
Screw pine	EI = 3 EcI = 13 SI = 8	Screw pine provides habitat to the land biodiversity and it protect the island during storms. The islanders plant screw pine around their house to reduce the damage due to storms. The flower and scenic fruits can easily attract the visitors, though these are not selling items in the island but the local people never mind if any visitor collects fruit from the plant.

Key resources	Community Ranking based on Importance	Why are they key resources to the Community?
Coconut tree	EI = 13 EcI = 4 SI = 6	The coconut is an important social, economic and ecological importance to the islanders. The visitors of the Saint Martin's island usually like to drink green coconut water. It is estimated about 11,000 coconut trees in the island (Hossain et al., 2007). Huge number of green and ripe coconut has been supplied to the main land of the country. The old trees and leaves have been used for house construction and cooking. Coconut trees protect the settlements from stormy winds and help to maintain the islands ecological balance.
Mangrove forest	EI = 7 EcI = 14 SI = 14	Mangrove forest has ecological significance while it has less importance to the islanders both socially and economically because poor people sometimes use mangrove for housing but the number is very low. Indeed, they claimed that neither they destroy nor they care of Mangrove regeneration. Currently there is only a very small remaining mangrove patch in Dakkhinpara. The potential for this residual mangrove patch to restore and regenerate is unclear (Molony, 2006), even though in principle it is protected having been identified as a core zone of the St. Martin's Island Environmentally Critical Area (UNDP, 2010). The flowers of the mangrove trees are very attractive.
Sea weed	EI = 6 EcI = 9 SI = 13	Seaweed are grown on the rocks, boulder, corals and even in the broken shells. The sub tidal and intertidal zone are the habitat of seaweed. Some of the community people collect sea weed and dried them up in order to sell them. The collectors sell the dried sea weed to the middlemen at Tk 150-200 per bag where each bag contain about 40 kg dried sea weed (Hossain et al., 2007).
Sea shell	EI = 8 EcI = 3 SI = 11	A seashell is a hard, protective outer layer created by an animal that lives in the sea. Most of the seashell are found on the western coast of the Uttar Para. The children collect sea shell from the shore and make ornaments as well as home décor craft are made from the shell.
Coral	EI = 1 EcI = 2 SI = 10	St. Martin is the only spot in Bangladesh where coral colonies are found. A total of 66 coral species were recorded, of which 19 are fossil corals, 36 living corals and the rest are under six families of subclass soft corals (Tomascik 1997). The genera Porites, Favites, Goniopora, Cyphastrea and Goniastrea are the most abundant. The soft coral community off the east coast is a unique feature of the subtidal zone.
Fish	EI = 4 EcI = 1 SI = 5	More than two hundred species of fish reported by community people, which have very importance to the islanders. Fishing is the dominated activities. Producing dry fish a prominent activity. Most of the fish are sun-dried locally then supplied to Cox's Bazar and Chittagong. Shrimp fry collection is also undertaken and are sold to suppliers serving the Cox's Bazar shrimp farms.
Sea turtle	EI = 5 EcI = 10 SI = 12	Sea turtle is ecologically important to the islanders as they are an important part of marine biodiversity. It has lower social and economic importance because the islanders now a days stop catching them due to declining their abundance at a great rate. At present, the most common turtles are Green turtle and the Olive ridley turtle.

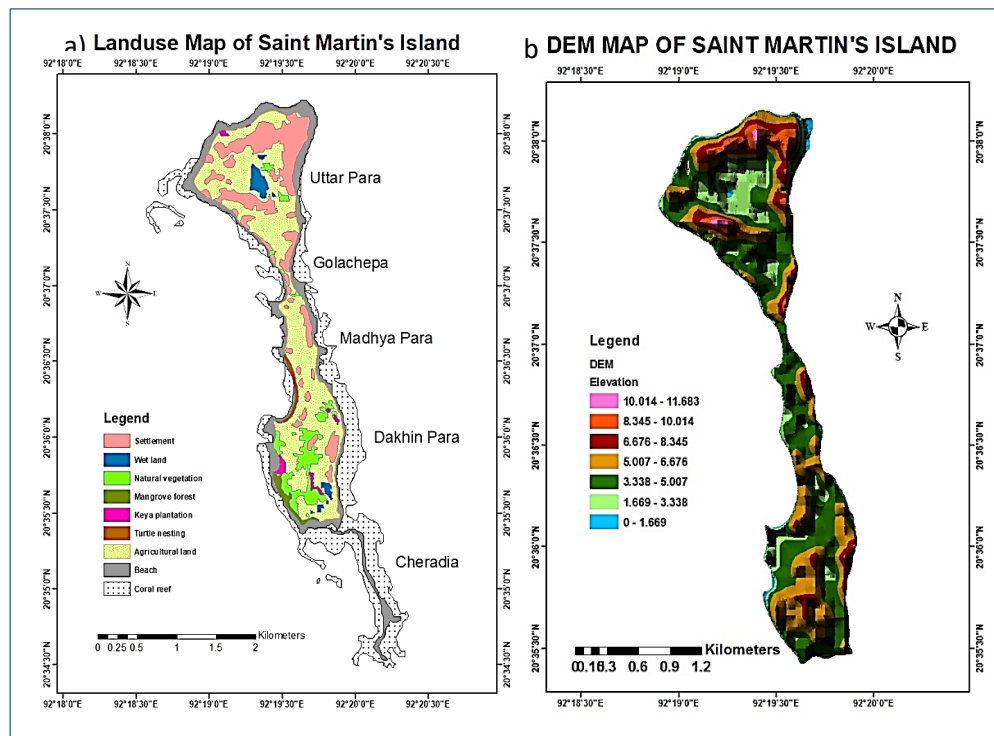
**Note:** EI = Ecological Importance; EcI = Economic Importance; ScI = Social Importance

\* The overall rank indicates the lowest the average value of three considered aspects the highest the overall rank. Average value of each resource is indicated inside the parenthesis.

Source: field survey, (2018).

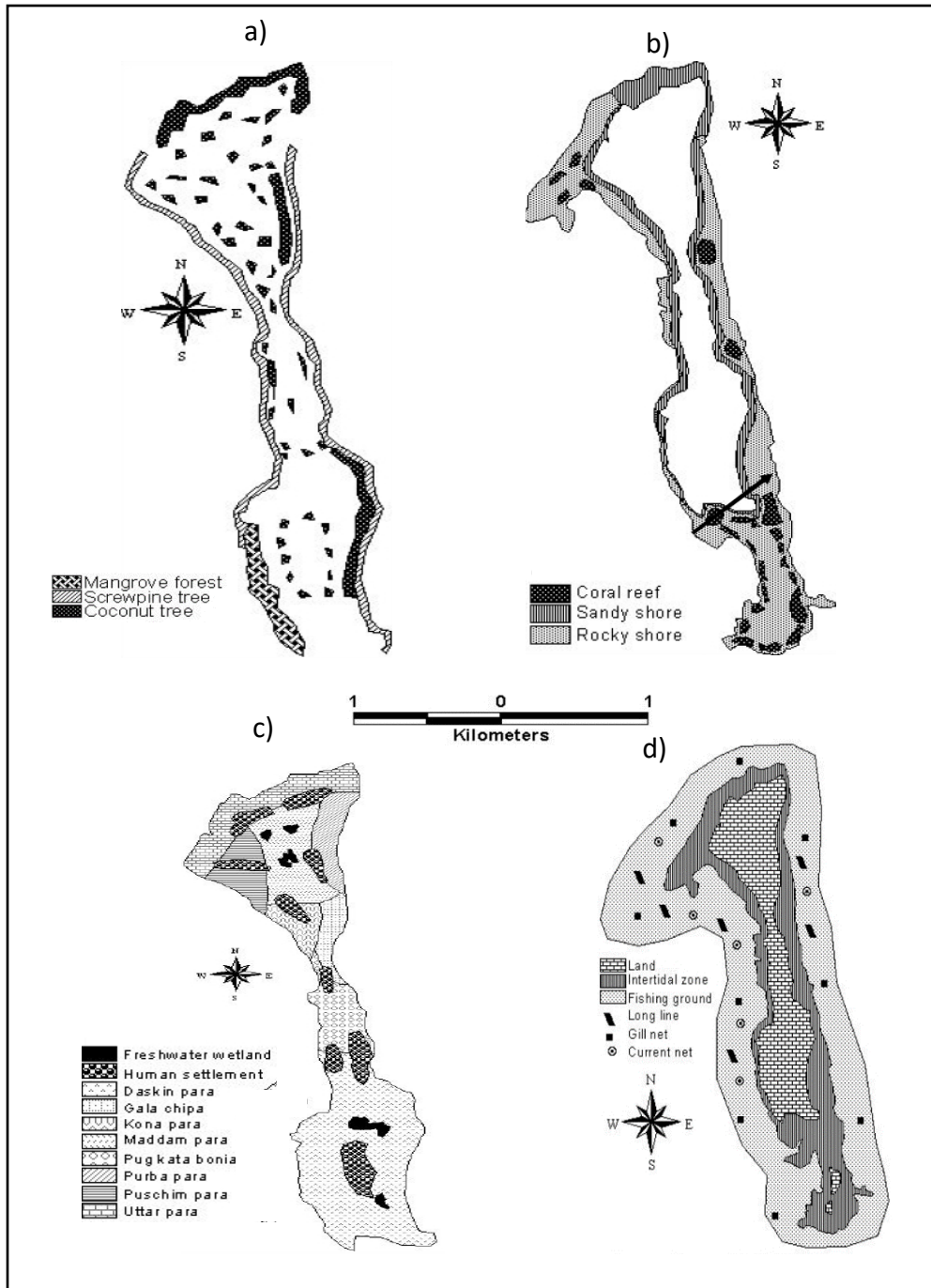
### Land use and the spatial extent of key resources

The spatial distribution of resources also explored in this study. For getting clearer picture on the location and extent of existing resources a detail land use map was prepared for the year 2018 (Map 3a). As the land type and elevation, largely determines land use pattern and extent of the resources, therefore, a Digital Elevation Map (DEM) was also prepared (Map 3b). Besides, detailed observation during transect walk led to discover inter-relationship among resource distribution, elevation and land use pattern of the island. Such land use map and DEM also provides a visualization of the patterns of natural resources and land uses of the island.



**Map 3:** Generalized Land use map (a) and Digital Elevation Map (b) of St. Martin's Island.

The land use map has clearly indicated the location and extent of the island resources (Map 3a and 4a, 4b, 4c and 4d). The general land use include plain land, intertidal zone, sandy shore, rocky shore, mangrove forest, coral zone, settlement, agricultural land, screw pine area (locally called *Keya*), coconut and betel nut area, fishing ground and wetlands. The land area during high tide and low tide is about 320 ha and 850 ha respectively. Uttarpara is the broadest part of the island with about 2 km width on north, gradually shrinks to a quarter km, and then again widens gradually towards south. The northern part is about 10 m and the southern part is about 4 m above the sea level. The northwestern part is entirely made up of rocky boulders and separated by a narrow stretch of water which even at low tide is about 3 ft deep. The eastern coast of Dakkhinpara rises about 4 m above the high tide level.



Map 4: a) Distribution of mangrove forest, screw pine and coconut tree area; b) extent and distribution of rocky shore, sandy shore and coral reef; c) location of freshwater wetlands, human settlement and administrative units; d) artisanal fishing ground around the Island.

Source: Modified after Hossain et al., 2007 and field survey, 2018.

The northeastern part of the island is a sandy beach or sandy shore extending a single stretch and averaging about 100 m in width at high tide (Map 4b). Sand flat up to 1 km in width and patches of dead coral and boulders are exposed at low tide. Such gently sloping sandy shore enriches the coastal line of the island. Moreover, about 50 m width sandy zone exists behind the rocky shore and encircled the island with relatively thicker (about 5 m) in the southwestern coast. The total sandy shore covered about 110 ha of the island. On the other hand, the rocky shore exists surrounding the island except the northeastern coast. This rocky shore protect the island from high wave. During low tide the rocky zone extend about 0.8-1.0 km and 2-2.5 km in the southwestern and southeastern coast respectively. The rocky zone covers about 364 ha that mostly disappeared during high tide. The average width of the rocky shore in the eastern side is about 200 m with maximum 500 m but the western side is quite narrow.

The distribution of coral is in littoral and sub-littoral zones, where dead and fossil corals in upper littoral zones of southern part i.e. Cheradia. Most of the living corals are present in the rock pools that remain submerged during high tide. No corals were observed in the sandy and muddy substratum. It is believed that a submerged reef is present on the south and southeast of the island and in all probability this reef is the western extension of one of the Malaysian sea coast. The artisinal fishing zone extends up to 500- 1000 m distance from the coast line. Total area of the artisinal fishing ground is about 1069 ha surrounding the island after the intertidal zone (Map 4d).

High density of settlement have found in Uttar Para followed by Madhyapara and Dakkhinpara with gradual low density. Most of the settlement have coconut and pine tree in the island. As the island is very fertile, agricultural are mostly paddy, watermelon, onion. Agriculture is dominated in Dakkhinpara with some in Madhyapara. In Uttarpara and Golachepa, fellow land was identified. The island consists of five freshwater wetlands, of which three in Uttarpara having 2.7 ha and other two in Dakkhinpara having 4 ha (Map 4c). The island has two creeks of which one located in the northwestern coast and extends about 1 km inside the island and another one in the east coast and extends about 500 m inside. Many houses have small pond in Uttarpara, as the elevation of is highest here. Small ponds are used for household activities.

Screw pine (locally called Keya) is the most dominant tree species and occupied about 44 ha, developed as the protected fence surrounding the island, except the north and northeast part. The species are dense, well developed and located in the upper fore dune. The coconut trees are distributed throughout the island scattered in general in the north and northeast part of the island. The eastern part of the island has more coconut plantation than the western part (Map 4a). The mangrove forest exists in the southwestern coast of the island (Map 4a) occupying about 15 ha. In this island the mangrove forest (mostly *Avicennia* and *Rhizophora* species) area is almost in the rocky area with pebbles coarse sands, scattered with 1.5 to 2.0 m height and bushy branches. The local community claimed that neither they damage nor take care of the mangrove forest, rather the strong physical processes may hamper the growth of the mangrove forest.

### Community perceived level and causes of key resources vulnerability

By using the community perception this research at first, has identified the level of vulnerability of the key resources (Table 2) and then explored the causes what the community people perceived. The rows of the matrix represent the vulnerability level and the columns represent the level of threat exert to the environment and the community people themselves.

**Table 2:** Vulnerability matrix of key resources perceived by the community people.

Level of Vulnerability	Resources					
	Extreme			Plain land		Coral Turtle Fish
	Very High			Surface water	Sea weed	Rocky shore
	High		Sandy shore	Ground water	Sand dune	
	Moderate		Sea shell	Screw pine		
	Low	Coconut Tree	Mangrove			
		Low	Moderate	High	Very High	Extreme
<b>Level of Threat ( to environment and community)</b>						

Source: Field survey, 2018.

Key resources of Saint Martin's Island became vulnerable due to various natural and anthropogenic causes. Along with the vulnerability assessment, this research also identified the causes of the vulnerability of key resources what the community people are belonging. Several causes were come into front and thus summarized in Table 3. No single cause is found for making each resource vulnerable. Rather combination of multipole impacts of both natural and anthropogenic causes creating low to high level vulnerability of each resources. The fisheries officer of Teknaf Upazila, one of the stakeholders attended in FGD stated that *"if one resource becomes vulnerable if make other resource vulnerable. For example, excessive removal of coral have made it extremely vulnerable for which the biodiversity depending on the coral have decreased, causing the overall marine environment highly vulnerable."* Similar statements were found form the community people. For example, Nurunnabi (Age 55, Coral collector, Uttarpara) stated *"few years ago, there were huge amount of shell around the beach. But this amount of shell have been decreasing drastically for making hand craft excessively as the economy of a group of people depend on it. Besides the tidal wave action increased now a days which also creating vulnerability to seashell."*

**Table 3:** Major causes of key resource vulnerability.

Key resources	Natural causes				Anthropogenic causes				
	Highly Sedimentation	Cyclone and storm surge	Beach or land Erosion	Ocean warming	Over exploitation	Dumping waste	Excessive tourist	Oil spills	Boat anchoring
Rocky shore	✓				✓	✓	✓		✓
Sandy shore		✓	✓			✓	✓		✓
Plain land		✓	✓		✓	✓	✓		
Ground water		✓			✓	✓			
Wetland		✓	✓			✓			
Sand dune		✓	✓		✓	✓	✓		
Screw pine		✓	✓				✓		
Coconut tree		✓							
Mangrove		✓							
Seaweed	✓	✓		✓	✓	✓			
Seashell	✓			✓	✓				
Coral	✓	✓	✓	✓	✓	✓	✓		✓
Fish	✓			✓	✓	✓	✓		
Sea turtle	✓		✓	✓		✓	✓	✓	

Source: Field survey, 2018.

Therefore, it is obvious that the key resources of Saint Martin's Island became vulnerable due to various natural and anthropogenic causes. Among the natural induced causes, high sedimentation load concentrated turbidity in the ocean water is very harmful to rocky shore, seaweed, seashell, coral, fish and sea turtle. Turbidity and sedimentation reduce the growth of these marine organic resources. Cyclone and storm surges are the most common natural hazard of the island which have occurred almost every year. This hazard is mainly destructive for screw pine and coconut tree due to strong stormy winds. Mangrove, seaweed and coral have also affected by the cyclone and storm surges. Land erosion is harmful to mainly plain land and wetland. The sandy shore, sand dune and screw pine became vulnerable due to beach erosion. Vulnerability of coral and sea turtle also associated with the increasing turbidity in the ocean water. The coral crisis is almost certainly the result of complex and synergistic interactions among local-scale human-imposed stresses and global-scale climatic stresses. Documented human stresses include increased nutrient and sediment loading, direct destruction, coastal habitat modification, contamination, and the very important chronic indirect effects of over fishing (UNDP, 2010). Though the community people do not have much knowledge on climate change, participated stakeholders in this study stated that rising ocean temperatures have been implicated in chronic stress and disease epidemics among corals, and in the occurrence of increasing numbers of mass coral bleaching episodes. The increase of ocean temperature became dangerous for marine organic resources including seaweed, seashell, fish and sea

turtle. These resources need an optimum temperature for their survival. Community people also indicated that the inter-tidal, sub-tidal and coastal habitats of this Island along with its adjacent coastal waters areas are also under vulnerabilities due to the large scale removal of keystone species and other marine resources e.g. seaweeds, molluscs, lobsters etc. for food and ornamental souvenirs. Habitat disturbance like obstructing the growth of marine algae is also occurring by picking rocks from the inter-tidal zone for construction and household uses. Construction of substantial tourist resorts have cleared natural vegetation in mentionable amount.

Community people asserted that over exploitation of rock and boulder from the rocky shore, excessive use of ground water and surface water for drinking and other purpose, extraction of soil from sand dune and over extraction of seaweed, coral and fish have made these resources vulnerable. Fresh water table is dropping compare to the past with the increasing freshwater demand by the increasing influx of annual tourists in recent years. Ground water is also using excessively now a days for the expansion of agriculture. The uses of shallow pump is one of root causes for such dropping water table couple with large-scale deforestation. Waste material and plastic have been dumped on the beach and the main land are making the rocky shore, sandy shore, plain land and sand dune dirty and vulnerable. Community people stated that due to the dumping of waste material on the island, there is a high chance of water contamination as the ground water level is very close (average 8 m) to the surface. During high tide dumped waste on the beach become mixed to the ocean water made the marine organic resources vulnerable by hampering the natural growth of these resources. Many hotels and resorts have exerted extreme pressure to the plain land and have made these resources vulnerable. Seaweed, screw pine, different species of shells and starfish are collected by the tourists regularly which make the condition of these resources vulnerable. A huge amount of crude oil are released in the sea water adjacent to the island from ferry services and boat engines used for carrying tourists to and from the island (Touhiduzzaman and Rahman, 2017). This oil is very harmful to the marine organic resources as they restrict the natural growth of these resources. Boat groundings at low tide cause direct physical damage to the boulder reef substrate as well as direct kills of corals. The increased rubble and fine sediments become available for resuspension and this further affects water clarity, coral recolonization, and coral health in general (Tomascik, 1997).

## **Conclusion**

From this study, it is revealed that resources of Saint Martin's Island is now in vulnerable condition due to mostly the anthropogenic causes rather than the natural causes. It is no doubt that many actions have already been taken and yet is ongoing by the GO/NGOs, however, what we see is that while actions have been taken or, at least, initiated on the areas identified as being of priority interest, the concern is that, for a number of reasons, progress has been significantly uneven. Activities that have been executed to a greater or lesser degree, but which appear to be in need of buttressing, include those related to other important issues like natural disasters, waste management and land resources. It is no doubt that as a tourist hotspot, the island directly contributes to national revenue, however, to maintain the carrying capacity of the island an integrated management scheme should be



considered, ultimately by which economic well-being, ecological integrity and social development will result accordingly. We need economic growth, as theoretically, other dimensions, namely effective resource and environmental management are seen to converge on the economic sphere, but in St. Martin's case, it is now the time to consider that economic growth as a form of revenue generation even cannot to be allowed which could lead to both the short and long-term environmental degradation. Rather, the concern is that subsumed under "sustainable development", every single development and management programme should be incorporated, if possible, either maximum or at least, the integrity of components of the environment, not for anything else but keep the St. Martin's Island alive. It requires the grant of significant political concessions by the major actors in addition to a quantum of community awareness and assistance, known to be feasible as most prominent bottom-up development.

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## **Effect of Industrialization on Farmers' Life: A Study on Sitakunda Upazilla, Chittagong**

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**Abstract:** From the ancient time agriculture based social system in known as the largest and independent society all over the world. But at present, industrialization acts as a factor not only to break the traditional agrarian society of the farmers but also affecting their economic condition. This study was undertaken to investigate the effects of industrialization on farmers' life in Sitakunda Upazila, Chattogram (Chittagong). The study was mainly based on primary data which were collected through questionnaire survey, in-depth interview, FGDs, and opinion survey. Collected data from questionnaire survey have been analyzed by simple frequency table and statistical graphs. FGD and in-depth interview data are qualitative data which analyzed in a narrative way after getting participant's main thought about the effect of industrialization. Opinion survey completed on official staff which has been focused on research result analysis of their idea about impact of industrialization. Secondary data also used to conduct the study. The results indicated that due to the acquisition and establishment of the industry, farmers are becoming landless and their agricultural production is being affected by the pollutants of industry. The result also indicated that farmers are also deprived of the right of the job in that industry, which are established in their agricultural land that were sold unwillingly without having proper price.

**Key words:** Agriculture, Industrialization, FGD, Questionnaire, Farmer.

### **Introduction**

Agriculture is the traditional occupation of the human society. From very ancient times it has been the main source of the livelihood of the vast majority of the population of the territories that constituted the Bengal province (Islam, 2007). Bangladesh Govt. plan target of reaching 10% annual GDP growth by 2021 is premised on a competitive manufacturing sector growing at or near double digits during 2011-2021 decade (GOB, 2012). But at present, the government of Bangladesh promotes rapid industrial development to increase export earnings and employment opportunity for the growing population and to relieve pressure on the available agricultural lands. According to Bangladesh Bureau of Statistics (BBS) estimates, the contribution of the broad industry sector to GDP stood at 31.54percent in FY2015-16which increased to 32.42percent in FY2016-17(BBS, 2018). The rapid growing industrial sector has given special importance to small and cottage industry, providing assistance to women entrepreneurs on a priority basis, setting up special economic zones in different parts of the country (Economic review, 2017). But site selection criteria for installation of the industry do not give importance for the value of the land. Acquisition of agricultural lands for industrial and other purposes i.e. Government

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offices are not rational because in most cases much more land is acquired than the actual requirement. Furthermore the agricultural value of the land is not taken into consideration (Hossain, 2000). As a result, with 160 million populations on 147000 square kilometers of land, Bangladesh faces a gradual fall of arable land due to its increased use for such non-farm purposes. The decline has created concerns about future food security for the nation which takes rice as staple food. Bangladesh requires additional 0.5 million tone of grains every year for its rising population. Over the decades since independence, rice output tripled to over 300 million tones in Bangladesh, yet the country has to depend on imports (Bangladesh economy, 2011).

Sitakunda is the home of a large number of industries from small to heavy. The heavy industrial activities of the country is located in this areas which include shipyards, re-rolling mills, textile mills, cement factory, glass factory, pharmaceutical plants, chemical plants, jute mills with other private sector medium size industrial developments and activities. But the growth of these industries has generally been unplanned without keeping the issue of environmental protection in careful consideration. Yousuf (2011) pointed out that the environment of Sitakunda upazila is under threat. On the western side, the coastal area has been severely polluted by the ship-breaking industry, while the eastern hilly side is being destroyed by land grabbers and earth diggers. During the last five years, at least 25 large and small ponds have been filled up for various projects like housing, setting up of industries or construction of roads. Most of the industrial estates and factories of Sitakunda are located on agricultural land. After the establishment of the industry, the environment of Sitakunda is being polluted because growth of industries has been unplanned and most industrial units have no adequate facilities for the treatment of wastes which they produce. The highly toxic effluents discharged in nature which contaminate water, air and land and affects organisms and ultimately human health. It reduces economic productivity and amenities. Das (2009) reported that soil pollution usually originates from the development of industry. Once pollutants enter and are incorporated into the soil, and their concentration in soil continue to increase and accumulate as toxic to all form of life, like plants, micro-organisms, human beings etc. The water is used by various ways like irrigation and livestock, power, industry and domestic consumption which actually becomes waste water because of dissolving industrial byproducts, pesticides; chemical fertilizers etc. Rahman (2005) has shown that the continuous use of polluted water for irrigation of agricultural land may result in metal accumulation in the surface soil which is toxic for crop production and ultimately creates animal and human health problems. Ali, et al (2001) pointed out that in Bangladesh, most of the industries are located near the banks of canals or rivers. This location pattern has arisen primarily from the ease of discharge of effluent. Effluents mostly untreated are primarily discharged into rivers and streams and these water bodies are largely used for irrigation. Pollution of the natural water bodies from industrial discharges is having the most damaging effect on the environment.

Most of the researchers have given their attention on the effects of industrialization on the elements of the environment – soil, air and water. But research about the effects of industrial pollution on the life of poor especially on farmers in our country is not adequate. So paper had taken an attempt to find out and assess the effect of industrialization on farmers' life. The aim of this paper is to understand the effects of industrialization on

farmers' life. In order to fulfil the aim of these paper a number of objective have been selected. They are: a) to know the industrial effect on farmers' property; b) to understand the industrial effect on agricultural production; c) to assess the effect on farmer society especially on their health.

### Study area

Sitakunda is such an Upazila where both agriculture and industries are present predominantly. It is one of the western most area of Chittagong and Chittagong hill tracts. It is situated at the northwestern part of Chattogram district, between  $22^{\circ}34'N$  and  $22^{\circ}43'N$  latitude and  $91^{\circ}38'E$  and  $91^{\circ}41'E$  longitude (Map1). It is delimited in the north by the Feni River, in the south by the Karnafuli River, in the east by the Halda River and in the west by the Sandwip channel. Sitakunda Town is the administrative center and the sole municipality (Pourashabha) of Sitakunda Upazila. The rest of the area is rural and organized into 10 Union.

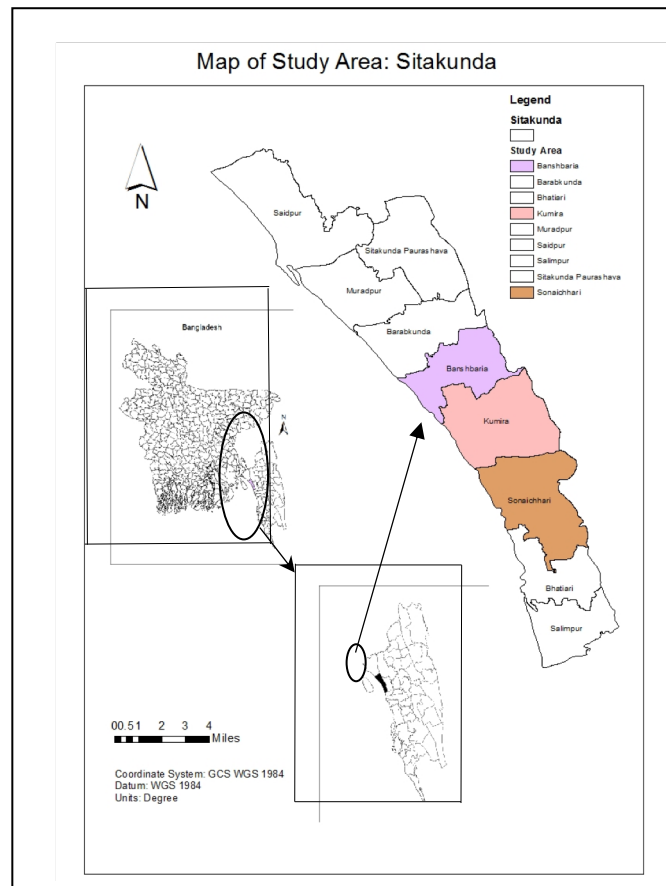


Fig1: Study Area (Banshbaria, Kumira and Sonaichhari Union in Sitakunda, Chattogram)

Source: Redrawn from Banglapedia, 2016

## **Methodology**

In Sitakunda, three unions namely Banshbaria, Kumira, and Sonaichhari were selected as the study area. Because maximum industries are located near to these villages. It was informed from people and also observed. After selection of study area, farmers who were engaged with agriculture directly or indirectly were selected as target group for questionnaire survey. Questionnaire structure was developed for household interview. Before final data collection about 20 questionnaire were pre-testing. There were a draft schedule pre-tested in study area to find out the suitability of the questionnaire.

After the pre-test, some parts of draft schedules were improved, rearranged and modified. The sample size for questionnaire survey was 150 which was taken during field visit on the basis of affected farmers household who lives very close to the industrial zone and who have lost their agricultural land due to industrialization. From reconnaissance survey it was revealed that 655 household in Sonaichhari, 467 in Kumira and 392 in Banshbaria was mostly affected who lived within 2 km from different industry. For similarity 10% household was selected randomly from each area. That why of 150 questionnaire 65 were Sonaichhari, 46 in Kumira and 39 in Banshbaria in a round figure. As a social survey the questionnaire had six sections to gather data and information about effects of industrialization on farmer's life. In three unions three FGDS was conducted with farmers who were male because female or women dominate land ownership was not available in the survey area. The discussion covered the experience of the participants regarding the extent of losses by industrialization. The numbers of FGDS participants were eight to ten. Opinion survey was conducted on teacher, union parishad (UP) chairman, agriculture officer etc. From observation it was noticed that agricultural land were bounded by wall and gradually turned into a fallow land which are making ready for new industries, settlement and roads. Secondary data were collected from various articles, books, published and unpublished thesis and project paper which were collected from International Union for Conservation of Nature, Bangladesh Agriculture University, Dhaka University, Jahangirnagar University and University of Chittagong, Dept. of Agriculture Extension and Dept. of Statistics, Sitakunda. Finally all collected data analyzed by statistical techniques.

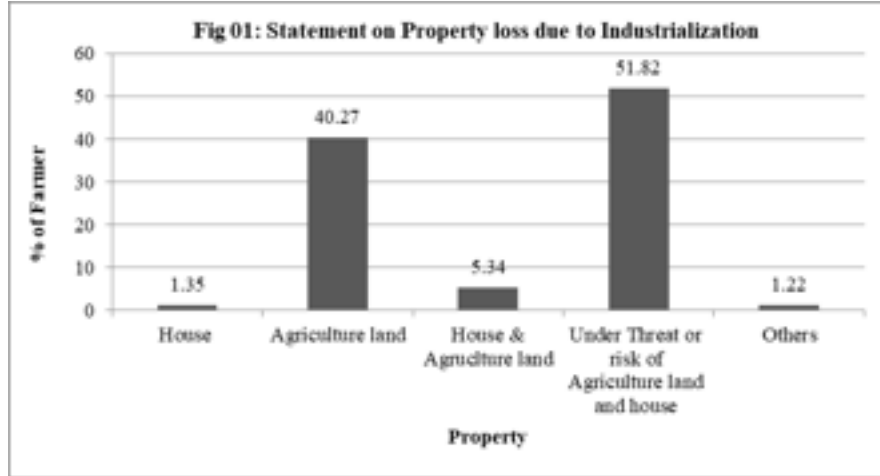
## **Results and Discussion**

### **Farmers are becoming landless**

Land is a basic factor of crop production and also the most inelastic and the scarcest in our resources. In the study area, agricultural lands are gradually decreasing day by day for the purpose of industry related uses. From the secondary data, it is found that during 2002 to 2003, about 140 hectares land were cultivated under boro rice and in 2010-2011 cultivated land declined to only 82 hectares. It is noticed that agricultural land is reduced by 58.57 percent from 2002-2003 to 2010-2011 (DAE, 2011)

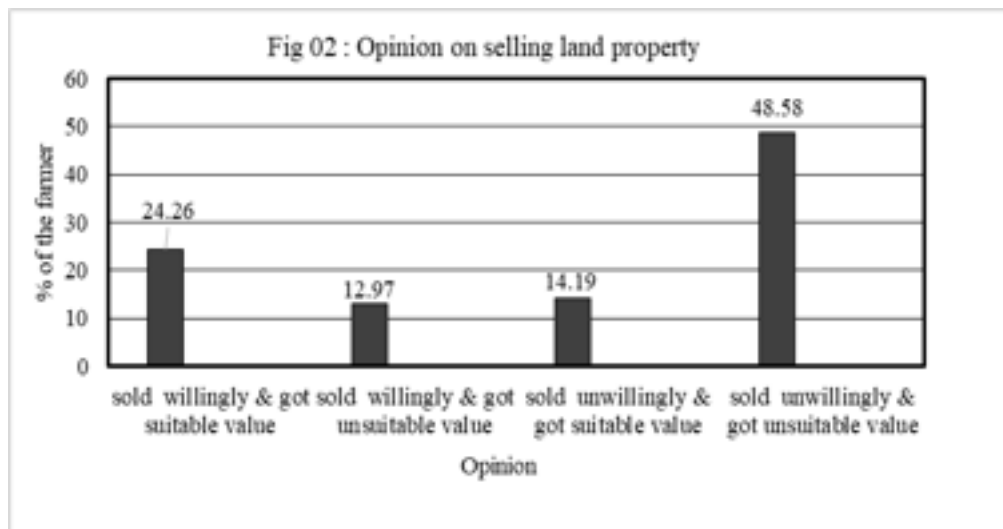
It was seen from the primary data that 40.27 percent farmers had lost their agricultural land and 5.34 percent farmers had lost both their houses and agricultural lands in the study area due to purchase of agriculture land by the owner of the industry. Agricultural land is under

threat of land purchasing of the area. 51.82 percent respondents express their view that they were at risk of losing their property due to expansion of industrialization (Fig. 01).



Source: Field survey, 2016

From FGD it is revealed that land brokers instigate the farmers in various ways such as per capita agriculture lands of farmers are decreasing day by day because of large number of family members. As a result, small portion of land cannot fulfill their yearly demand. With this weak point land brokers take the advantage to purchase the land from farmers. Besides this being virtual constant supply of land and jobless situation of young generation forced the farmers to sell their valuable land. Sometimes the industrialist acquired the land by force and illegally with the help of political leader. In this case, some instigated farmers sell their valuable agricultural land to them and sometimes, they are cheated (fig: 02).



Source: Field survey, 2016



Study shows that only 24.26% farmers sold their property willingly and got suitable value and about 48.58% farmers sold their property unwillingly and got unsuitable value. For these causes per capita agricultural lands of the farmers are decreasing day by day in Sitakunda upazila.

Table 1: Total Agricultural Land of the Farmers

Amount of the agricultural land ownership (decimal)	% of the farmers in		
	Kumira	Banshbaria	Sonaichhari
<15	20.00	20.51	20.60
15-30	19.56	10.02	13.85
30-45	4.35	5.13	4.61
45-60	4.35	-----	-----
60-75	5.13	-----	-----
75-90	-----	-----	1.54
>90	2.17	-----	1.50
Total land owner	50.43	40.79	42.10
Total land less	49.57	59.21	57.90

Source: Field survey, 2016

From the survey it was revealed that most of the farmers are coming landless. Table-01 shows that about half of the farmers are landless in the study area where 49.57%, 59.21% and 57.90% landless farmers are in Kumira, Banshbaria and Sonaichhari respectively. In Sitakunda, many people have started the business of land. They are creating force on innocent farmers to sell the agricultural land who are financially able. Needy farmers sell their land due to fall into temptation of cash money although they were depriving from actual price. As a result, farmers are becoming landless and they cannot leave behind any land property for their next generation.

### Decreasing of food production

In Sitakunda upazila, total agricultural production of the farmers was reduced due to the reduction of per capita agriculture land of the farmers. It is not only for the reduction of agricultural land but also for the effect of smoke (Industrial gaseous output) and liquid waste of the industry. In the study area agricultural land of 42.7% farmers are located near the industry which is being badly affected by industrial effluents and smoke. Now, in the eastern side of the study area which is hilly, there are less flower production and less pollination in the plants by the insects which result in less production due to smoke. From FGD and opinion survey it has been come out that different types of vegetables production in Sitakunda including bean which is famous for all over the country are also being affected by the liquid effluents coming from different types of industry mainly textile mill. During rainy season, in the western side of the Dhaka-Chattogram trunk road, most of the lands

remain uncultivated due to liquid waste which comes from the ship breaking industries of the coastal area and from the different types of heavy industries of eastern side which drainage system are passing to the western side. Some farmers said that they need to sow the seeds yet again in the same field in same cropping season because young plant cannot persist in the field due to pollution.

Drainage system has been blocked due to the construction of boundary wall, filling up of water bodies during the infrastructural development of the industry in Sitakunda. For these reasons, irrigation facility for the boro rice has been affected strongly. Previous time the farmers of Sitakunda enriched their food production through boro rice cultivation which depended on irrigation. But at present due to lack of irrigation facility, farmers have abandoned the boro rice cultivation in the Robi season. About 40-55% production has reduced per 40 decimal according to 37.49% farmers in three study unions. On the other hand amount of decreased production was 40-55% per 40 decimal according to 39.13% farmers in Kumira, 41.03% in Banshbaria and 32.31% in Sonaichhari (Table.2).

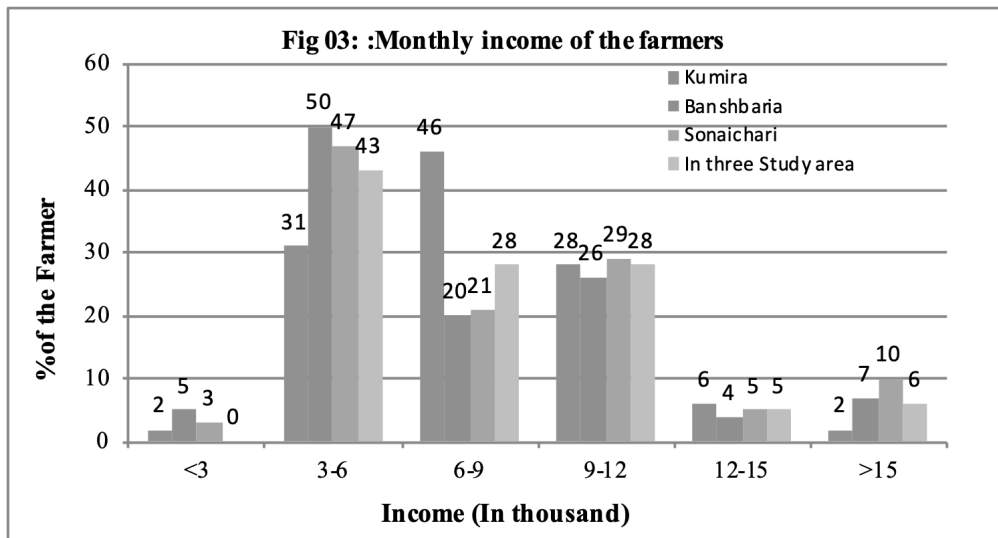
Table 2: Comment on agricultural production due to industrialization per 40 decimal

Agricultural Production		Percentage of Respondents ( farmers)			
Decrease	Range (%)	Kumira	Banshbaria	Sonaichhari	Study area (avg.)
	10-25	10.87	15.39	9.23	11.83
	25-40	8.7	20.51	15.38	14.86
	40-55	39.13	41.03	32.31	37.49
	55-70	19.57	2.56	26.15	16.09
	70-85	17.39	12.82	4.62	11.61
Increase (over all)		2.17	5.13	1.54	2.95
No change (over all)		2.17	2.56	10.77	5.17

Source: Field survey, 2016

### Variation of Income

Incomes of farmers vary greatly from year to year, because prices of products fluctuate with weather conditions and other factors that influence the quantity and quality of agriculture output and the demand for those products. Monthly income of the farmers ranged from less than 35.71 US\$ (1US\$=BD Tk 84) to more than 178.57 US\$ where on average highest percentage (45.42%) of the farmers had low income ranged from US\$ 35.71 to US\$ 71.43. The low income group farmers get low production because their agriculture lands are located near industry and it is badly affected by industrial effluents and smoke.



Source: Field survey, 2016

About 18% farmers had monthly income ranged from US\$ 107.14 to US\$ 142.86 and this group of farmer engaged themselves not only agriculture but also business & part-time job in the industry. Some farmers had worked in Jute Mill for 8 to 9 hours in everyday and they get 13.10 US\$ for six day. Rest of the time they worked in their agricultural fields.

### **Increasing application of agriculture inputs and its expenditure**

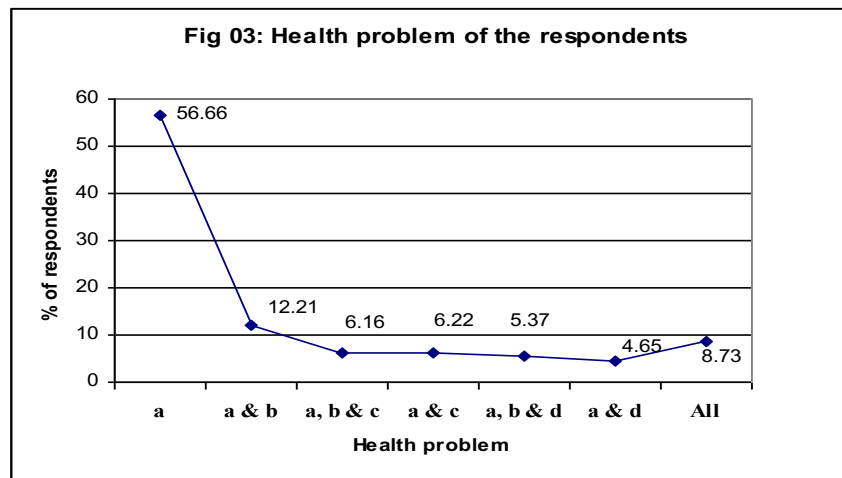
Due to the decrease of total agricultural land and for the increasing effects of pollution, high dose of fertilizers are being applied by the farmers in their little amount of land to get maximum yield. In the study area, according to 58.60% farmers, application of fertilizer and pesticide has increased within last 10 to 15 years due to industrial product on their land. For more production in less land, selection of hybrid varieties is gradually increasing by the farmers instead of HYV varieties. In the study area, some farmers did not get expected production like their past generation in HYV cultivation and it is only due to pollution. So they adopted hybrid seeds. Most of the farmers hold the same opinion that although hybrid gives high yield but it needs high dose of fertilizer. High dose of pesticides also need to be applied by the farmers to control the increasing pest in hybrid cultivation which increase extra expenditure for poor farmers. Traditionally in Bangladesh, from the current agriculture production, farmers always keep seeds for the next cultivation. Thus they save the money which would be spent for the purchasing of the seed. But, in the case of hybrid, there is no chance to keep the seeds for the future and farmers need to buy new hybrid seeds from the agent of the company which are expensive and burden for poor farmers. Besides, the maintenance of hybrid cultivation is comparatively difficult for illiterate farmers who are used to use simple method for cultivation.

As agricultural production is insufficient to meet the basic needs of the farmers so it is difficult for them to make savings after maintaining their family need. Thus their

purchasing powers are becoming very low to buy new agriculture land and agricultural instruments. It indicates that total numbers of the self-dependent farmers are not increasing due to lack of capital. Study also shows that about 42% farmers had no agricultural instruments and they rent agricultural instruments from able farmers who are engaged with these types of business in farming.

### Effects of industrialization on society

For the industrialization several problems have been seen in farmer society such as residents or settlement problems, social crime (theft, fraud, harassment etc.) social disorder and health problems. Research data show that 56.66 percent respondents expressed that respiratory problems became common in the study area due to the industrialization. About 12.21 percent respondents pointed that their suffering from both respiratory and skin diseases, 8.73 percent respondents were affected by all kinds of health problem (Fig. 04).



Note: a: respiratory problem, b: skin diseases, c: eye diseases, d: hearing problem.

They also reported that local people who live in the neighborhood of the industry were suffering mostly from such types of problem. In the case of all types of health related problems, children and Senior citizens were found to be suffered mostly. Institution of education is not also free from industrial effects. Kumira Residential Girls School and College is located in heavy environmental polluted zone where KYCR coil industry is situated in southern side and Royal cement factory in northern side of this institution. The teachers, students and guardian are anxious about the effects of the pollutants of these industries. So, all the inhabitants are against of environmental pollution and making movement to get rid of it. According to 93.3% farmers, due to the industrialization in Sitakunda, settlement density has increased because a lot of out sider people who are mainly industrial worker have settle near to the industrial area. Local females are feeling insecure for the increased people.

## Conclusion

The farmers of the Sitakunda area are not well educated and their monthly incomes are limited which is depend on agriculture production. Most of them are landless and they are dependent on others for agricultural instruments. From opinion survey of sub assistant plant production officer it is known that agricultural production from the diminished agriculture lands is gradually decreasing due to industrial pollution. So it is difficult for them to maintain the basic needs of their family through insufficient production. All these negative signs in the life of the farmers are the result of the unplanned industrialization directly or indirectly. It is known that agriculture and industry are considered as the two major pillars of our national economy. So maintaining the dominance of agriculture, industry can be run. Agriculture must be given the priority in that place, where land is perfect for agriculture. However, where lands are unsuitable for cultivation those land must be used for establishing the industry in proper way. Effluent treatment facilities must be present in all the industries. Industrial chimney must be remained at the fixed altitude so that air pollution can be reduced. In the absence of these facilities, punishment must be ensured according to law.

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## Women's Involvement in Agronomic Activities in Rural Mohammadpur, Cumilla District

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**Abstract:** Bangladesh is a developing country where agriculture is the single largest contributor to the national economy. Its' growth and sustainability depend on its farmers; both male and female. More than 65% of about 168.07 million population lives in rural areas of Bangladesh where poverty, inequality and unemployment are predominant. However, rural women as a vital part of micro-economy are involved in various agronomic activities to support their families. This paper is based on rural women's participation in agronomic activities. Therefore, this study tried to find out the socio-economic condition of the rural women and their contribution to the rural society particularly in Mohammadpur Union of Cumilla district in Bangladesh. The data were collected through dual procedures like primary and secondary sources. Primary data was collected through field survey, questionnaire survey (350 respondents, maintained random sampling) and Focus Group Discussion (each group consists 7-8 persons, 4/5 were female and 3/4 were male) from August 2018 to January 2019. Modern technological tools (ArcGIS 10.5 and JMP) were used to calculate the collected data. This study explored that women were intensely involved in various agronomic activities like; homestead agriculture, handicrafts, cattle grazing, and micro-farming. The findings of this study were suggested that how the socio-economic condition of rural women can be expanded through empowering programs.

**Keywords:** Agronomic, Women, Socio-Economic development, Bangladesh

### Introduction

Agriculture is the main concern occupation of the remoter where 49% of the total population is engaged in agro-economic activities (Agricultural Dairy, 2012). The agricultural activities were contributed more than 15% GDP in the last fiscal year. Moreover, there are various agro-economic sectors in rural Bangladesh comprising of crops, livestock, fisheries, and forests account for 55 %, 14%, 22 %, and 9% respectively (BBS, 2017). On the contrary, the contribution of agriculture to the national economy has been reduced gradually due to rising sectors (garments industries, ICT and service sectors) (BBS, 2017). Besides that, agro-economic is a vital element to gain individual families food solvency to reduce rural poverty (Islam et al. 2018).

Literature suggested that women play a significant role in rural agriculture that was reflected in the formulation of agricultural development policies (Kaur and Sharma,

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1991; Unnevehr Stanford, 1985 and Agarwal, 1998). It is noted that rural women are only engaged in the post-harvest processing of crops in Bangladesh. Therefore, the national economy was gradually declined. It is estimated that women workers increased from 3.2 million (BBS, 2016) to 21 million (LFS, 1989) which largely found in rural areas (Rahman and Routray, 1998). It is calculated that approximately 25% women's labor was involved in post-harvest operation in rice production (Scott and Carr, 1985) which indicates that potential forces of rural women are a vast reservoir of human resources in the remote areas of Bangladesh (Jahan, 2000). However, the contribution of rural women particularly in the field of agro-economic to develop socio-economic condition cannot be undenied. Rural women are generally involved in various agronomic activities like homestead generating, sowing, weeding, harvesting, drying, compositing transplanting, and tree plantation (Prakash et al. 2012). But the economic benefits have not gone in hand due to lack of NGOs, or GOs credit program, education, training, health and nutrition and access to production resources and services (Mahibullah, 2013). This study suggested that widespread participation of rural women in village associations, marketing, co-operatives and other community organizations can help to reduce the social limitations to improve rural economy through agricultural production (Akanda, 1994). On the contrary, women, as a part of Muslim society, they are hardly involved in agricultural activities in the remote areas of Bangladesh (Hossain and Bayes, 2009; Abdullah and Zeidenstein, 1982). As of late, they are involved in homestead vegetation production and post-harvest operations along with livestock and poultry rearing activities. There were thousands of studies were conducted on women's activities in the remote areas of Bangladesh during 1980s that illustrate the women's contribution in the agricultural development (Abdullah and Zeidenstein, 1982; Farouk, 1979 and 1983; Ahsan, et.al. 1986; Halim and McCarrthy, 1985; Begum, 1985; Chowdhury, 1986; Westergaard, 1983 and Jaim and Rahman, 1988). But sometimes productive work is a burden to rural women especially in developing countries because they usually worked within a homestead. Therefore, productive work is often counted as so-called non-productive work (Hossain et al. 2004).

This research focuses on the nature of participation of rural women in agricultural activities in the Mohammadpur union of Cumilla district. However, the aim of this study is to find out the involvement of rural women in agronomic activities and their impacts on socio-economic development in the said study area. Therefore, specific objectives set to fulfill this aim includes (1) to investigate the current socio-economic conditions of rural women; (2) To map the nature and extent of participation of rural women in agricultural; (3) to find out the major constraints for women to involve in agronomic activities and finally (4) to generate a policy guideline for the involvement of women in the agronomic activities in the Rural Mohammadpur, Cumilla District, Bangladesh.

## **Data and Methodology**

### **Study area**

The Cumilla region was once under ancient Samatata and was later a part of the Tripura State. This district came under the control of the kings of the Harikela in the ninth

century AD. Lalmai Mainamati was ruled by Deva dynasty (eighth century AD) and Chandra dynasty (during the tenth and mid-eleventh century AD). Cumilla district holds 180 unions under 12 upazilas. West Mohammadpur Union of Cumilla district is economically significant zone. It is located between  $90^{\circ}47'40.11''\text{E}$  and  $90^{\circ}49'34.89''\text{E}$  longitude  $23^{\circ}30'36.83''\text{N}$  and  $23^{\circ}27'12.08''\text{N}$  latitude.

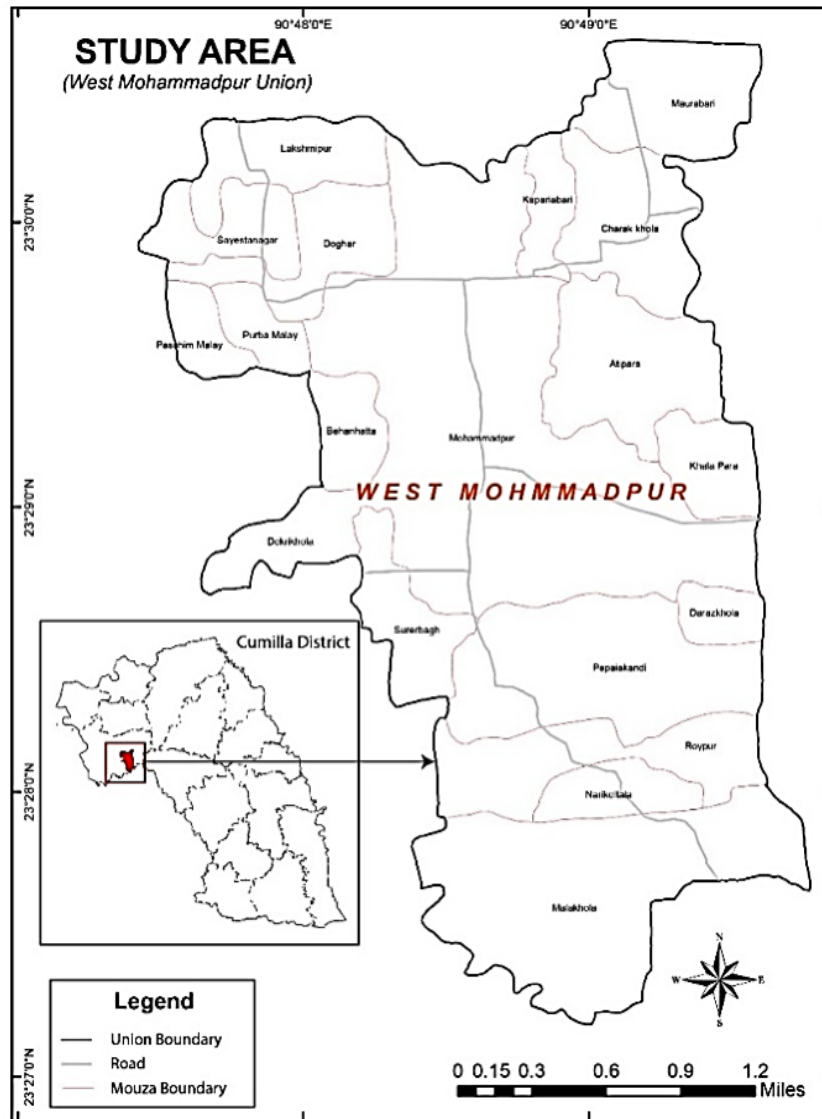


Figure 1: Mohammadpur Union, Cumilla District, Bangladesh



Table 1. Basic Information about the study area

<i>Criteria's</i>	<i>Information</i>
Mouzas	18
Male	17,457
Female	17,322
School, College, Mosques	13

### Materials and methods

In the present research the methodology outlined below was designed as a selection of the study area, sources of data (both primary and secondary), sampling techniques, data collection procedures, data analysis and statistical procedures.

Primary data were collected from (i) field observation; (ii) Focus Group Discussion (each group consists of 7-8 persons; 4-5 women and 3-4 men) and finally (iii) questionnaire survey (350 questionnaires have been conducted through random sampling and it's cover 350 household).

Interview of the respondents were analyzed by following sections-

- (a) Local communities: Focus Group Discussion (10 FGDs where each group consists of 7-8 persons; 4-5 women and 3-4 men).
- (b) Women who are involved in agronomic activities: There were 350 questionnaires conducted on women's agronomic activities, sampling type- randomly.
- (c) Head of households: Social and cultural barrier for the women participation in the agronomic activities.
- (d) Policy experts: University teachers, NGOs/GOs officials, community leaders.

Previous and present agronomic data, published and unpublished journals, conference papers, books, agriculture related government and non-government organization's records etc. were used as secondary data source.

Technological tools were used for further analysis of socio-economic and questionnaire data. The data were analyzed by following sections-

- (a) Study areas map was generated by ArcMap 10.5 using BCA datasets which were commonly used in Bangladesh.
- (b) Socio-economic data were analyzed by JMP statistical software.
- (c) FGD and experts opinions were captured through call recorder device and further analyzed by statistical software and finally;
- (d) Questionnaire data were analyzed by JMP statistical software which include agronomic, social and cultural data of the study site.

## Result and discussion

### Current Socio-economic condition of rural women

Socio-economic condition of rural women in the study area were considered based on five basic parameters i.e.; age of the respondents, Institutional Background, profession, monthly income and marital status of the respondents in the study area. These are given in the following table 2.

Table 2. Socio-economic condition of the respondents

Age of the respondents			Institutional Background			Profession			Monthly income (Tk)			Marital status		
Interval	f	%	Level	f	%	Types	f	%	Range	f	%	Status	f	%
15-25	62	17.7	Uneducated	162	46.29	House wife	120	34.28	0-1500	105	30	Married	269	76.85
25-35	102	29.14	PSC	67	19.14	Student	42	12	1500-3000	91	26	Unmarried	32	9.14
35-45	108	29.71	SSC/Dakhil	58	15.57	Service holder	14	4	3000-4500	41	11.71	Divorced	10	2.86
45-55	44	12.57	HSC/ Alim	37	10.57	Day labor	68	19.42	4500-6000	60	17.14	Widow	39	11.14
55-65	25	7.14	Vocational/Honours/ Fazil	21	6	Related in agronomic activity	106	30.28	6000-7500	30	8.57	<b>Total</b>	<b>350</b>	<b>100</b>
65+	9	2.57	Masters/ Kamil	5	1.42				7500-9000	23	6.57			
<b>Total</b>	<b>350</b>	<b>100</b>	<b>Total</b>	<b>350</b>	<b>100</b>	<b>Total</b>	<b>350</b>	<b>100</b>	9000+	35	10			
									<b>Total</b>	<b>350</b>	<b>100</b>			

Source: Questionnaire survey 2018, Here; f= Number of respondents as frequency

From the above table-2, it is observed that in the study area maximum respondents were aged between 25 to 45 years. This table also shows that the majority of the respondents were illiterate which is 46.29% of the total respondents. The rest of the respondents were literate which followed as PSC passed (19.14%), SSC/Dakhil passed (15.57%), HSC/Alim passed (10.57%), degree/Hons/vocational/Fazil passed (6%) and only 1.42% of total respondents are Master's/Kamil passed. In case of occupation, the majority of the respondents were housewives (34.28%) and Day labor (19.42%) whereas 30.28% of total respondents were directly related to agronomic activity (Cultivation, cattle grazing, micro farming etc.). On the contrary, only 10% of total respondents earned more than 9000 taka per month while 30% of total respondents earned nothing or less than 1500 taka per month. The majority of respondents (76.85%) are observed as married.

### Social status Index of women

The social status of rural women in Bangladesh is not satisfactory due to lack of education, self-awareness, financial dependency on others, social and religious hinders. According to BIDS (2005) women's social status was measured based on some parameters. These are (1) Institutional Background; (2) Workforce participation; (3) Economic status of women; (4) Women participation in family's events; (5) Social rights; and finally (6) Property rights.

- (a) Institutional Background: As per our constitution, education is a basic right for all the citizens of Bangladesh, both male and female equally. But due to many social

and religious obstacles and barriers, the scenario of women's education in our society is in a delicate situation and many factors like age, ethnicity, race, religion plays a vital role in this. In the said area, Women's educational situation is not satisfactory (Anonymous, 2017).

- (b) **Workforce participation:** According to table 2 the illiteracy rate of this area was 46.69% which means that half of the women in the study area were illiterate. As a result, most of them are directly or indirectly involved in primary economic activities like day labor. For this reason, their social and economic status is quite poor. On the other hand, literate women can participate in various economic sectors with better income which brings prospects in their life and family.
- (c) **Economic status of women:** In national context women are involved in various sector and they are playing a vital role in our society (Chowdhury et al. 2011). Employed women have the possibility to ensure their social status and progress. Women friendly policies and environments create a great opportunity to play a vital role to ensure effective participation of women in socio-economic development (Mohibbullah, 2013). In the study area women were actively involved in various economic events, especially in agronomic activities. But only 10% of 350 representatives earned over 9000tk/month whereas 30% women earns below 1500tk/month (Table 2).
- (d) **Women participation in family's events:** In Mohammadpur union women's contribution to family events are very high but these contributions don't recognize by their male family members like father, husband, brother and others. They have been given only a few rights to take any decision in any particular action in their family and society.

Table 3. Role on a family's decision-making of women

The opinion of the respondents	Frequency	Percentage (%)
Yes	98	25
No	202	57.71
No response	50	14.25
<b>Total</b>	<b>350</b>	<b>100</b>

Source: Questionnaire survey 2018

Table 3 consists 57.71% of the respondent could not play any role in their family decision. Only 25% of them were able to participate in family decisions. That represents the domination of males and showed how they neglected in their social life.

- (e) **Social rights:** Every human should have knowledge about his/her constitutional or social rights especially for the women. In this study area among the respondents only a few women were conscious about their social rights. If they realize their social rights, they can play role in any action and can take any initiative to increase the involvement of rural women.

- (f) Property rights: Women's inheritance right in property is always been neglected in Bangladesh. Gender biased laws in patriarchal society rules make difficult to access their land. In many places, religious misinterpretation is meant for women right In Bangladesh. Even some society deny the Muslim's shariah law in this issue.

### Participation of women in agricultural activities

In recent years, women's participation in agriculture has increased but their involvement in crop production has drastically decreased. However, women got more involved in livestock, poultry production and homestead agriculture which has increased gradually in recent years (Jaim and Hossain, 2011). As being the key human resources in rural development, women's productivity severely depends on their involvement rate in agricultural activities. Without their effective participation social and economic development will be incomplete. In Bangladesh, various social development program tends to treat women as a special target group. The policy framework now has been broadened which reflects various ways in which men and women relations constrain or advance efforts to boost growth and reduce poverty for all (Mohibullah, 2013). Therefore, rural women's involvement in various agronomic activities is generally considered as development program of any action. So, proper involvement of rural women can play a significant role in rural socio-economic development of Bangladesh.

#### (a) Women's involvement in various social programs

Nowadays, women are involving them in various events to support their families. Also, they were taking part in various agronomic activities for ensuring their family food security (Jahan, 2000). To improve their skills and to create awareness about economic solvency, there have been going some projects likely institutional program, Handicrafts training, NGOs credit, Health and hygiene program, Health and sanitation program like community clinic, education on early marriage, population and environment-related program, NGOs/GOs credit program, agri-loans, agricultural aids and foreign aids etc.

Table 4. Category of Women's involvement in social programs

Study sites information	
Program category	Percentage (%)*
Formal and informal educational/institutional program	14.0
Women development program (Handicrafts training, NGOs credit, Health and hygiene program)	22.0
Community development program (Health and sanitation program like community clinic, education on early marriage, population and environment)	33.0
NGOs/GOs credit	71.0
Credit program, agri-loans, agricultural aids, foreign aids	49.0

Source: questionnaire survey 2018\*Multiple answers were considered

Table 4 shows that the programs have been running in Mohammadpur union, Cumilla district where most of the running programs are micro-credit related and the majority of the respondents are directly involved in these programs. 71% of total respondents are involved with various Government and NGO credit programs. Whereas formal and informal educational/institutional programs have the least participation (14%) in the study area. Other skill development programs like Handicrafts training, green product training, etc. (22%) and some community development programs like health and sanitation programs, awareness on early marriage, etc. (33%) are also active in this study area.

### **(b) Working sectors segmentation**

In this study area majority of the respondents involved in agronomic activities that could be direct or indirect. Many of the respondents are involved in many types of activities at a time. within this, some of these are shown in Table 5 according to their working sector segmentation.

Table 5. Types of participation by the rural women on agricultural activities

<b>Types</b>	<b>Frequency*</b>	<b>Percentage(%)*</b>
Crop processing/harvesting	203	58
Cattle rearing	178	51
Homestead gardening	67	19
Crop cultivation	48	13
Livestock/poultry rising	44	13
Pisciculture	33	10
Seasonal vegetable cultivation	32	9
Horticulture	14	4

Source: questionnaire survey 2018\*Multiple answers were considered

### **Key problems confronted by women as obstacles during agronomic activities**

Rural women in the study area are faced with many barriers in their quest for effective participation in agricultural production. During collecting data, they highlighted a number of issues that are the main obstacles to their engagement in agriculture. Those obstacles are shown in table 6 below.

Table 6. Major complication for participation in agriculture

SL No.	Types of problem	Opinion (in %) *	Rank
01	Absence of institutional training/education	75	1
02	Lack of access to work in the agricultural field for pursuing agronomic activities	73	2
03	Capital and manpower crisis for agricultural activities	67	3
04	Fertilizer distribution anomalies by GOs and NGOs	63	4
05	Seeds management problems provided by distributors	53	5
06	Lack of proper knowledge to use insecticides	48	6
07	Absence of market facilities like hat/bazaar and seasonal barriers	40	7
08	Electricity and irrigation crisis during summer time	32	8
09	Poor transportation and communication facilities	22	9
10	Religious and social barrier	17	10

Source: Questionnaire survey-2018\* Multiple answers were considered

Table 6 indicates the constraints of rural women for spontaneous participation in Agronomic activities. This table indicates that the maximum respondents had no institutional or non-institutional training about agriculture before which followed by 75% of the total respondent. The majority of the women have lack of access to work in the agricultural field for pursuing agronomic activities which is almost 73% of them. Crisis of capital is one of the major problems of them to take initiative for cultivation which is almost 67%. GOs and Some NGOs distribute fertilizer among them but this amount is not enough for most of them. Almost 53% of them have complained about quality seeds. Some organization has been giving high productive seed for last few years but the amount is too poor for individuals. Proper market facility (40%), irrigation problem during summer (32%), Transportation problem for distribution (22%) and finally religious and social barrier (17%) discourage them to engage with agronomic activities in Mohammadpur Union, Cumilla district.

#### **A policy guideline for the involvement of rural women and some recommendation to improve agronomic activity intended for rural development**

While doing this research, some issues are carefully noticed that rural women are facing many obstacles in literally every way. Various Government and Non-Government projects have been running to develop the socio-economic condition of rural women but the result is in a very delicate situation for various causes. Based on comments of related experts and officials along with respondent's perception, a brief summary and recommendations has been made which is given below-

- (a) The religious and cultural views in this area are against the social and economic empowerment of women for which many projects of this cause have faltered due to the lack of cooperation from the local people and cultural bodies. Through intensive and class-oriented social publicity, the Government could help to create an improved impact on women empowerment in this region.
- (b) The government should ensure that the willing women can get their capital for firming and other economic activities through microloans with low interest and long tenure periods. Though the situation is gradually improving with the involvement of many venturing NGOs, it will be beneficial for both groups if the government ensures the security of financing at the root level.
- (c) Providing high-quality seeds, pesticides and fertilizers at a cheap rate to these women in the firming season will significantly improve their crop yield which is essential for the sustainability and growth of their socio-economic status. Though the Government has implemented some projects for this purpose, it needs more attention and financial subsidy so that the women can get the Government's full benefit.
- (d) Increase allocation in the national budget in education, training and literacy programs for girls and women in the farming communities to support women's role in agricultural production.

## **Conclusion**

Although women in Bangladesh are getting involved in various economic activities, the contribution of rural women in socio-economy is not satisfactory. Government and non-governmental organizations have already taken many initiatives but they have not yet been able to ensure the expected participation of rural women in economic activities. Social, economic, cultural and legal constraints working against their economic contribution to rural development. Therefore, gender discrimination, contempt for women and financial hardship are still prevalent in the rural society. Besides, women have not been allowed the chance to comprehend their maximum capacity. This study was found that a huge number of rural women directly or indirectly involve in agronomic activities but their contribution has not been recognized enough in our society. Furthermore, they are confined to spontaneous participation due to social, cultural and religious barriers. Through the proper guidance and training like skill acquisition program, technological training, agricultural school, conference etc. can play a significant role in rural areas of Bangladesh. The policymakers have the responsibility to face those challenges and it is mandatory to develop the rural economy by involving women who are almost half of the total population of Bangladesh.

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## **Inventorying the Present Cropping Pattern of the Bangshi Floodplain: A case Study on the Uttarparagaon Mouza, Dhamrai, Dhaka**

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**Suraia Arefin**<sup>\*\*</sup>  
**Mohammad Ali**<sup>\*\*</sup>

**Abstract:** This paper focused on present cropping pattern of the Bangshi Floodplain, a case on Uttarparagaon Mouza, Dhamrai. The cropping pattern of the study area and inventorying the relation between the land level and type of practiced agricultural crops is the main aim of this research. A cropping pattern is the yearly sequence, temporal and partial arrangement of crops in a given land area. Agriculture is one of the most important sectors in the economy of Bangladesh. It is the major source of livelihood in the rural areas, where about 80 percent of the populations live. Uttarparagaon Mouza is almost a plain having different types of features in terms of land use or land cover. It is an extended part of Madhupur-Bhawal Garh which is a part of Pleistocene terrace. Data have been collected from both of the primary and secondary sources. Firstly, for the identification of agricultural land use and its areal extent, Satellite imagery of this particular mouza have been downloaded from Google earth pro. Then Geo-referencing of the image has been completed through ArcMap 10.4.1. Using the indicators of visual satellite image interpretation, the agricultural land use including its areal extent have been identified and calculated. For getting data about cropping pattern, a questionnaire survey has been conducted among the 60 respondents who are selected thorough the random sampling method. Later, Microsoft Excel 2013 has been used for data processing and presenting through tables and figures. The presented data have been critically analyzed and put narratives on the basis of observations. Uttar Paragaon Mouza is an agriculture dominated area in terms of land use. The percentage of total agricultural land use is 72.07% with respect to whole area. Different type of cropping practices have been found in the study area. These are different according to the land level. There is an existing gradual sequence of cropping practice in the study area. Though this research has been conducted centering a small area but it can be a direction of relation between the land levels and its associated practiced agricultural crops.

**Key words:** Cropping pattern, land level, Kanda, Nal and Beel

### **Introduction**

Agriculture is one of the most important sectors in the economy of Bangladesh. It is the major source of livelihood in the rural areas, where about 80 percent of the populations live. (Hoque, 2001). A cropping pattern is the yearly sequence, temporal and partial arrangement of crops in a given land area. It is dependent on physical, historical, social, institutional and economic factors as well as government policies (Agrawal & Kassam, 1976). Approximately two-thirds of the labour force is employed in agriculture. Although its share in the GDP is predictably declining, agriculture (crops, livestock, fisheries and

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forestry) contributes approximately one-third of the GDP and agricultural production accounts for 32 percent of the value of exports. The performance of this sector affects the overall economic growth. With irrigation covering only around 42 percent of the potentially irrigated area, agriculture is still weather dependent and has grown slower than was earlier expected, particularly because of the predominantly small farmer holdings in Bangladesh (Hoque, 2001). The cropping pattern and the changes therein depend on a large number of factors like climate, soil type, rainfall, agricultural technology, availability of irrigation facilities (Shahidullah et al., 1970). However, Bangladesh is endowed with a favorable climate and soil conditions for the production of a variety of crops all the year round. The rich genetic estate, the richness in ecosystem diversity, and the vast untapped human resources who can learn and adopt new skills have been the major points of comparative advantage in Bangladesh. Thus, there are ample opportunities for crop diversification balancing the production of major crops with that of minor crops. Uttarparagaon Mouza is almost a plain having different types of features in terms of land use or land cover. It is an extended part of Madhupur-BhawalGarh which is a part of Pleistocene terrace. River Bongshi and Dholesschori flows nearby the study area. During wet season, huge alluvial sediments are settled down on the top-soil of the agricultural land. So, the agricultural arable land of this area is fertile and congenial for agricultural practices. Most of the agricultural practices are river based. As Bangladesh is influenced by monsoon climate, so there is a seasonal impact on agriculture. The livelihood of the local inhabitants is diverse due to the impact of the local climate and the presence of river course.

### **Aim and Objectives**

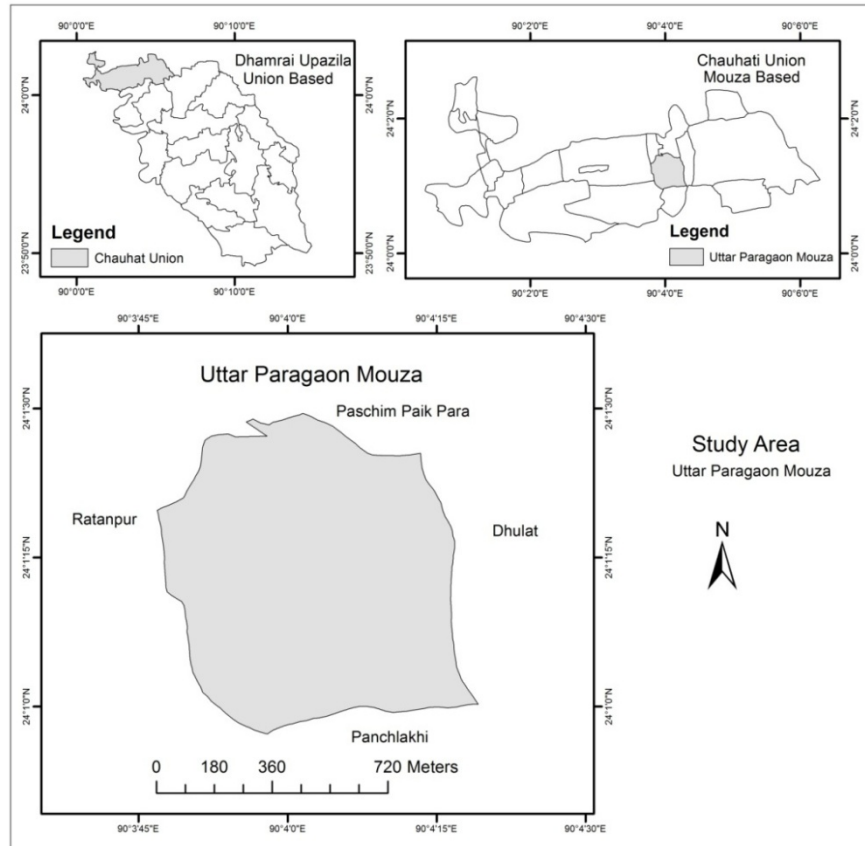
The main aim of this research is to explore the cropping pattern of the study area. To implement this aim, the specific objectives are:

- i. To identify the location of agricultural land use and its areal extension using satellite image;
- ii. To document the name of agricultural crops and its practices time (duration) of the year and
- iii. To relate the cropping pattern with the land level.

### **Study area**

Uttar paragaon Mouza is located in Dhamrai Upazila which is about 40 kilometers North-west of the capital city of Dhaka, it is one of the Mouza of Dhaka district. This Mouza is surrounded by the Paschim Paikpara on the North, Panchlakhi on the south, Ratanpur and Bakula in the west and Dhulat in the east which has been shown in Map 1. Uttar Paragaon mouza is located within the coordinates of  $24^{\circ}0'50.4''$  N to  $24^{\circ}1'22.8''$  N and  $90^{\circ}3'46.8''$  E to  $90^{\circ}4'19.2''$  E. The total area of this Mouza is 64.77 hectares. Uttar Paragaon mouza is composed of the alluvium soil of the Bongshi River. It is an important river in central Bangladesh.

Map 1: Location of study area (Uttar Paragaon Mouza)



Source: BCA data, using ArcMap 10.4.1

It originates in Jamalpur, from the course of the old Brahmaputra and flows past the Madhupur tract. It flows through Tangail and meets the Tongi in Gazipur. It passes near Jatiyo Smriti Soudho in Savar and falls into the Dhaleshwari. About 238 kilometers (148 mi) long, it is not navigable for most of the year except when swelled by the rains of the monsoon. Main exports Rice, jute, medicine, ceramic, vegetables. Extinct or nearly extinct traditional transport Palanquin, bullock cart, horse carriage. Average temperature is maximum 34.5<sup>0</sup> C and minimum 11.9<sup>0</sup> C.

### Data and Methods

Data collection is the primary and root level work or activities in a research of an area. For this study, both of primary and secondary data have been used. Firstly, for the identification of the agricultural land and its areal extent of the study area, satellite image of particular mouza have been downloaded from the Google earth pro with the help of administrative boundary of the particular Mouza using Bangladesh Country Almanac (BCA) data. After the completion of Geo-referencing, the agricultural land use and other associated land uses have been identified by visual image interpretation using ArcMap

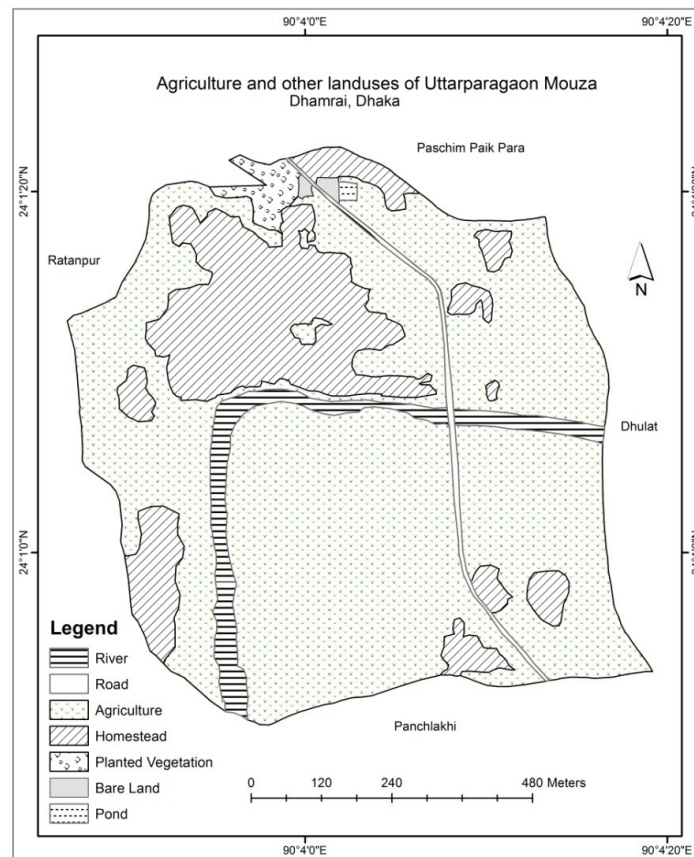
10.4.1. Using calculate geometry tools of ArcMap, the areal extension of every particular land use have been calculated. With the help of Microsoft Excel 2013, the percentages of all land uses have been calculated. For the identification of cropping pattern and relation between cropping pattern and land level, field observation, questionnaire survey and literature review have considered as data collection method. Then the collected data have been processed thorough the Microsoft Excel 2013 and ArcMap tools and presented through the table, figure and maps. Finally, data has been critically analyzed by giving narratives.

## Results and Discussion

Location of agricultural land use and its areal extension:

The location of agricultural crops have been enlisted and its areal extension has been calculated. From the map 2, it has been observed that the Uttar Paragaon Mouza is diversified for agricultural crops and its practices. 72.07 % of total land is occupied for agriculture. So it among the land uses, agriculture is the dominant. As the study area is a part of floodplain, so there is a optimum physical environment prevailing.

Map 2: Agriculture and other landsuses of Uttar Paragaon Mouza, Dhamrai, Dhaka



Source: Google Earth image, 2018; using ArcMap 10.4.1

Table 1: The percentage of land use at Uttar Paragaon Mouza

Feature	Area (in Hectare)	Percentage (%)
Agriculture	46.68	72.07
Homestead	13.48	20.81
Planted Vegetation	0.86	1.32
River	2.89	4.46
Bare Land	0.17	0.27
Road	0.61	0.94
Pond	0.08	0.13

Source: Google Earth image, 2018; using ArcMap 10.4.1

### **Documentation of the name of agricultural crops and its practices time:**

In general, there are three types of cropping season prevailing in this Mouza .These are- a. Kharif I, b. Kharif II and c. Rabi crop

#### **Kharif crop**

Crops grown during the season that starts from April and extends up to November, when the moisture supply from rainfall plus soil storage is enough to support rainfed crops. In other words, Kharif crops are grown in the spring or summer season and harvested in late summer or in early winter. The season is conveniently' divided into Kharif I and Kharif II. Kharif I, often called Pre-Kharif, actually starts from the last' week of March and ends in May. The Kharif season is characterized by high temperature, rainfall and humidity (Banglapedia, 2012).

#### **Rabi crop**

Crops grown in one of the two agricultural seasons called Rabi that begins at the end of the humid period when the Southeast monsoon starts ceasing in November and extends up to the end of March. The season is characterized by dry sunny weather and warm at the beginning and end, but cool in December-February. The average length of the Rabi growing period ranges from 100-120 days in the extreme west to 140-150 days in the Northeast part of Bangladesh (Banglapedia, 2012).

### Crop list of the study area

Table 2: The crop list (crop types and name of crops) of the study area

Cereals	Tuber and root crops	Pulses	Fiber crops
Aus, Aman, Boro, Maize, Wheat	Potato, sweet potato, Mukhikachu	Chickpea, Lentil, Grass pea, Cowpea	Jute, Mesta, Cotton
Stimulant crops	Oil seeds	Spices	Sugar crops
Tobacco	Mustard, Sesame, Groundnut	chilies, Onion, Garlic, Coriander, Black cumin, Ginger, Turmeric, Green chilies	Sugarcane
Fruits plants	Vegetables		
Banana, Papaya, Water melon, Lemon	Cabbage, Cauliflower, Brinjal, Tomato Radish, Spinach, Bottle gourd, Lady's finger, Bean, Cucumber, Sweet gourd		

Source: Questionnaire survey, 2018

### Crop calendar

Crop calendar of the study area												
Crop type Month	Rabi		Kharif 1			Kharif 2				Rabi		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cucumber, Lemon,			✓	✓	✓							
Aman ,Lady's finger,papaya,jute						✓	✓	✓	✓			
Boro ,wheat, Maize Lentil, Potato, Chickpea, Grasspea,Cowpea	✓	✓								✓	✓	
Sugarcane, Mukhikachu ,			✓	✓	✓							
Tobacco, Cabbage, Cauliflower, Brinjal, Tomato, Raddish, Spinach	✓	✓								✓	✓	✓
Brinjal, Potol			✓	✓	✓							
Bottle Gourd, Bean, Sugarcane, Black cumin, Coriander, Garlic						✓	✓	✓	✓			
Onion,Chilli, Groundnut, Mustard, Sesame	✓	✓								✓	✓	✓

Figure 1: Crop calendar of the study area; Source: Questionnaire survey, 2018

### Cropping pattern of the study area

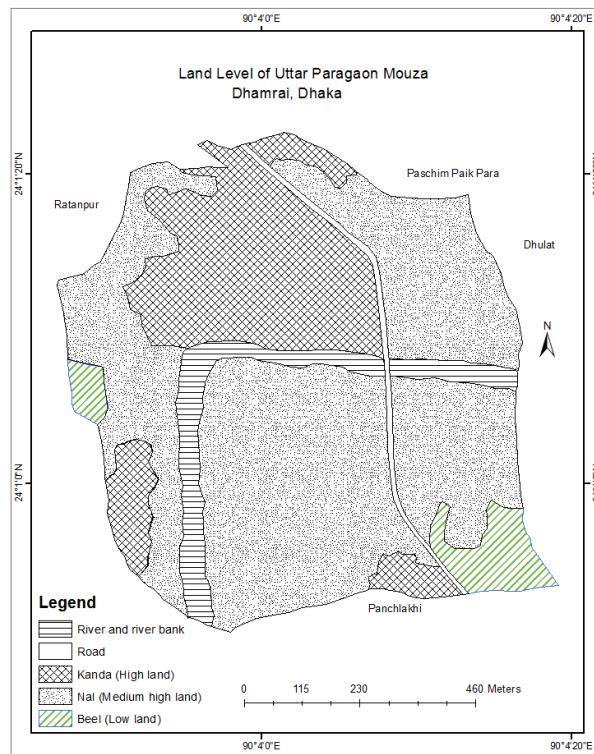
The people cultivate various types of crops which are described before but these crops are not grown same time. Crops are divided in three seasons in 12 months; such as: Kharif 1 (March to May), Kharif 2 (May to September) and Rabi (October to March). The crops are grown differently in these season, which are depicted in the figure 1.

### Relation of the cropping pattern with the land level:

Uttar Paragaon Mouza is a small area. Its area is 64.77 Hectares but this total area not only use in agriculture, also use, settlement, road and river. The river covered huge area in this mouza and river uses for fish cultivation, sometimes irrigation not all months. We discuss here mainly the cropping pattern of Uttar Paragaon Mouza. Cropping pattern include the agricultural land use in different time of the year. All the agricultural crops are not grown all kind of land, because of the variation of Soil quality, Land type, Climate and Irrigation facility which is illustrated in the figure 2. So it is understood that different types of crop grows at different types of land. Sometimes some crops are grown all types of land. The study area is characterized by three types of land. These are –1. Kanda (high land) 2. Nal (Medium high land) 3. Beel (low land).

### Land classification map

Map 3: Different types of land of the study area on the basis of land level





Source: Google Earth image, 2018; using ArcMap 10.4.1

Table 3: Different types of land and its percentage

Feature name	Area (in Hectare)	Percentage (%)
River and river bank	4.34	6.70
Road	1.00	1.54
Kanda (High land)	16.20	25.10
Nal (Medium high land)	40.20	62.00
Beel (Low land)	3.03	4.66

Source: Google Earth image, 2018; using ArcMap 10.4.1

The diagram show that different type of land .Such as high land (kanda), middle land (nal ) Low land (beel) and some area cover by river, it also low land . The area kanda covered 16.20 hectares, nal 4.20 hectares and beel 3.03 hectares.

### Land related cropping pattern

Table 4: Land type and associated cropping pattern of the study area

Land Type	Cropping Pattern
High (Kanda)	1. Boro - T.Aman – Fallow
	2. Potato - Boro (HYV) - T.Aman
	3. Pulses - Jute – Fallow
	4. Wheat - Kaon - T.Aman
	5. Tomato - Aus – Vegetables
Medium high (Nal)	1. Potato - Boro - T.Aman
	2. Wheat - T.Aman – Pulses
	3. Oilseed - Boro - T.Aman
	4. Boro - T.Aman – Mustard
	5. Tomato - Aus – Vegetable
Low (Beel)	1. Potato - BoroB.Aman
	2. Boro - T.Aman – Fallow
	3. Kaon - T.Aman – Fallow
	4. Wheat - Boro - T.Aman
	5. Jute - T.Aman – Fallow

Source: Field survey, 2018

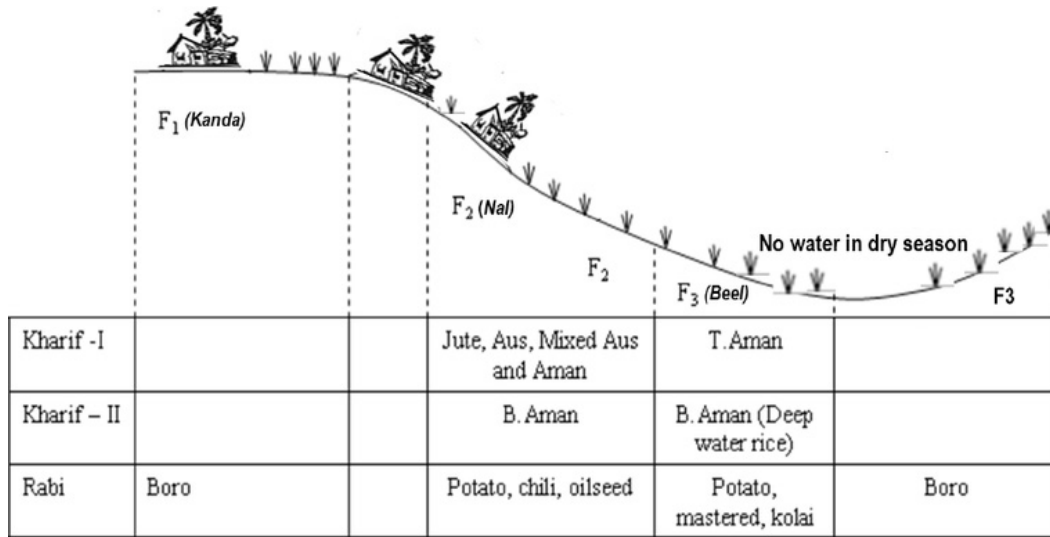


Figure 2: Agricultural crops of different season with the land level; Source: Talukder & Shamsuddin, 2012; modified by author, 2018

In the very low-lying areas, the cropping pattern is paddy cultivation followed by keeping the land fallow, although the pattern is changing over time. The reason behind such a pattern could be the early arrival of floods. In medium and high land, the main pattern is consecutive two paddy crops i.e. Paddy followed by paddy. On the other hand, in all topographic conditions, the general pattern is to keep land fallow after growing one non-paddy crop. Crop diversification, to whatever degree it takes place, is evident in high and medium land, as early flooding is unfriendly to vegetables, fruits and cash crops. That is why crop diversification is the lowest in low land, and relatively high in medium and high land.

**Findings**

- The location of agricultural land use has been demarcated and their areal extensions have been measured. Uttar Paragaon Mouza is an agriculture dominated area in terms of land use. The percentage of total agricultural land use is 72.07% with respect to whole area.
- Different type of cropping practices are found in the study area. Among these, Aus, Aman, Boro, Maize, Jute, Mustered, Onion, Garlic, Potato, Banana, Tomato, Cabbage, Brinjal, Ben, Pumkin, Chilli, Arum, Wheat are the most popular cropping practice.
- Cropping practices are different according to the land level. There is an existing gradual sequence of cropping practice in the study area; such as: during Kharif I and Kharif II, there is no agricultural practice at Kanda (High land), on the contrary there is a diversified cropping practice observed at Nal and Beel. During robi season, mainly vegetables are practiced in both of Kanda, Nal and Beel. Paddy productions are minimum robi season. Only Boro is cultivated at Kanda and low lying swamp area of the study area.

## Conclusion and Recommendation

Geographically, Uttar Paragaon Mouza is the extended part of Bhowal-Madhupur garh and it is a flood plain of Bangsi River. So the soil is very fertile and congenial for agricultural practices. Most of the time, cropping pattern follows a gradual sequence with the season and land level. As a flood plain, some part of this mouza is yearly flooded. So most of the agricultural land is refilled by new top layer of sediments. Consequently, agricultural land become fertile than previous condition. But sometimes, due to flood occurrence, this sequence may be changed in that particular year and the farmers have to face unwanted circumstance. To overcome that situation, farmers do not get sufficient assistance from the government or Non-governmental Organization. So this assistance should this sorts of assistance should be ensured at that particular critical moment. Besides, there is no data archive about the amount of crop production in Upazila office. So a modern data archive should be developed with the assistance of local government office. To encourage crop diversification, some prospective cropping patterns, improved practices and irrigation management should be demonstrated at different locations. The major problems in cropping practice are decreasing agricultural land, low socio economic condition of the farmers, problem in mechanization.

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## **Rural to Urban Transformation in Chittagong Hill Tract Region: Assessing the Linkage through Utility Services and Peoples' Satisfaction in Matiranga Municipality**

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**Dr. Md. Mizanur Rahman** \*\*

**Abstract:** The process of being urban is called urbanization. In Bangladesh, after 1990s the growth rate of urbanization increases rapidly. But this rate is not equal everywhere. Specially, this inequality is more intense in hill tract areas compare to other regions of Bangladesh. Variation of urban services and desirable urban conveniences are said to be the most important reasons of this growing inequality. This study has assessed the linkage through utility services and people's satisfaction in Matiranga municipality. Required investigations were based on perceptual as well as factual data sources. The perceptual data have been collected through field survey that mainly based on structural questionnaire and secondary information. To uncover the ground realities relating to peoples' satisfaction and the state of urban services, the interview method has also been applied. The present status of urban conveniences of Matiranga municipality has been explored through field survey data. A satisfaction index has been applied to determine the satisfaction level of existing urban facilities of Matiranga Municipality. The index focuses on how people are satisfied or dissatisfied with urban services. This study attempts to find out the necessary areas that require more attention for sustainable urban development. The assessment as well as the study result may useful as a starting point and/or may work as a guideline to develop comprehensive tools to evaluate the current status of urban services and people's satisfaction. It desirably brings a prescription for the local municipality which is helpful for identifying the 'areas of concern' and accordingly takes necessary steps to fulfill the sustainable development goals along with the government.

**Keywords:** Urban transformation, Satisfaction Level, Urban Convenience, Utility Services.

### **Introduction**

Urbanization refers to the increasing number of people that live in urban areas. Urbanization is not merely a modern phenomenon, but a rapid and historic transformation of human social roots on a global scale, whereby predominantly rural culture is being rapidly replaced by predominantly urban culture. Today, 55% of the world's population lives in urban areas, a proportion that is expected to increase to 68% by 2050 (Kawsar, 2012). Urbanization focuses on the increasing proportion of population living in urban areas. Bangladesh, as a developing country urbanization gradually rises here. According

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to population census-2001, urbanization levels in Bangladesh is still comparatively low (23.1 percent in 2001) and it fluctuates by the criteria of cities, (i.e. rate of urban population, urban environment, utility service provisions and its availability etc.). Bangladesh has a low level of urbanization for the country as a whole, there is significant variation in the level by districts or other geographic or administrative regions. Dhaka city is 88.31% level of urbanized on the other hand Chittagong hill tract areas are 11.85% (Nazem, 2003). This situation changes swiftly after 2005. It is predicted that almost half of the total population of Chittagong Hill Tracts will be urban population in 2030 (The World Bank, 2015). But the quality of urban environment in Bangladesh is not satisfactory (Sarker, 2009) that merely depends on some indicators like nature of infrastructure, modern facilities, quality of life style, utility services (sanitation, sewerage, drainage, drinking water supply, garbage disposal, electricity, gas and fuel for cooking) as well as the structure of management (Islam *et. al.*, 1997). There is clear record of highly inadequate supply of clean water, unhygienic sanitation condition and high incidence of diseases, violence, crime and social tensions in cities in Bangladesh (Kawsar, 2012). The development of any country relates strongly with the pace of urbanization. In the last century, 'no country has ever reached middle income status without a significant population shift into cities' (Annez and Buckley, 2009). But it has some negative impacts, especially on under developed and developing countries. The impacts of urbanization in Bangladesh ranges from mass poverty, gross inequality, high unemployment, under-employment, overcrowding, housing and proliferation of slums and squatters to the large deterioration in the environmental conditions those have become the major concerns of policy issue (Kawsar, 2012). The degradation in the quality of the urban environment is the consequence of several unplanned human activities, which may affect the environment either directly or indirectly. As the urban population grows the enhanced activities exceed the tolerable limits or carrying capacity of the urban area. Proper management of such activities or their outcomes is no longer possible resulting in a degraded environment. In this way rapid urbanization may lead to environmental degradation, which may be manifested in the deterioration of the physical as well as the human environment of the urban area and the rural environment encompassing it. It may also result in the destruction and degradation of different ecosystems having links with the urban area (Khuda, 2001). The Chittagong Hill Tracts (CHT) consists of three districts Rangamati, Khagrachari and Bandarban. They are located in the South-East of the country, near the Myanmar and Indian border and make up 10 per cent of the total land area of the country but only 1 per cent of the country's population. The total population in the CHT is about 1.3 million, of which 90 per cent lives in the rural areas. At least 11 different indigenous ethnic groups are available in this region, this is a unique part of the country, both in terms of landscape, ecosystem and its people. Over the last 30 years, Bengali settlers from other parts of Bangladesh have been allocated land in the CHT districts and now represent approximately 50 per cent of the CHT population (The World Bank, 2015).

Matiranga municipality, one of the fastest developing and growing cities under Khagrachari district. The area belongs to 25.5 square km. which was declared as municipality in 2002 (Matiranga municipality, 2018). It is located beside Chittagong-Khagrachari highway that influences much to grow as an urban center. At the initial stage

Matiranga municipality was not enough urbanized but it has developed much after sixteen years of its way.

### Aim & Objectives

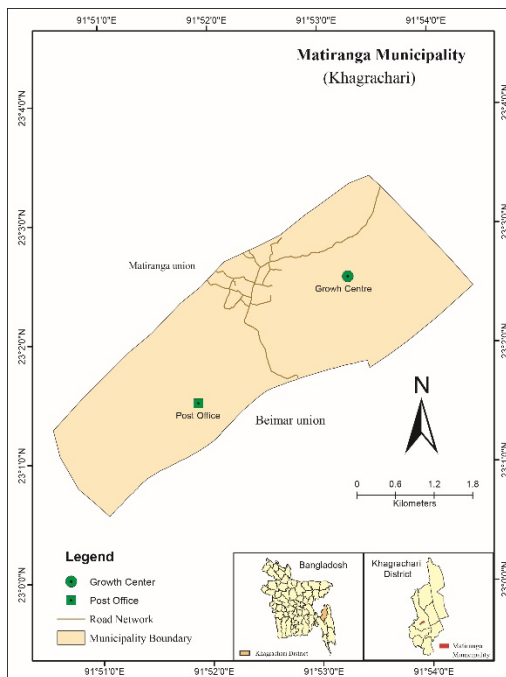
The main aim of this research is to examine the reason of rural to urban transformation considering the overall situation of urban livability in Matiranga municipality, Khagrachari. To obtain in-depth information or to fulfill the aim following objectives are set to complete the research work.

- I. To identify the trend of urbanization of Matiranga Municipality Area.
- II. To evaluate the urban conveniences considering the utility service provisions of the study area.
- III. To determine peoples' level of satisfaction on different existing utility services.

### Study Area

Matiranga municipality is located in South-eastern part of Bangladesh under Khagrachari district. It is a hilly region which declared as a municipality in 2002. Matiranga municipality is located between 23°0'32.37"North to 23°3'22.92"North latitude and 91°50'41.14"East to 91°53'56.25"East longitude. It is surrounded by Matiranga union in the North and Beimar union in the South. Matiranga municipality has been taken into consideration due to its recent growing trend of urbanization. Chittagong Hill Tract Districts seem to be a neglected part of Bangladesh due to different socio-political, economic, environmental, ethnic and environmental point of view. Processes of urbanization are also different compare to the plain land due to its different physical and cultural settings. Moreover, there is no study found that assess the trend of urbanization in the selected region. Hence, Matiranga municipality has been taken purposively as study area for the current study. This municipality currently covers 25.5 square kilometers having 7 Wards and 128 Mouzas. According to Bangladesh Bureau of Statistics (Population Census 2011) the number of household in this municipality recorded at 7931 with a total population count 32342.

Figure 01: Study Area



Source: Google Earth (Compiled by Authors)



## Data and Methodology

The present investigation was based on perceptual as well as factual data sources. The perceptual data have been collected through field survey which was based on structural questionnaire and interview. Total 164 selected samples were considered and simple random sampling technique has been adopted during data collection at the household level. Sample size has determined using the following equation-

$$\text{Sample Size} = \frac{z^2 \cdot P (1 - P) / e^2}{1 + (z^2 \cdot P \frac{(1-P)}{e^2 N})}$$

(Source: curioresearch.net, 2018)

Where, Confidence Level = 80%

Margin of Error = 10%

These factual data have been collected from various secondary sources like local authority, review papers, journals, books, magazines, newspaper and other recent publications, internet/online sources and national and international published data. The collected data and information i.e. perceptual and factual data, relevant literature and final tabulate supervision have been analyzed with the help of required computer software such as Statistical Package for Social Science (SPSS, version-18), Microsoft Excel and Microsoft word. The statistical data have been presented in the tabular and graphical form to make it easy and understandable. Furthermore, Historical satellite imageries have been collected from Google Earth Pro 7.1.1.1888 version and analyzed through ArcGIS (Version 10.3) to investigate the raising trend of urbanization and developed relevant mapping.

## Index of Satisfaction

To determine the levels of satisfaction concerning existing urban utility facilities and other associated urban environmental condition and convenience variables by the respondents, the following satisfaction index developed by Hall, Yen and Tan (1975) was selected (Majumder *et. al.*, 2007)

$$I_s = \left( \frac{f_s - f_d}{N} \right)$$

Here,  $I_s$  = Satisfaction Index  
 $f_s$  = Number of Satisfied Respondents  
 $f_d$  = Number of Dissatisfied Respondents  
 $N$  = Total Number of Respondents.

For this satisfaction index,  $I_s = +1$ , meaning highest level of satisfaction and  $I_s = -1$ , meaning highest level of dissatisfaction. The above satisfaction index has been used by Hossain 1995; Eusuf 1996 and Hasan, 1999 to determine the satisfaction index of respondents of various income groups and also determine the level of satisfaction index of urban environmental quality.

## **Urbanization in Bangladesh**

Urbanization refers to increasing number population living in urban areas. It is a long term process relevant to the conversion of rural areas to urban (Michael, 2002). Urbanization in Bangladesh increases at a high speed after 1995. Recently, Bangladesh performs faster urban growth amongst South Asian countries that observed between 2000 and 2010(The World Bank, 2015). At present 35.04% of the total population is living in urban areas where as it was only below 20% in 1990 (Statista, 2018). But it is matter of great concern that urbanization in CHT (Chittagong Hill Tracts) areas are remarkable and comparable with other areas of Bangladesh. In 2000, It was estimated that only 8-10% people of that area lived in urban places (Sarker, 2004).But in the last 25 years this situation improves much because of declaration of new urban centers in the CHT region.

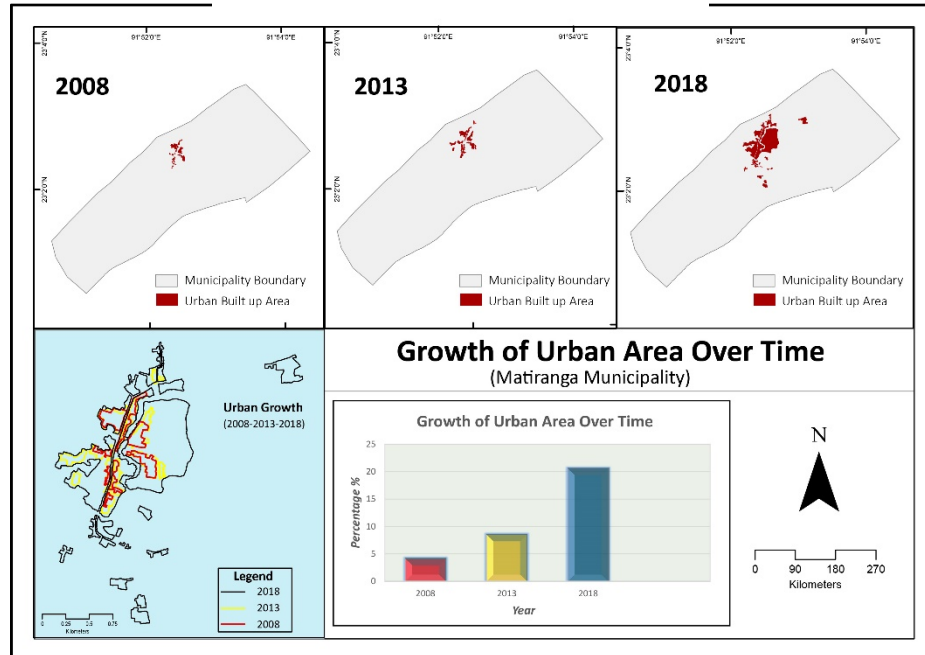
## **Trend of Urbanization in Matiranga Municipality**

Urbanization trend indicates the gradual transformation of rural landuse to built-up urban landuse or increase of urban area over time. Generally, it focuses on the gradual change of urbanization of a particular period over an area. Matiranga municipality was declared in 2002 for inspiring the socio-economic and structural development. But the output was not satisfactory in six years of its age. In 2008, only 4.18% (613 acres) of its total area used as urban settlement. The concentration of urban land use was confined on the Chittagong-Khagrachari highway only. This condition was not so much improved until the end of the year 2012. In 2013, Proportion of urban land use slightly increased and it was 8.58% (1024.87 acres) of the total area. It shows a positive sign especially after 2016 with the upraising trend of urban land use. Now-a-days (2018), the proportion of urban land use of Matiranga municipality is more than 20% (4319 acres) of the total area. Mainly, the urbanization trend has changed over time because of the construction of new urban structure, development of new road network and different initiatives taken by municipal authorities along with the local administration.

## **Existing Urban Utility Services and the State of Convenience**

Urban conveniences indicate the opportunities or the urban basic amenities or the utility services that we enjoy while living in urban areas. The opportunities include transport, health care, electricity, waste management, water supply, drainage, sanitation and so on. This research intends to observe the status of the different urban services like transport communication, health care, water supply and sanitation, fuel, gas, electricity facilities, solid waste management and quality of urban environment in the Municipal area. Considering the satisfaction level index an attempt has been made to take opinion from the city residents considering above mentioned urban services those are directly associated with the urban convenience.

Figure 02: Growth of Urban Area over

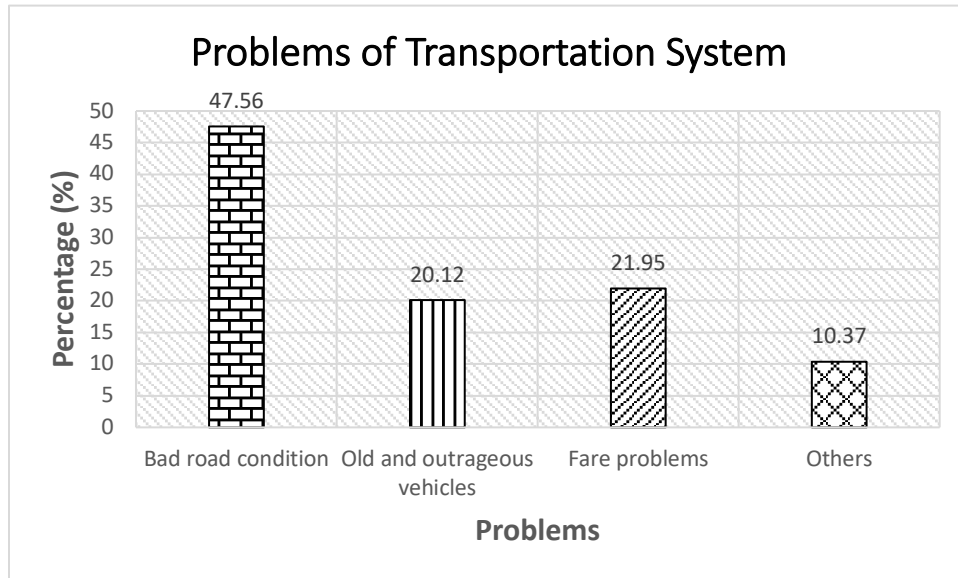


Source: Google Earth (Compiled by Authors)

## Transport System

Generally, transport system in urban area depends on various things such as driver, helper, pedestrian, passenger, traffic and signaling system, type of vehicle/transport, surface of road and their overall management system. In Matiranga, main transport media is auto rickshaw, bus, private car and mixed vehicular (Different vehicles in the queue including small vehicles and heavy vehicles and different traffic participants including pedestrians, bicyclists and motor vehicles) (TRB, 2008) and level of transport management is not well enough. Bad road (i.e. narrow, broken road, big hole in the road), dreadful condition of transport (old and outrageous condition of the vehicles) and fare problems (over charging tendency) are the main hindrance of existing transportation system of the municipality area. According to the field survey, about 47.56% people of Matiranga suffers due to dreadful road condition while assessing their experience on their existing transportation system. Similarly, dreadful transport services and fare problem seem to be intense as more than 42% people raised these issues. Rest of the people opined that rough behaviour and harassment are very common and without proper remedies of such problem the transportation sector will not be improved in the municipality area (Field Interview, 2018).

Figure 3: Problem of Transportation System



Source: Questionnaire Survey, 2018

### Health Care System

Government hospital (Khagrahari District Sadar Hospital) is the main and major healthcare service provider of Matiranga municipality. Minor healthcare services include Matiranga upazilla health complex and medical care centers run by different NGOs. They provide healthcare facilities for lower class people and middle income groups. High income group get healthcare facilities from private hospitals of Chattogram City. In Matiranga, people are often facing known and unknown diseases. Respondents opined that major health hazard is Malaria (35.37%), Typhoid (27.44%), Diarrhea (7.93%), and Dysentery (3.00%). It is noticeable that about 29.26% respondents claimed that they are affected by non-familiar/rare diseases in this area (Field Survey, 2018). Especially infants and pregnant mothers suffer from vaccine preventable diseases such as measles and neonatal tetanus and proper delivery cases in this area. Polluted and contaminated water and lack of awareness as well as mosquito is regarded as the main disease vector in this area, (Field Survey, 2018). Although people are not satisfied regarding their current state of healthcare services they prefer to live in the municipality area. Remoteness as well as lack of transportation, road network and inaccessible location poses serious threat to peoples' lives and thus people are moving towards the city area.

### Sources of Drinking Water and Sanitation

In Matiranga municipality, people are using different types of water source for their drinking and other household purpose. These sources include hand tube well, piped water supply, well, rainwater harvesting and fountains. Tube well (59.15%) and piped water (16.46%) are prime source of water within the core municipality area; while well, rainwater harvesting and fountains are also used especially in the outer edge of the city.

Most of the respondents are satisfied with the quality of their water as about 55.49% respondents claimed water quality as good followed by 25.61% declared as moderate. It is noticeable that about 18.9% respondents are not satisfied with their drinking water quality and claimed as bad. In few cases respondents mention the presence of iron, sand, earthworms and even insects in their water. During the field survey, people also mentioned the problems associated with limited connection of municipal piped water and the lack of maintenance in the piped network in the municipality area (Field Survey, 2018).

Sanitation status in household level cannot be judged properly as it depends on the income level and the residential structure of the dwellers. In the study area, people use different types of 'pucca' sanitary latrine, unsanitary 'kutcha' latrine, hanging latrine and open defecation for their natural call. There is no sewerage network in the municipality however, different types of septic tank and ring slab latrines are widely used as 'pucca' sanitary latrines. According to the field survey data, about 46.95% respondents use 'pucca' latrine whereas, 26.22% use 'kutcha' latrine, 15.85% use hanging latrine and a remarkable 13.0% used to defecate in nature or open spaces in the Municipal areas. It is remarkable because the country is going to achieve total sanitation as only 3% people defecate in the open (JMP 2014 cited in Hanchett, 2016). Therefore, Matiranga municipality requires more sanitation related activities and projects to improve the sanitation status and correspond with national sanitation status.

### **Source of Fuel**

The quality of urban lifestyle mostly depends on the source of fuel. In this study, the source of fuel indicates the materials that people used to cooking purpose. Most of the urban areas of Bangladesh use pipeline gas connection, cylinder gas and kerosene oil. The uses of bio-fuels in urban areas are generally rare in the context of Bangladesh. However, in Matiranga municipality about 73.78% respondents use bio-fuels which are collected from nearby forest, homestead vegetation, 'jhum' cultivation, husbandry etc and the rest use cylinder gas, Kerosene stove, electric heater, etc. In regard to the use of bio-fuel in cooking purpose Matiranga municipality achieved more environmental friendly way to reduce the fuel crisis.

### **Electricity Supply**

Supply of electricity in 2021 to all remote parts of the country is one of the biggest challenges of Bangladesh government. In Matiranga municipality, the proportion of electricity user increases between the year 2001 and 2011. In 2011, 28.58% people lives with electric facility where it was only 8.21% in 2001 (BBS 2001 & BBS 2011). According to field survey, the current electricity coverage has been figured out from the municipal authority which increased around two-fold compare to the situation in 2011. Questionnaire Survey revealed the fact that people are somehow satisfied with their current state of electric supply system. Only few respondents claimed that the system needs to be improved while they are experiencing with frequent load-shading, problems associated with illegal electric connection, meter tampering, etc. Interestingly, from the people's opinion during the interview it is found that people from the rural areas basically

coming to the Municipality area due to take advantage of electricity as most of the rural/remote areas are not under electricity coverage.

### **Household Waste Management**

Solid waste management is the major concern of municipality authority because mismanagement of waste perceptibly creates different types of environmental hazard i.e. air, surface and ground water and soil pollution that may create urban flood or water logging, offensive odor, breeding point of mosquito, flies' rodent and encroachment of footpath in urban area. In Matiranga municipality area, household waste management is found to be unscientific, disorganized and hazardous for the urban environment. From the field survey, it is found that about 19.51% respondents usually dump their waste in the holes that have been created near to their house. It is a community based initiative and may regarded as good practice while those respondents also argued that the municipality authority never served their area. About 12.80% respondents used to throw their household waste in municipal dustbins. It is claimed that those dustbins are not emptied regularly that create nuisance and odor and people seem to be dissatisfied about their waste collection and overall management system. About 40.24% respondents dump their waste haphazardly in nearby fallow logs while the rest not follow any specific waste management practice (Questionnaire Survey, 2018).

### **Level of Satisfaction**

Level of satisfaction in this study shows the amount of satisfied and/or dissatisfied respondents against the present state of different municipal services. Generally, the quality of life is found to be better than the people living in fringe and remote rural settings. People's expectation may vary from one urban area to another on the basis of the level of urbanization, economic concentration, availability of facilities, the nature of income group, etc. Matiranga municipality is a rising urban area and geographically located in underdeveloped region having comparatively less population. This city is developing its facilities and services in maintaining a slow pace. In this study, the level of satisfaction has been analyzed through using the satisfaction index and tried to develop the rank of different municipality and other available existing services in the municipality area. Considering the satisfaction index, an attempt has been made to identify people's opinion on the level and rank of conveniences on different municipal and other services which is presented in the following table.

Table 01: Level of satisfaction and Rank on different urban services and conveniences

Urban Conveniences	Number of Satisfied Respondent ( <i>F<sub>s</sub></i> )	Number of Dissatisfied Respondent ( <i>F<sub>d</sub></i> )	Satisfaction Index Is= $\frac{(F_s - F_d)}{N}$	Satisfaction* & Rank**	
Health Care System	9	155	-0.89	D	1
Fuel Source	14	150	-0.83	D	2
Waste Management	22	142	-0.73	D	3
Electric Facility	33	131	-0.6	D	4
Education Facilities	42	122	-0.49	D	5
Sanitation	43	121	-0.46	D	6
Water supply	67	97	-0.18	D	7
Market Facilities	68	96	-0.17	D	8
Transport Facilities	74	90	-0.09	D	9
Religious Institution	89	75	0.08	S	4
Settlement Structure	91	73	0.11	S	3
Social Bondage	93	71	0.13	S	2
Environmental Quality	137	27	0.67	S	1

\* Level: S= Satisfied; D= Dissatisfied      \*\* Rank Indicates the Level of Satisfaction

Source: Questionnaire Survey, 2018

According to this assessment, Majority portion of urban population of the study area thinks about the urban facilities are not satisfactory in Matiranga municipality. Health care facilities (-0.89) has shown the highest negative value in the satisfaction index. Inadequate number of registered doctor, illiterate/inexperienced nurse, insufficient medicine, lack of operational instruments and facilities like x-ray and other diagnostic facilities, unsuitable condition of hospital environment are the main barriers. As a result, citizens' are dispossessed to obtain proper x-ray report, test and nursing from this institute in the area. Economically solvent people get health care facility form private doctors which is not affordable for all.

People of Matiranga talk about the crisis of fuel and it is placed as rank two of satisfaction level with the score of -0.83. The majority portion of the people in this area use bio-fuels, clay stoves, kerosene stove because of the absence of piped gas connection. Only higher class people use cylinder gas but it is not available everywhere. Another major crisis of the study area is household waste management. It is placed as third rank of highest negative value of satisfaction index. Undulating surface is common land space in hilly area, citizens' throwing households waste in fallow land, dumping hole (near house), open municipal dustbin and vacant and open place in their residents because of

the lack of dustbin and absence of community based household waste carrying van facilities.

Furthermore, a large scale of dissatisfaction presence in electricity, education facility and sanitation facilities. These are ranked as 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> in the satisfaction index. People of Matiranga expect continuous supply of electricity but they are not getting it as frequent load-shading is evident. They also think about the more development in educational sector. Mainly, they talk about the lack of qualified teacher, modern education institutions etc. They also concerned about the sanitation facilities too. Overall, people of the study area are not much satisfied about water supply, market and transportation system. During the interview a resident (age 52) in the municipality area refer to their day-to-day sufferings in the following way.

*“How do you define it as an urban area? Urban facilities are not available here. No connection of gas, water supply, and absence of well-developed schools and colleges, absence of well facilitated hospital are common here. We just got the declaration as a paurashava. We pay taxes every year but where are our services? You can't imagine how far we have to go to buy a bottle of cylinder gas, we need to move 10-15 km, to consult with a reputed doctor we have to travel to Bandarban Sadar or Chittagong town.”*

This type of vocalization is very common in Matiranga municipality. In the study area, most of the people are not satisfied about their urban services those have created to increase their convenience. Specially, people of the study area talked more about the weaknesses of health care system. Almost 90% people believed that health care system of Matiranga municipality is not performing enough that can meet the expectation of the residents. Another nail-biting issue is the supply of fuel. More than 75% people are disappointed about this issue (Ali and Molla, 2010). People are also concerned about the education facilities, water supply, sanitation and transportation system. According to local resident Farook (35)...

*“An urban living is similar to having the facilities of modern social life”*

That means modern facilities are the first priority to be an urban area. But summarization of the opinion of local people clears that urban conveniences are not enough satisfactory for them. According to the Mayor of Matiranga municipality...

*“As a hill tract area it is quite difficult to manage all modern facilities at a time. Matiranga municipality is not a mature one in compare with well managed one. We have many limitations and problems. We try our best for the betterment of the overall condition.”*

The statement clears that the officials of Matiranga municipality work with a lot of limitations like lack of budget, man power and under the policy and regulatory framework. However, it is found that the authority pays less attention on the public demand. Development is always appropriate where concentration of population is more and all the development policies become successful if it can serve the target groups. That's why the first priority should be taken into consideration about perception of the target group about the problems. The current practice needs to be replaced with more



focused planning and municipal activities as it is extremely necessary in the Matiranga municipality to overcome all constrains.

On the contrary, respondents show positive response about the religious institutions, settlement structure, social bondage and quality of environment in the municipality area. That usually means, to improve the urban environment the authority of Matiranga municipality should focus on those sectors of dissatisfaction on the basis of the value mentioned in the column of level of satisfaction index (Table 01).

## Conclusion

Bangladesh is a developing country. Mainly the level of development of a nation depends on several criteria. Among them growth of urban center and raising trend of urban population is most common. In Bangladesh both of these increases much in last twenty years. Matiranga municipality is located in Khagrahari district. It is declared as an urban center in 2002. The region is geographically distinct from the plain land, made up of very steep, rugged hilly terrain, remoteness of villages and various political issues associated with protracted conflict in CHTs. The majority of people live in poverty, unemployment is rife, there is an overall lack of economic opportunity and the proper functioning of various social services is inhibited (Sarker, 2004). Agricultural activities are the prime source of household income and the annual net household income of a rural household is around USD 925, supporting an average family of 5 persons (Ali and Molla, 2010). About 75 per cent of CHTs households are living below the lower poverty line (< USD 12 per person per month) and 86 per cent below the upper poverty line (<USD 15 per person per month)(The World Bank, 2015). But as a municipality area people of this area expect some urban facilities and better life style with their low income. It is a difficult task but proper management and planning of the responsible authority can play a big role to overcome this situation.

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## Comparison between NDWI and Unsupervised Classification for Urban Water Bodies Identification Based on Landsat Data

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**Abstract:** In recent time, remote sensing techniques are most common and well known for water body identification; especially in wetland. Several classification methods and machine learning algorithms are being used for water body extraction from satellite image data. However, the study is an attempt for the identification of reliable and accurate machine learning algorithm from the unsupervised classification techniques and NDWI method. Dhaka Metropolitan (DMP) area is chosen as the case study area to detect water body. Low and mid resolution Landsat sensor data of 1975, 1995 and 2014 have been used for this objective. Major findings from this study revealed that the water body of DMP area are decreasing deliberately and reduction rate of water bodies is 14.83% from 1977 to 2014. Another significant finding also shows that NDWI method gives higher value than the unsupervised classification techniques both in area and accuracy assessment report which is 66% for unsupervised classification and 86% for NDWI. As a result, this study delineates that NDWI is much more reliable and accurate than the unsupervised classification techniques. As a recommendation of the analysis of this study, it can be declared that NDWI techniques can be used for water body identification for its accuracy.

**Key Words:** Remote Sensing, Machine Learning Algorithm, Unsupervised Classification, NDWI, Accuracy Assessment.

### Introduction

Urban water bodies are important parts of the urban ecosystem that are of great significance for urban environmental testing, urban heat-island effects, and urban ecosystem maintenance (Chen et al. 2018). However, water resources over urban areas are gradually decreasing due to the rapid urbanization, population growth, agricultural irrigation, and environmental degradation. Therefore, it becomes an important task to retrieve and monitor the urban water information for management and decision-making of water resources in urban areas (Huang et al. 2015).

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Now-a-days, remote sensing technology plays a very important role on detecting, extracting, and monitoring surface water (Acharya, Subedi, and Lee 2019). There are numerous studies which focused on wetlands or water bodies using remote sensing images and techniques (Yagmur, Musaoglu, and Taskin 2019). Open and free access mid-resolution multi-spectral satellite images such as Landsat brings further benefits in the process (Qiao et al. 2012). Thus, the authors begin to utilize the Landsat database to extract surface water from Landsat scene that covers different types of surface water along with features that resemble water, such as shadows, forests, built-ups, snow and clouds (Acharya et al. 2019).

For a more accurate estimation of wetlands, several water indices have been developed for detecting water area and jointly been used with spectral bands of the satellite images (Yagmur et al. 2019). Among all those indices Unsupervised Classification Techniques, Normalized Difference Water Index (NDWI), Modified Normalized Difference Water Index (MNDWI), Water Ratio Index (WRI), and Normalized Difference Vegetation Index (NDVI) shows better results than those of spectral bands. From these indices the Normalized Difference Water Index (NDWI) & Unsupervised classification techniques are used to identify the waterbodies in Dhaka Metropolitan area from 1977 to 2014.

Machine learning algorithms have gained popularity for classification of land use/cover such as wetland classification (Yagmur et al. 2019). To identify the accuracy between those two machine learning algorithms for urban water body extraction is the main purpose of this study.

### **Study Area**

Dhaka Metropolitan (DMP) area of Bangladesh is located between latitudes 23°42' and 23°54'N and longitudes 90°20' and 90°28'E. Dhaka is the economic, political and cultural center of Bangladesh. It is one of the major cities of South Asia, the largest city in Eastern South Asia and among the Bay of Bengal countries; and one of the largest cities among OIC countries. As part of the Bengal plain, the city is bounded by the Buriganga River, Turag River, Dhaleshwari River and Shitalakshya River (Banglapedia 2019).

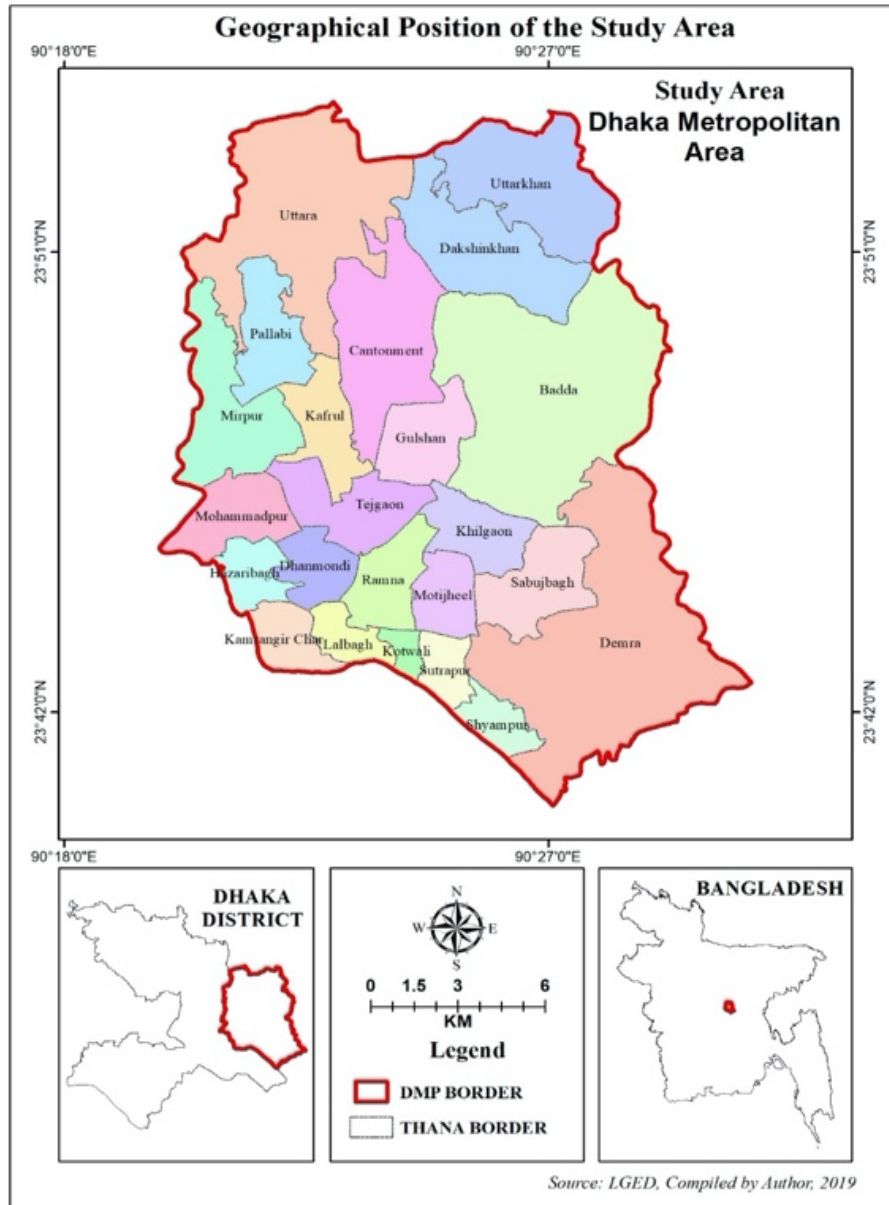


Figure 1: Geographical location of DMP

### Data Acquisition

The Landsat data of (1977, 1995 & 2014) are downloaded from USGS Earth observation website (<https://earthexplorer.usgs.gov/>) (Table1). Images collected throughout the cold-dry period generally the month of January were selected for downloading, to lessen the effect of cloud and rainfall (Giri et al. 2008). Though in this study the water body are extracted from the satellite image so rainfall has a significant effect on it. As it known that

due to huge rainfall the low laying landmass and many other places are filled with rainwater and then it looks like as a water body but in reality it was not a water body. For this reason the rainfall data are also considered to minimize the error. The rainfall data are collected from the Bangladesh Meteorological Department (BMD) and here it seen that there is no rainfall in last 15 days of image acquisition date.

Table 1: Properties of Landsat Imagery and Rainfall Data

Sensor	Year	Projection	Path-Row	Date Acquisition Date	Spatial Resolution (m)	Rainfall in Last 15 days of Acquisition date (mm)
LS02 MSS	1977	UTM	147-44	03/01/1977	60	00
LS05 TM	1995	UTM	137-44	05/01/1995	30	00
LS08 OLI	2014	UTM	137-44	25/01/2014	30	00

Source: (USGS, 2019) & (BMD, 2018)

## Materials & Methods

In this study the Landsat are mainly used for water body identification and classification by using NDWI and Unsupervised techniques. Landsat data are mainly a combination of several bands according to their wavelength (blue band, green band, red band, infrared band, thermal band, panchromatic). Landsat MSS having a total of 4 band, while Landsat TM & OLI have gradually 8 & 11 bands. For calculation the Normalized Difference Water Index (NDWI) only two bands (NIR & Green) are needed (Linkedin 2019). Landsat MSS, TM & OLI data's band, wavelength are given below (Table 2).

Normalize Difference Water Index (NDWI) is use for the water bodies analysis. The index uses Green and Near infra-red bands of remote sensing images. NDWI is developed by Gao (1996) to enhance the water related features of the landscapes. This index uses the near infrared (NIR) and the Green bands (Linkedin 2019). NDWI can be calculated by following formula:

$$NDWI = \frac{\text{Green} - \text{NIR}}{\text{Green} + \text{NIR}} \quad (\text{Choung and Jo 2017})$$

$$NDWI \text{ for Landsat 2 (MSS)} = \frac{\text{Band 4} - \text{Band 6}}{\text{Band 4} + \text{Band 6}}$$

$$NDWI \text{ for Landsat 5 (TM)} = \frac{\text{Band 2} - \text{Band 4}}{\text{Band 2} + \text{Band 4}}$$

$$NDWI \text{ for Landsat 8 (OLI)} = \frac{\text{Band 3} - \text{Band 5}}{\text{Band 3} + \text{Band 5}}$$

Table 2: Landsat Band and Their Spectral Wavelength

Bands	MSS (Landsat 1-3 MSS)		TM (Landsat 4,5 TM)			OLI (Landsat 8)			
	Band 1	NA		<b>Blue</b>	0.45-0.52	30 m	<b>Coastal Aerosol</b>	0.433-0.453	30 m
Band 2	NA		<b>Green</b>	0.52-0.60	30 m	<b>Blue</b>	0.45-0.515	30 m	
Band 3	NA		<b>Red</b>	0.63-0.69	30 m	<b>Green</b>	0.52-0.60	30 m	
Band 4	<b>Green</b>	0.5-0.6	80 m	<b>NIR</b>	0.76-0.90	30 m	<b>Red</b>	0.63-0.68	30 m
Band 5	<b>Red</b>	0.6-0.7	80 m	<b>SWIR</b>	1.55-1.75	30 m	<b>NIR</b>	0.84-0.88	30 m
Band 6	<b>NIR</b>	0.7-0.8	80 m	<b>TIR</b>	10.40-12.50	120 m	<b>SWIR -1</b>	1.56-1.66	30 m
Band 7	<b>NIR</b>	0.8-1.1	80 m	<b>SWIR</b>	2.08-2.35	30 m	<b>SWIR -2</b>	2.10-2.30	30 m
Band 8	NA		<b>Pan</b>	0.52-0.90	15 m	<b>Pan</b>	0.5-0.68	15 m	
Band 9						<b>Curus</b>	1.36-1.39	30 m	
Band 10						<b>TIRS -1</b>	10.6-11.2	100 m	
Band 11						<b>TIRS -2</b>	11.5-12.5	100 m	

Source: (NASA 2019)

Rather than this equations several GIS (Geoprocessing, Digitizing, overly analysis, Mapping) and RS (Layer Stack, Visualization, Subset) methods were also adopting in this research work. Microsoft (MS) word and Microsoft excel were also used for data processing in different steps. From the data collection to result analysis, every step is given in the following methodological framework (Abburu 2015).

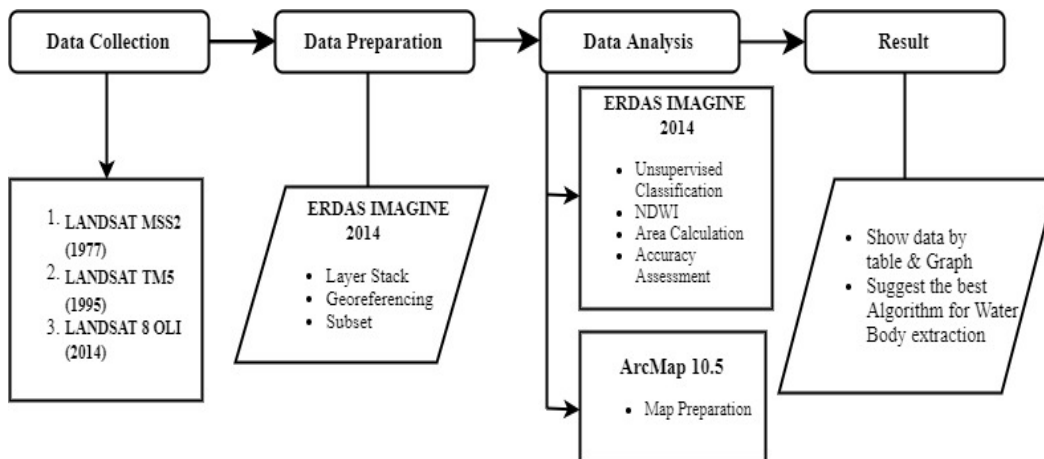


Figure 2: Methodological Framework



### Water body Area Calculation Using NDWI Technique

On the basis of the proposed equation the NDWI method the water body are identified in this study. By using the NDWI techniques the water body area of DMP are calculated here and that are shown in the table 3. Here from this table it seen that the water body in DMP area are decreased at an alarming rate. It reduced at least 4906.23 ha in this 37 years interval from 1977 to 2014.

Table 3: Area of Water Bodies in DMP by NDWI from 1977 to 2014

Categories	1977 Area (ha)	Accuracy Assessment		1995 Area (ha)	Accuracy Assessment		2014 Area (ha)	Accuracy Assessment	
		User's	Producer's		User's	Producer's		User's	Producer's
Water body	7292.54	76 %	90.48%	5206.89	78%	90.70%	2386.31	88%	89.80%
Land	24082.8	92%	79.31%	26168.5	92%	80.70%	28989.06	90%	88.24%
Total	31375.37			31375.37			31375.37		

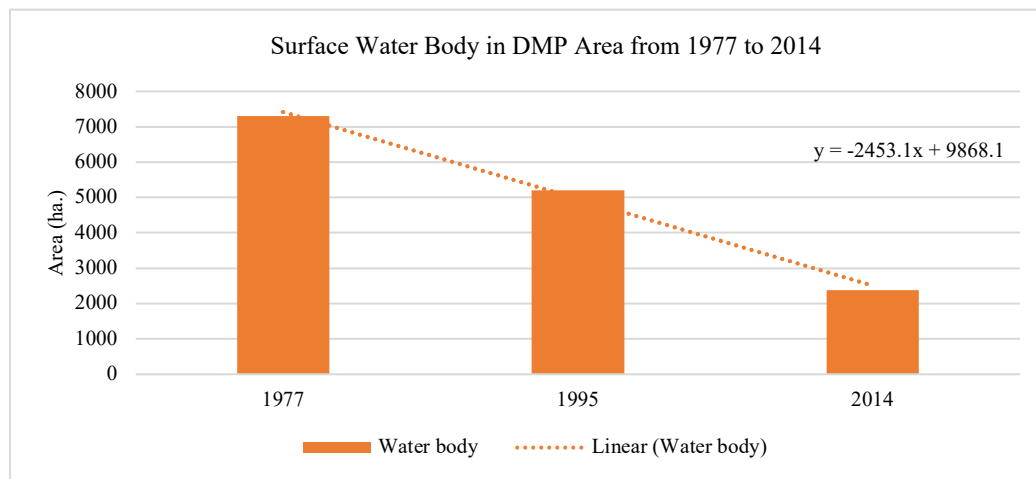


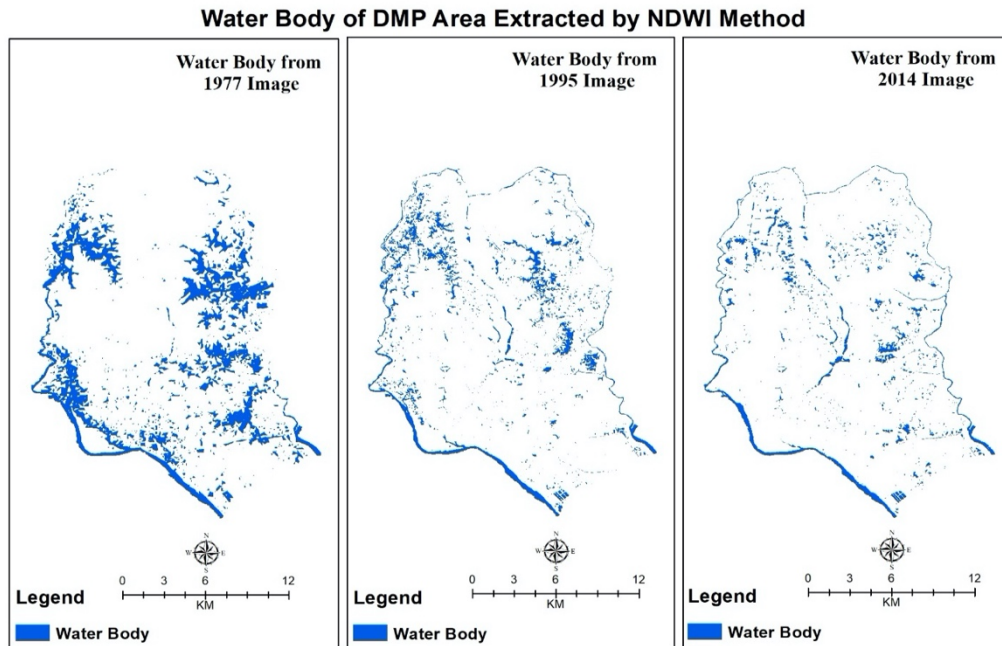
Figure 3: Surface Water Body in DMP Area by NDWI from 1977-2014

The figure 3 indicate that the water body in DMP area are decreasing continuously. Though it is an urban area so the rapid urbanization process and industrialization is the main reason for this. From the year 1977 to 1995 in this 18 years interval the water body decreased almost 2085.65 hectares and from the year 1995 to 2014 in this 19 years interval the water body decreased 2820.58 hectares. So here, the water body reduction rate is higher in last 19 years than before and all of the water body are converted into landmass for people use. From the year 1977 to 2014 in this 37 years interval almost 4906.23 ha water body are reduced. Here the trend line shows a negative value which indicate almost in an average 2453.10 ha water body are reduced in every 18 years interval. From the NDWI classified image we also find different values of producer's accuracy and user's accuracy for each class which are also tabulated in table 3. For the year 1977 the user's accuracy is 76.00% for water body and producer's accuracy is 90.48%. That means the producer of this map can claim that 90.48% area is identified as water body as such, a user of this map will find only 76.00% accuracy. Similarly for the year of 1995 and 2014 the producer's accuracy is

90.70% and 89.80% while the user’s accuracy is 78.00% and 88.00%. From the table 3 one thing is clear that both the producer’s and user’s accuracy are increasing with time. The image quality of these three image is mainly responsible for this. For the year 1977 Landsat 02 image are used which resolution is 60 m while for 1995 and 2014 the Landsat 05 and Landsat 08 image are used whose resolution is 30m. It means the high resolution image gives more accurate results than the low resolution image.

Figure 4: Water Body of DMP area Extracted by NDWI method

**Water body Area Calculation Using Unsupervised Technique**



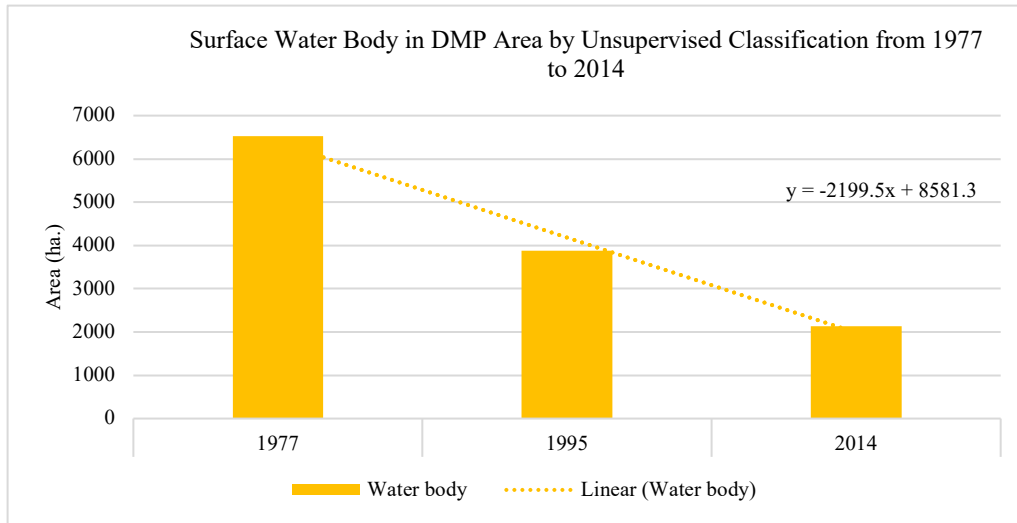
Source: Compiled by Author, 2019

By using the Unsupervised Classification techniques the water body area of DMP are also calculated here and that are shown in the table 4. Here from this table it seen that the water body in DMP area are also decreased at an alarming rate. It reduced at least 4398.96 hectares in this 37 years interval from 1977 to 2014.

Table 4: Area of Water Bodies in DMP by Unsupervised Classification from 1977 - 2014

Categories	1977		Accuracy		1995 Area (ha)	Accuracy		2014 Area (ha)	Accuracy			
	Area (ha)		User's	Producer's		User's	Producer's		User's	Producer's		
Water body	6531.61		58%	61.70%	3882.88		62%	68.89%	2132.65		68%	72.34%
Land	24844.03		64%	60.38%	27492.58		72%	65.45%	29243.26		74%	69.81%
Total	31375.64				31375.46				31375.91			

Figure 5: Water Body in DMP Area by Unsupervised Classification from 1977 to 2014



From the figure 5 it seen that the trend line also gives negative value that means the amount of water body are decreased in an average 2199.50 hectares in every 18 years interval. For unsupervised classification from the year 1977 to 2014 the overall reduced water body is 4398.96 ha. In case of unsupervised classification it seen from the year 1977 to 1995 the water body reduction amount is 2648.73 ha. and from the year 1995 to 2014 the reduction amount is 1750.23 ha. Which indicate the water body reduction rate is almost 1.51 times higher in last 19 years compare to the previous 18 years.

For unsupervised classification various accuracy evaluating parameters were computed and tabulated in Table 4. For the year 1977, 1995 and 2014 the producer's accuracy of water body is gradually 61.70%, 68.89% and 72.34%. Here the measure of producer's accuracy (Sensitivity) reflects the accuracy of prediction of the particular category. And for the year 1977, 1995 and 2014 the user's accuracy of water body is gradually 58.00%, 62.00% and 68.00%. Here The User's accuracy reflects the reliability of the classification to the user. In these case the same thing also seen here and that is, with the increase of image resolution the accuracy also increase it means resolution of an image also played a significant role in accuracy assessment.

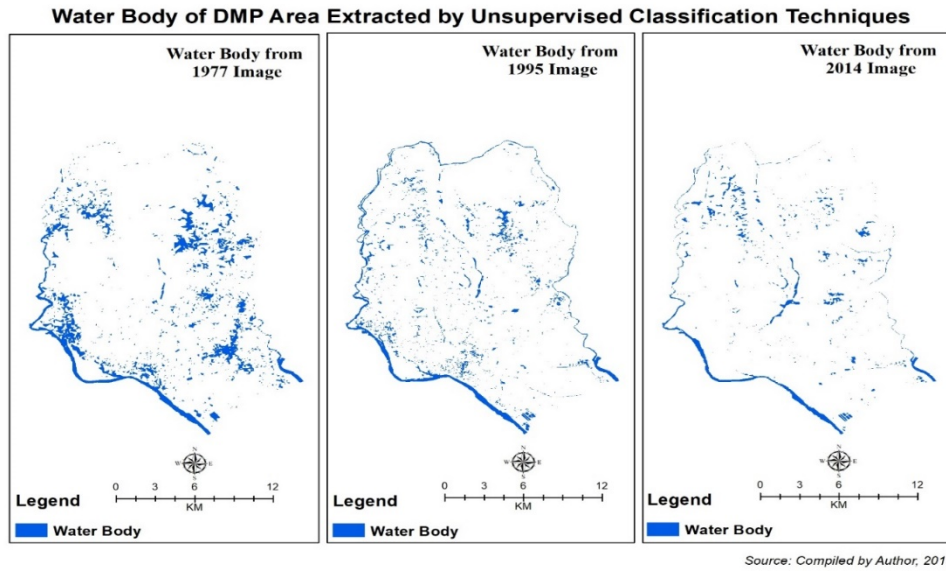


Figure 6: Water Body of DMP area Extracted by Unsupervised Classification Techniques  
Comparison between two techniques

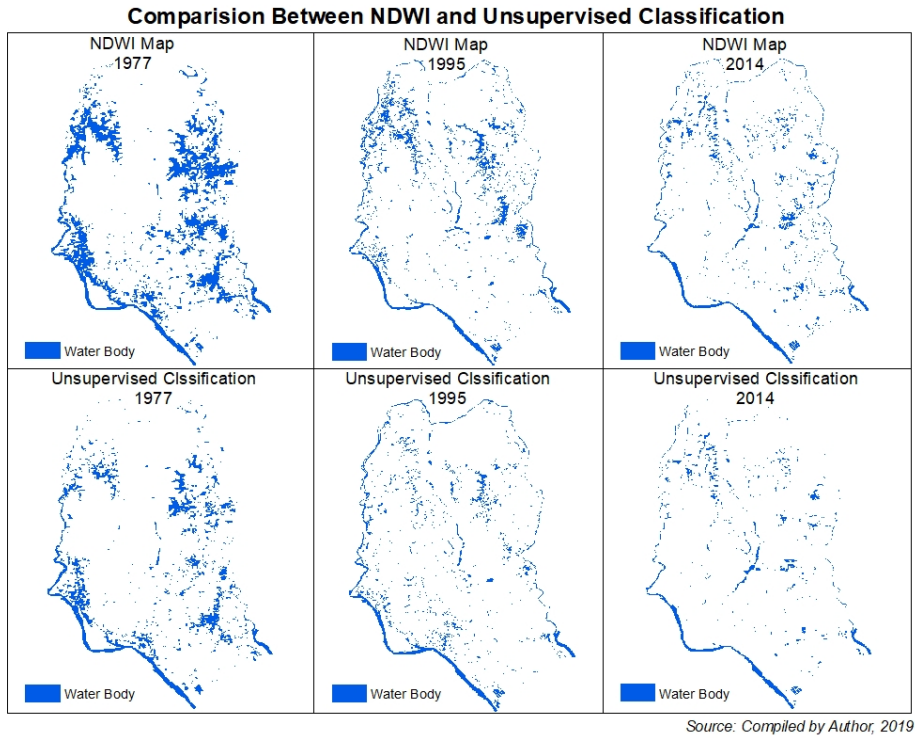


Figure 7: Comparison Between NDWI and Unsupervised classification Map

The figure 7 shows that there is a sharp difference in area measured by NDWI and Unsupervised classification techniques and also in their accuracy. The difference between NDWI and Unsupervised Classification and also in their accuracy are tabulated in table 5 and figure 8.

Table 5: Comparison Between NDWI and Unsupervised Classification

Category	NDWI			Unsupervised Classification		
	1977	1995	2014	1977	1995	2014
Water Body (%)	23.24%	16.60%	07.61%	20.82%	12.38%	06.80%
Landmass (%)	76.76%	83.40%	92.93%	79.18%	87.62%	93.20%
Overall Accuracy	84.00%	85.00%	89.00%	61.00%	67.00%	71.00%

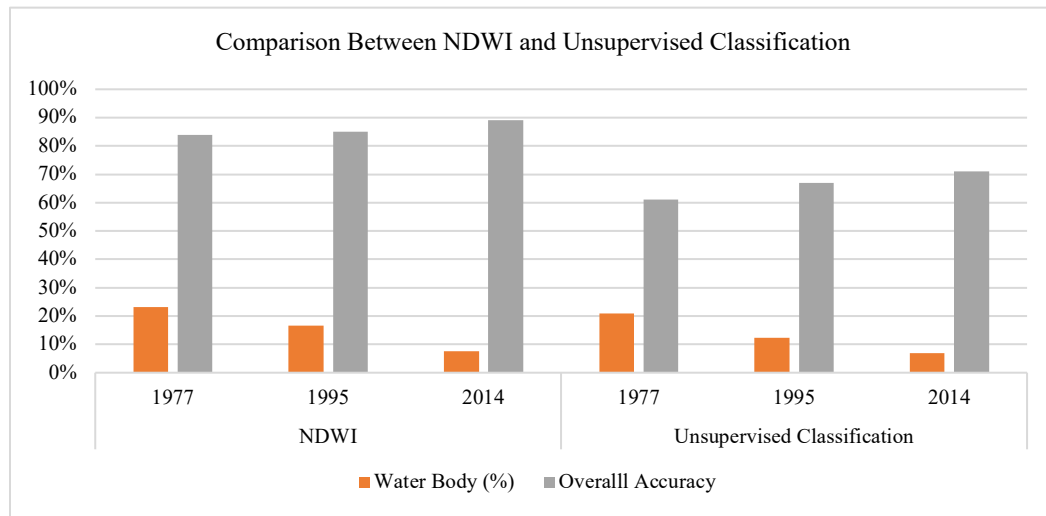


Figure 8: Comparison between NDWI and Unsupervised Classification

The above table and Graph represent that for NDWI classification reduction rate is 6.65% from the year 1977 to 1995 while in year 1995 to 2014 in this 19 years interval it' rate is 8.99%. The overall reduction rate between the years 1977 to 2014 is 15.64%. The table 5 & the figure 8 also shows a negative reduction rate for unsupervised classification it seen from the year 1977 to 1995 the water body reduction rate is 8.44%. Compare to NDWI calculation the unsupervised classification calculation gives 1.79% higher value for these 18 years. From the year 1995 to 2014 the unsupervised classification the reduction rate is 5.58%. That means in these 19 years interval the unsupervised classification gives 3.41% lower values compare to the NDWI values. For unsupervised classification from the year 1977 to 2014 the overall reduction rate is 14.02 % which is also 1.62% lower than the NDWI value. So there is a sharp difference between both techniques for this reason the accuracy assessment result the given below to find out the best techniques for water body identification.

Here for the unsupervised classification the overall accuracy for the year of 1977, 1995 and 2014 is in between 61% to 71% which represents a very poor accuracy. While for the NDWI the overall accuracy value is in between 84% to 89%. The average overall accuracy for unsupervised classification is 66% and 86% for NDWI which is much more reliable than the unsupervised classification techniques.

## Conclusion

In this study we extracted the urban water and measure its change rate by using machine learning algorithm from the Landsat dataset. Two types of machine learning algorithms were used here for classifying low and mid resolution remote sensing data. It seems that machine learning methods are very useful for the accurate classification of surface water in Bangladesh. Here from this two study it is confirm that the water of DMP area is decreasing day by day. With this two machine learning techniques the results shows that's the unsupervised classification techniques gives much lower value than the NWDI classification. The accuracy assessment shows the NDWI is more reliable than the unsupervised classification techniques. This study concludes that from these two machine learning algorithm NDWI techniques can be used for its more accuracy and reliability.

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## Service Area and Accessibility of Urban Parks: An Exploration of Park Access in Dhaka, Bangladesh

Ummeh Saika\*  
Toshio Kikuchi\*\*

**Abstract:** Urban parks are vital part of whole urban environment. A starting point for inquiries about park utilization and the potential benefits of urban green spaces must begin with an assessment of their geographical accessibility. This study investigates the service area and accessibility of parks of Dhaka city as an example of developing nation. The case study site covers eight urban parks of Dhaka metropolitan area of Bangladesh. Two aspects (physical and social) were applied for this study. After calculating all data result was showed by maps using GIS. The service area of parks in a developing country different from the NRPA standard. According to accessibility of parks, in small and medium size parks people mainly visited from near place. In large size park people come from different distance. Again in only one extra large park covered the whole city area. Mainly distance from origin to parks, time and purpose control the accessibility of parks. The significance of the study reveals that the size and distance of parks influence the user of parks in Dhaka city.

**Key words:** Urban parks; Dhaka city; service area; accessibility.

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### Introduction

The world's population crossed the 7 billion mark in 2011. According to UNFPA projections, within the next two decades the world's urban population will increase to almost 5 billion (UNFPA, 2007). Between 2000 and 2030, urban populations in Asia and Africa are expected to double and urban areas of the developing world will make up 81 per cent of urban humanity (UNFPA, 2007). Most of these urban areas, including Dhaka, are already mega-cities (with more than 10 million people). Growing populations and urban centers are creating significant pressures on limited environmental resources in the mega-cities.

As a result of rapid urbanization, there is huge encroachment upon green spaces which causes to deforestation, water logging, flooding and pollution of water, soil and air in the urban area. This is particularly evident in the developing countries where cities sprawl extensively. Like any other sustainable city, Dhaka needs a vast stock of green spaces for urban life or utilities and circulation and for environmental stability.

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Parks and open spaces are one of the most significant components of urban environment that is of great importance for the people who live in urban areas. Parks and open spaces if properly more accessible can improve social cohesion and interaction as more people patronize them. Better accessibility to facilities also ensures economic efficiency in the use of such facilities because when they service more people, they would be more cost effective. Open green spaces, playgrounds, parks in the city acts like its lungs besides being used as active recreational and leisure areas for its citizens (Tabassum et al., 2013).

Urban park is probably one of the oldest feature of cities. Nowadays urban parks are emerging as one of the most important spaces in the urban fabric. They help to enhance the image of a city, and improve the quality of urban life; people come to them for recreation, social gathering, and passive enjoyment (Iqbal et al., 2010). Parks are key component of urban environment. Parks are one of the important source of maintenance natural ecosystem and also preserving the biodiversity in the urban area. Because of this, easy accessibility of parks play considerable role in physical health for the majority of the people in city areas. (Nicholls, 2001).

### **History of parks in urban area**

Urban parks are the oldest features in the city. According to Springgate (2002), parks are peaceful, tranquil, beautiful spaces to which people are intrinsically attracted. Historically, urban parks emerged from public spaces that were used as grazing land in cities or towns. Evidence from Western Europe in the 17th century and New England towns in the United States shows that inhabitants set aside lands near their towns, cities, or villages for the common use of their citizens. The citizens used these areas, or “commons” to graze livestock, and hold the animals before selling them or using them in the village or town (Newton, 1971 and Jellicoe, 1975). Over time, these grazing lands became important spaces in the city as people started to use them for other purposes.

In the western world, the modern concept of the urban park started in the early 19th century, during the Industrial Revolution. At this early stage, urban parks were important features that could improve the quality of urban life, which declined during the rapid industrialization of this time. Parks became places to escape from the stresses of chaotic industrial cities. The idea swept the United States, England, and mainland Europe. Cities in Sweden, Denmark, and Holland started to develop urban parks to improve the quality of their cities (Jellicoe, 1975).

In addition to rapid industrialization, mass urban migration was another factor that stimulated the growth of urban parks. Crowded urban spaces, due to an influx of people massively degraded the quality of urban life. Parks served as places of recreation and leisure. In the late 19th century, urban parks started to be developed at public expense (Yuen, 1996), when the social reform of the working population in Britain paved the way for early legislation providing open spaces in cities and towns. Since the 19th century, urban parks have transformed American and European cities. They have not only enhanced and beautified the urban environment, but also have become “important structural components in the shaping of urban form” (Yuen, 1996, p. 955). During the colonization period in the late 19th century, Europeans introduced the concept of the urban park to Asia.

### **Urban parks in Dhaka city**

Due to rapid urbanization the city is growing immensely and rapidly expanding than other city centers in the country. The ongoing development activities are creating constant pressure to squeezing all open spaces out of the urban fabric (Nilufer, 2000).

Lack of variety of activities is phenomenal in Dhaka's urban parks, but the use of the urban parks is significant and diversified. Seasonal and occasional events, even large scale festivals are also seen to take place in parks (Iqbal et al., 2010).

Most of the areas of Dhaka city are so unplanned that there is very little scope for creating a new park or open space to meet the needs of the growing population. In this case, it is inevitable that the existing parks need to be improved or developed. But unfortunately till now no initiatives have been taken to improve the parks of Dhaka city (Alam, 2012). If the prevailing conditions remain unchanged then Dhaka will definitely collapse (Hasan, 2012)

Nilufer (2000) tried to classified Dhaka city (recreational area) parks based on open space hierarchy by Greater London Council, GLC. All the four types of GLC standards fall under the category of Urban Recreational Areas of the former group. According to GLC standards classification of parks are as follows: Metropolitan Park, District Park, Local Park, 'Mini' Park She also mentioned that none of the western standards are comparable to the case of Dhaka.

Tabassum et al., 2011 mentioned there is no typological classification of parks in Dhaka city according to different international standard, not even of our own. Therefore the development of parks has not been followed any standard planning/ design criteria at any physical level. Because of the absence of any central controlling agencies there is also no complete list of open space found in city. At present it seems urgent to identify and quantify the available stock of open spaces in the city. However such a venture needs enormous resources. Therefore she tried to find out the limitation and also investigated the current situations of parks under DCC control.

Khan (2014) used space syntax is a method for describing and analyzing the relationships between social structure and spatial structure of Dhaka city parks.

Accordingly, there is no clear characteristics and accessibility of parks in Dhaka city which is also applied for others developing countries.

To proved the research specifically, sought to answer two questions: (1) Are environmental factors such as size and distance related to the use of the urban parks? (2) How accessibility of parks associated with the characteristics of park users?

### **Research objective and approaches**

The main objective of this research is to know the service area and spatial accessibility of parks of Dhaka city as a developing nation. Actual accessibility of visitors to urban parks was assessing on the basis of buffering analysis. Analysis has been performed on the basis of distance and time. This study also explicates the comparison between the service area and accessibility of parks. The study focuses to measure the accessibility of people in selected parks (eight case study parks) of Dhaka city. The approaches of the study includes

the measurement of service area based on physical size of parks and spatial accessibility of people towards urban parks. For the purpose travel time of travel to reach park and distance of the respondent from destination to park were observed.

### **Previous study about size and distance of parks**

In many studies, accessibility is used as a measure of a park's ability to provide services, and distance to a park is considered as an important component of accessibility (Wen et al., 2013; Rossi et al., 2015). For example, Nicholls and Shafer (2001) evaluated equity and accessibility of local parks by analyzing fixed buffer zones. Although distance can be used to reflect the area of a park that provides services, it is often difficult to identify the appropriate distance at which park services become inaccessible. Moreover, recreational services of parks are not isotropic and homogeneous, but change with increasing distance. Some studies investigated distance decay effects and found a weakening of recreational services with increasing distance (Peschardt et al., 2012; Hooper, 2015).

Most studies have demonstrated an understanding of the spatial physical factors influencing park access and use (McCormack et al., 2010; Kaczynski et al., 2016). For example, Van Herzele and Wiedemann (2003) found that the sense of space, the natural environment, the degree of quietness, and available park facilities were the most important factors affecting park use, while Erkip (1997) indicated that distance to the park was the key factor in determining park accessibility. Some other studies emphasized that the importance of such spatial-physical factors could be offset by socio-demographic factors (Moore et al., 2008; Macintyre et al., 2008; Lee, 2016). For example, Byrne and Wolch (2009) found that people may not visit nearby parks for cultural reasons. To fill this gap of knowledge, both physical and non-physical dimensions have been considered in recent studies (Lindsey et al., 2001; Wang et al., 2013). For example, Wang et al., (2015) found that both physical and social variables, such as proximity to the park and a pleasant walking experience, were statistically significant to perceived park accessibility in Brisbane, Australia.

### **Parks in Dhaka city as a Case Study**

From government organization (DNCC and DSCC) collected the data of size of parks. Most of the parks of Dhaka city's parks size lower than 10 acres. Only few parks size are within 10 to 100 acres. Only one park size is 210 acres.

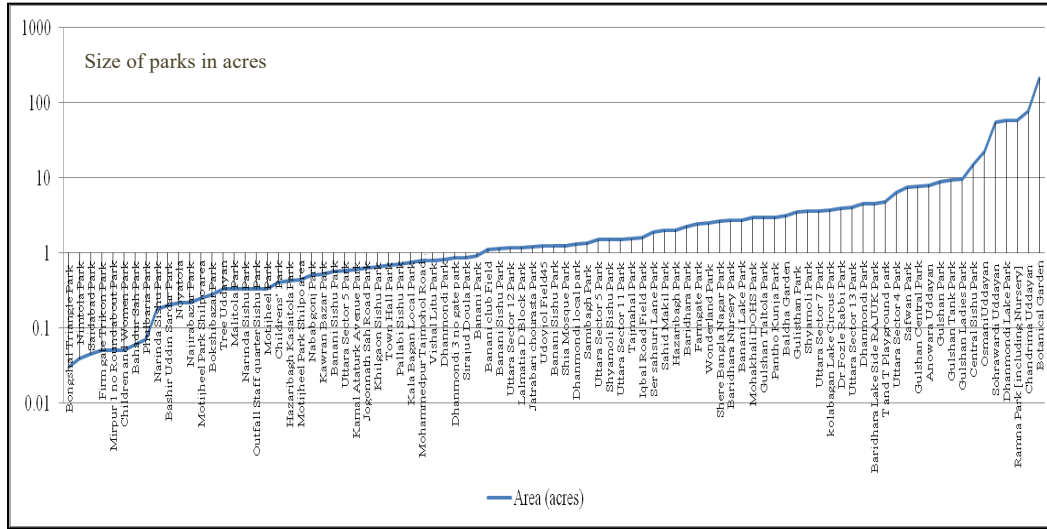


Figure 1: Size of parks (acres) in Dhaka city

After study international park's classification, based on physical size, the parks of Dhaka city were classified into four types (Saika et al., 2017).

Table 1: Classification of parks in Dhaka City

Type of park	Size	Number of parks
<b>Small</b>	0 - 4 acres or 0 - 0.016 km <sup>2</sup>	<b>71</b>
<b>Medium</b>	5 - 40 acres or 0.0202 - 0.162 km <sup>2</sup>	<b>13</b>
<b>Large</b>	> 40 acres or 0.162 km <sup>2</sup>	<b>4</b>
<b>Extra large</b>	200 acres + or 0.809 km <sup>2</sup> +	<b>1</b>

Most of the parks of Dhaka city under the small size parks are scatteredly distributed. There are thirteen numbers of medium size parks which mostly distributed in north part of city and four large size parks in city center area. Again only one extra large park is situated in the city boundary.

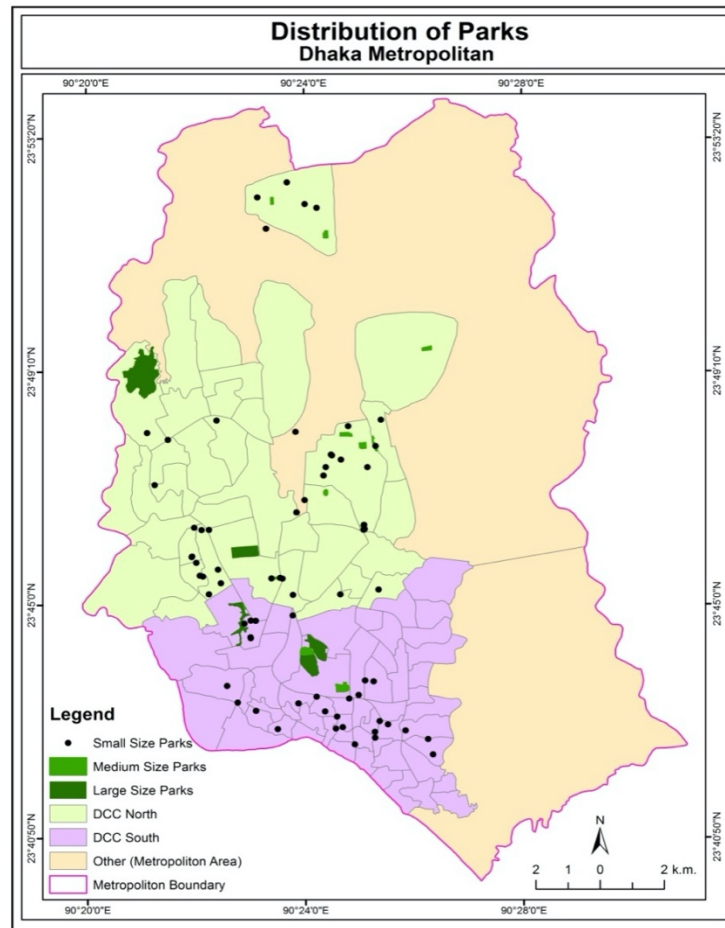


Figure 2: Different size of parks in Dhaka city

### Methodology

From the previous study, it has become obvious there is no typological classification of parks in the city according to different international standard, not even of ours. Therefore the development of parks has not been followed any standard planning/ design criteria at any physical level (Tabassum and Suchana, 2011). Because of the absence of any central controlling agencies there is also no complete list of open space and park found in city. At present it seems urgent to identify and quantify the available stock of parks in the city. After classified eight case study parks were selected from each region of Dhaka Metropolitan area. Below (Table 2) able to show the location of case study parks with their name.

Table 2: Name of case study parks

Park Location	Small size park	Medium size park	Large size park	Extra large size park
<i>Southern part of City</i>	Bahadur sha, (S3)	Osmani Uddan, (M3)	<i>City center</i> Dhanmondi lake, (L)	<i>City boundary</i> Botanical garden, (EL)
<i>Middle part of City</i>	Pantho kunjjo, (S2)	Anwara, (M2)		
<i>Northern part of City</i>	Uttara sector 7, (S1)	Gulshan Lake, (M1)		

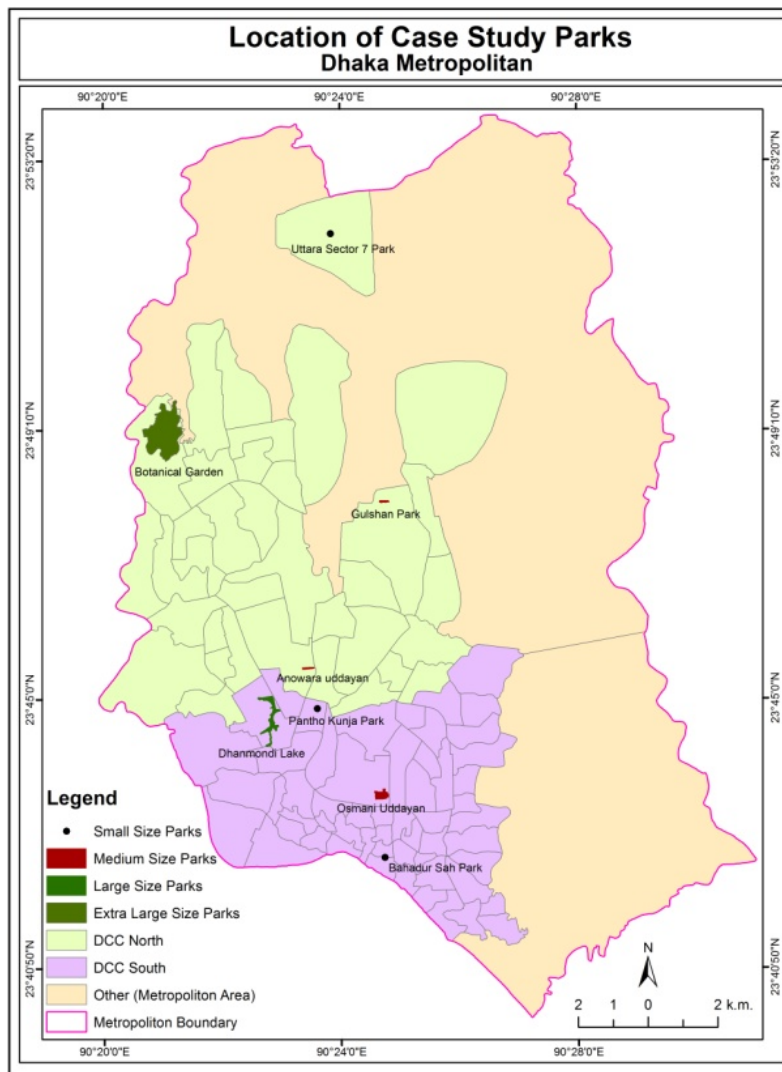


Figure 3: Location of case study parks

### Questionnaire data analysis –

For analysis characteristics of parks, questionnaire survey of parks visitors and field observations were carried out as primary data sources. The sample was selected randomly from each parks visitors and sample size was for small size parks 80, medium size parks 90, large and extra large parks 100. This survey was done from October to November in 2015. Questionnaire data analyzed by frequency and cross table using SPSS.

### Service area analysis –

For identifying service area, first compared with case study parks with NRPA American standard. By using GPS, measured visitors distance from park to home. Service area calculating by average distance of park visitors. After analysis, draw the service area of case study parks by using GIS.

### Accessibility –

#### Visitors point (resident)

Buffer zone (Saleem and Ijaz, 2014; Neema et al., 2014; Nicholls and Shafer, 2001)

Techniques used in GIS for draw buffer zone given below,

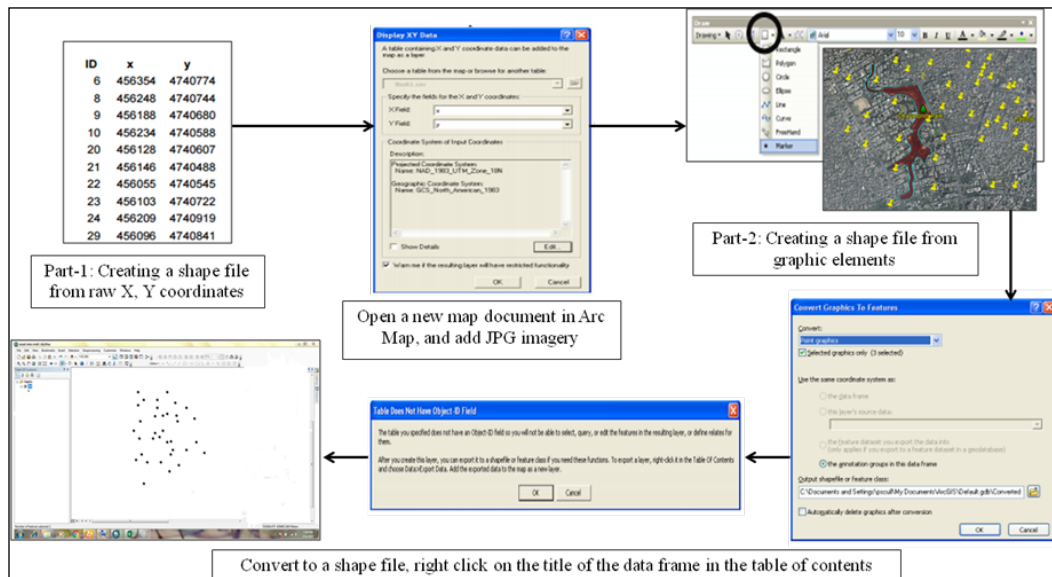


Figure 4: Techniques used in GIS for draw buffer zone to measure accessibility

### Urban parks and their service area

Basically the service area of an urban green space covers the range of action where its potential users live and tends to border to the farthest user that has the availability to move to this space. This differs with the type of urban green space and the attractiveness and accessibility conditions. It is related to the measurement network depending on the attribute and criteria in question and has a more realist approach compared to buffer approach (linear

distance) because have account the multiple limitations that influences the network dynamics. The concept can also be applied to a public equipment or service that has a territorial expression (Figueiredo, 2016).

For an urban park, it is very essential to identify the service area. Service area of a park means the particular range of area where population can be used the park facilities. It mainly depends on the size of the parks. Service areas are consistent with the guidelines established by the NRPA (Table 3).

Table 3: According to (NRPA, 2014) range of service area of different size parks

Park Types	Size (acres)	Serve area (radius in miles/km)
<b>Mini Park</b>	< 1	1/4 mile / 0.402 km
<b>Neighborhood Park/Playground</b>	1 - 15	1 mile / 1.609 km
<b>Community Park</b>	16 - 99	3 miles / 4.828 km
<b>Regional / Metropolitan Park</b>	100 - 499	serve the entire city
<b>Regional Park Reserve</b>	> 500	serve those areas within a one-hour driving distance
<b>Special Use Area</b>	no specific standards	-
<b>Linear Park</b>	no specific standards	-
<b>Conservancy</b>	no specific standards	-

The special use parks and facilities do not have defined service areas as they are considered to offer amenities and services that appeal to the entire resident population of the urban area. In some cases, the actual service area of any park may be larger if the park includes amenities of regional appeal. Smaller service areas are also possible where major roadways act as barriers to park access (Saika, et al. 2017). In this study roadway barriers are not shown.



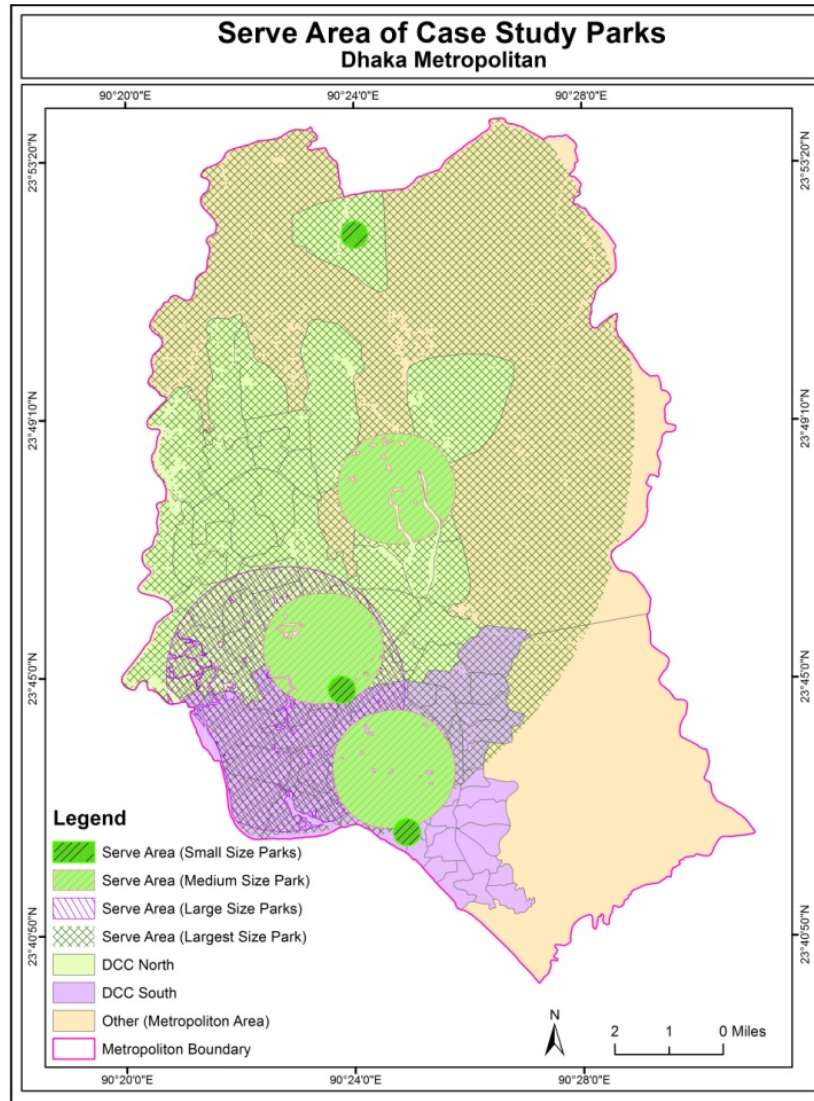


Figure 5: Service area of eight case study parks according to NRPA standard

The above map (Figure 5) illustrates the service areas for eight case study parks of Dhaka city by NRPA standard. NRPA defines park service area based on international standards. However, this data is not suitable for all courtyards special in developing countries. In developing countries, cities are mainly developed in unplanned ways. And due to the pressure of overpopulation and different land use, it is possible to encroach the park area. Again, the number and size of parks also influence the service area. So it is necessary to find out the real picture of service areas of parks in Dhaka city.

For measuring the actual service area of parks of Dhaka city, in this research, distance (origin to parks) data of visitors of eight case study parks was used. Distance of visitors was measured by GPS and average distance  $\bar{x}$  was calculated for measuring service area.

$$\bar{x} = \frac{1}{N} \sum_{i=1}^N x_i$$

Here,

Average distance of visitors for each parks,  $\bar{x}$ :

$\sum$ , represents the summation

x, represents distance from home to park

N, represents number of visitors

Average distance of different size parks are given below:

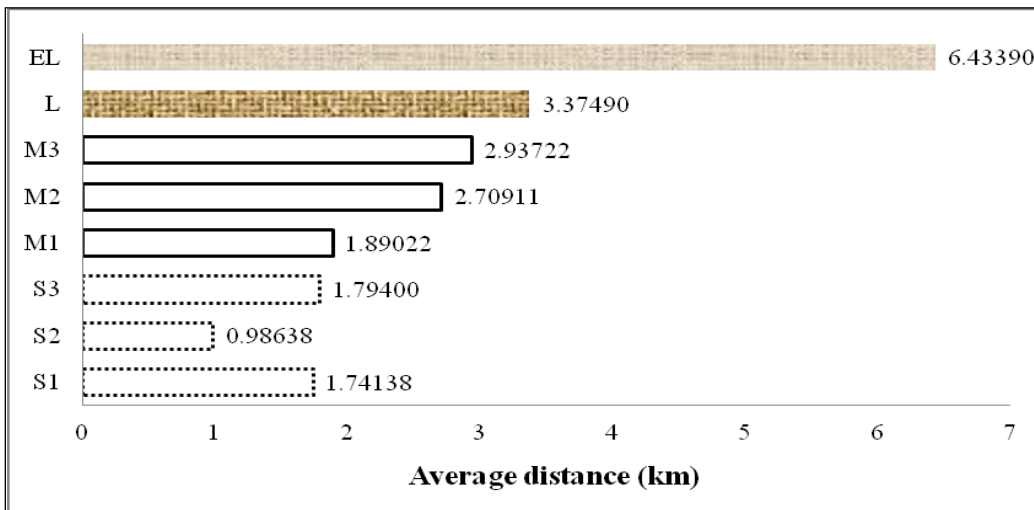


Figure 6: Visitors average distance of different size parks

For calculating service area of parks in Dhaka city, again calculated average all distance values base on the size of parks. Service area of different size of parks in Dhaka city are given below,

Table 4: Service area of different size parks in Dhaka city

Service area	Distance (Km)
<b>Small size parks, <math>\bar{x}_S</math></b>	1.507
<b>Medium size parks, <math>\bar{x}_M</math></b>	2.512
<b>Large size parks, <math>\bar{x}_L</math></b>	3.375
<b>Extra large size park, <math>\bar{x}_{EL}</math></b>	6.434

Based on visitor pattern of different size parks, after calculating average distance for each park, service area of parks in Dhaka city can be define by below model (Figure 7).

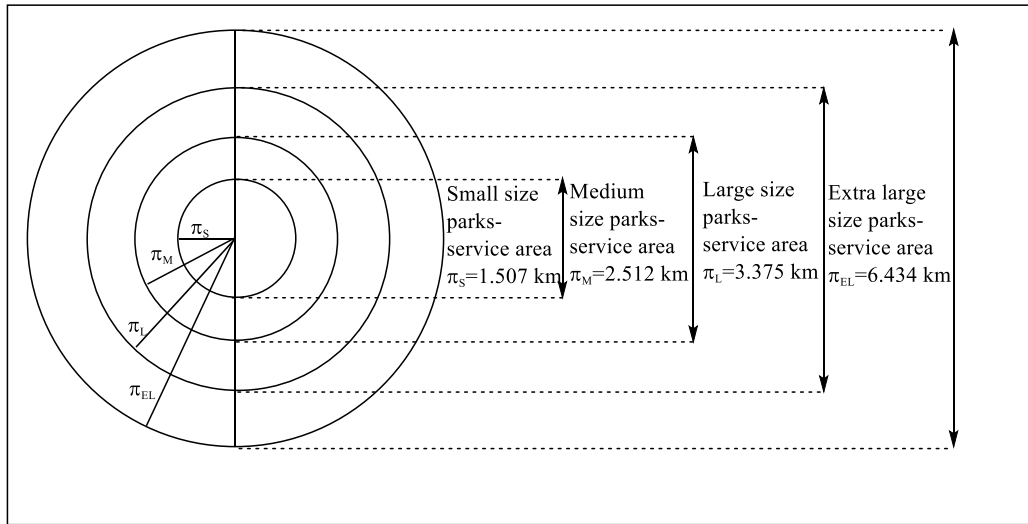
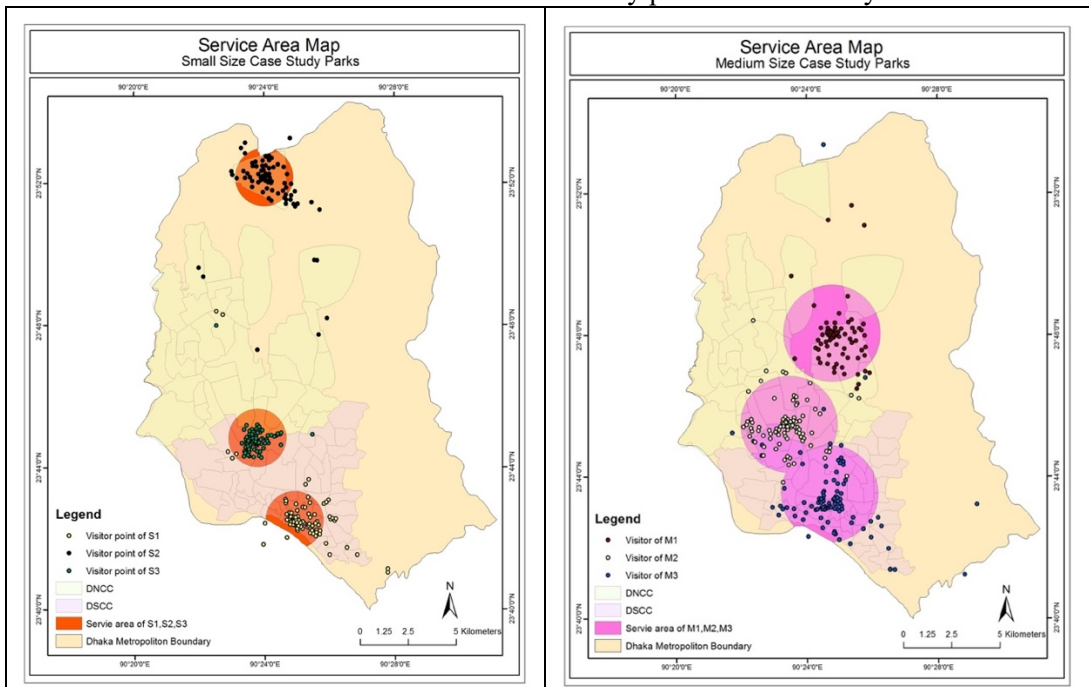
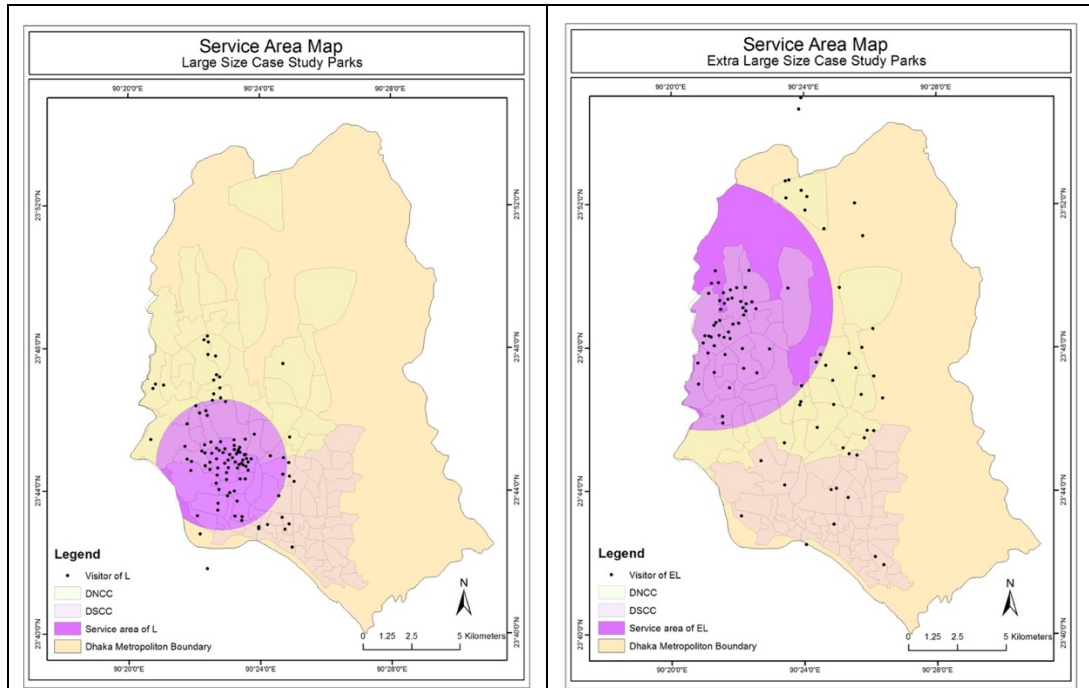


Figure 7: Model of service area of different size parks in Dhaka city

That means, its showed that service area of parks of Dhaka city different from international standard. The maps on the following (Table 5) show the service areas for small, medium, large and extra large case study parks of Dhaka city based on field survey.

Table 5: Service area of case study parks in Dhaka city





### Accessibility of parks in Dhaka city

Measuring accessibility to urban parks is a commanding tool to analyze individual mobility patterns of visitors. Parks play a multi-purpose role in urban areas that provides social, economic and environmental benefits (Saleem, et al. 2014). The major focus of the analysis is to study parks / green spaces in urban areas, including through the measure of parks accessibility and the relative area and the number of parks in communities (Potestio et al., 2009). Measuring accessibility to urban parks is the potential tool to examine individual mobility patterns (Reyes et al., 2014).

Park equity studies use accessibility measures to determine whether the distribution of parks benefit some people more than others. Accessibility measures must therefore determine who benefits and why. While the goal of equity analysis is clear, the methods applied in measuring park accessibility vary. Many methods have been set forth, with no clear standard of which type of method should be applied to measuring accessibility to parks specifically, and how the application to other industries vary. An important issue remaining largely unexplored is how variation in the measurement of access can affect the results of spatial equity (Talen, 1997; Talen, 1998).

For this research, mainly two parameters were investigated to check the accessibility of urban parks in Dhaka city: 1) Distance and 2) Time.

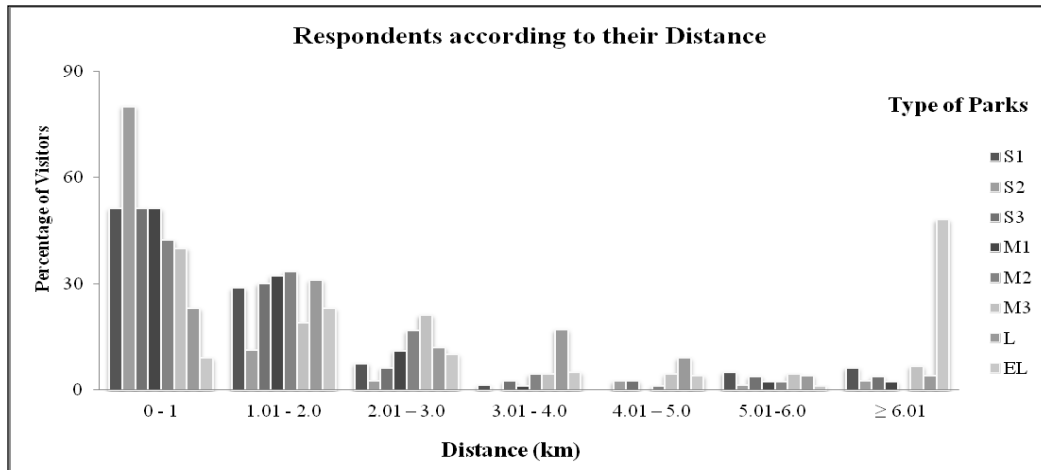


Figure 8: Respondents According to their Distance from Destination to Parks

From figure 8 we see that distance has affected by the size of parks and the number of visitors. Small size of parks (S1, S2 and S3), large number of visitors come from within 1 km. In medium size parks (M1, M2, M3), most of the visitors come from near distance 1 - 3 km. In the large park (L) a large number visitors come from distance 2 - 4 km. And only one extra large park which situated city boundary and far away from city center, most of the visitors come from more than 6 km. For short distance people always choice small size park and for large size park people come from different part of the city.

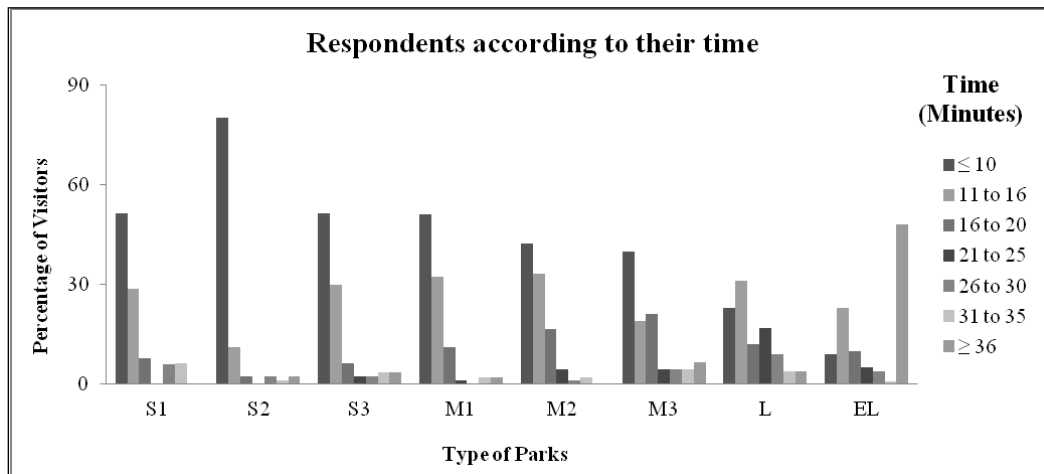


Figure 9: Respondents According to their Distance from Destination to Parks

Note: Ignore visitors different types of local vehicles (Rickshaw, CNG Auto rickshaws (4 Stroke), Bus, Motor car, Auto tempo, Motorcycle and Others), without traffic jam and other obstacle.

Time is another important parameter to measure accessibility of parks. From figure 9, we see that time has affected by the size of parks and the number of visitors. Small size of

parks (S1, S2 and S3), large number of visitors need less than 10 minutes. In medium size parks (M1, M2, M3), more than half of the visitor come from near distance within 15 minutes. Again in large park (L) people come from different time range. Because this particular park situated in city center and famous for various program. So in here visitors come to attend program from diverse places. And only one extra large park which situated city boundary and far away from city center, most of the visitor need more than half an hour. In small and medium size parks, people needs shot time and accessibility is high. On the other hand extra large size parks because of distance people needs more time to visit.

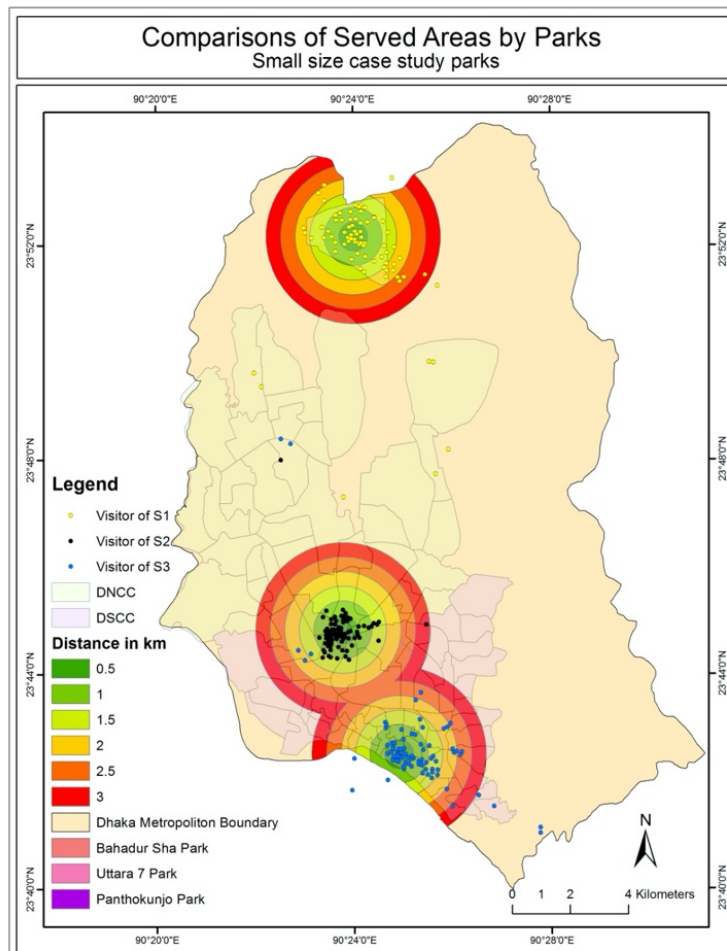


Figure 10: Comparisons of served areas by small size case study parks

In figure 10, concentric buffers demonstrate the association between distance (km) and spatial accessibility of visitors towards small size case study parks. Buffers were taken at the distance of 0.5 km. The comparison of these three parks indicates that small size parks of Dhaka city serve its neighborhood areas. Most of the visitors visit the parks for different activates e.g. walk, play sports and games, for entertainment and meeting friends etc. And people also visit these parks for daily purpose.

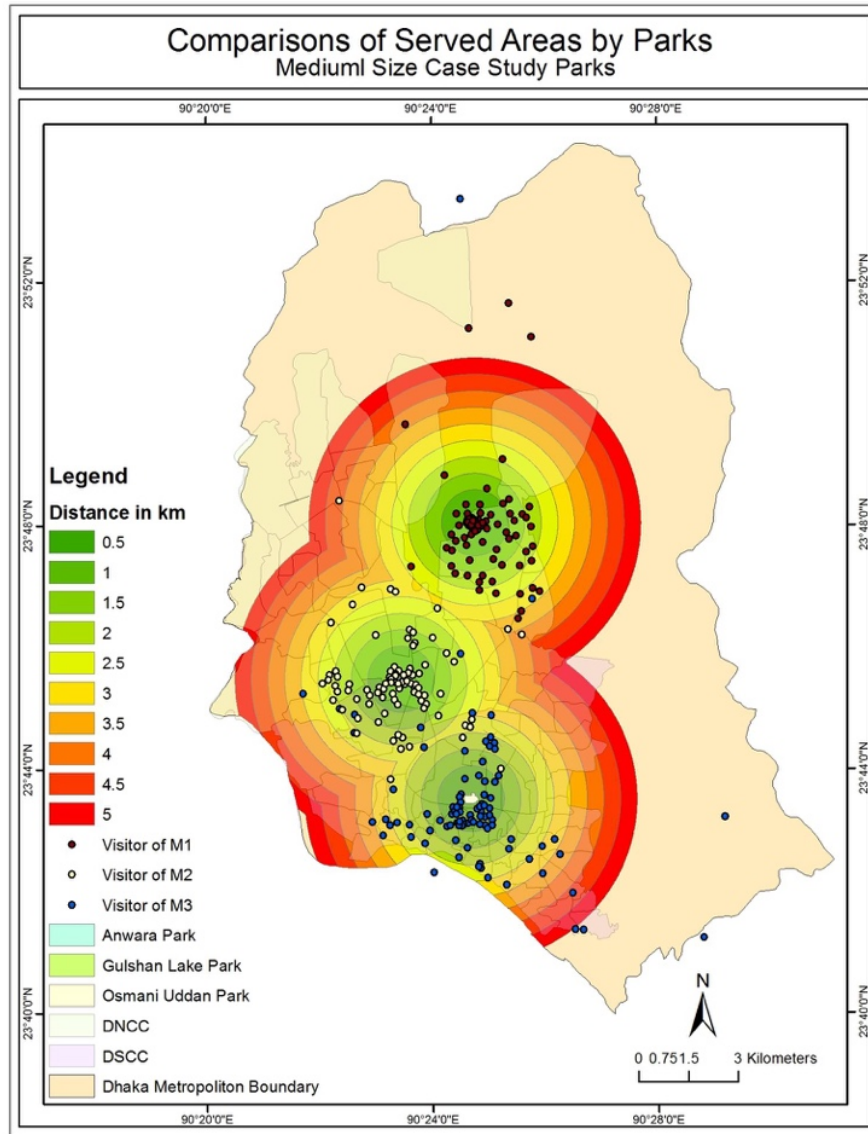


Figure 11: Comparisons of served areas by medium size case study parks

In figure 11, concentric buffers reveal the association between distance (km) and spatial accessibility of visitors towards medium size case study parks. Buffers were taken at the distance of 0.5 km. In this parks most of the people come from 1 - 2 km distance. Again, some people (residence near the parks) also come from below 1 km use the park as neighborhood park. Surrounding area of park also a important factor to use of park. Example, Osmani uddan park, situated opposite of South City Corporation Office. People come from all part and also outer part of the city for that City Corporation Office and they wait or take rest inside the park. So visitor pattern is different from other parks. In medium size parks people mainly visit daily to weekly.

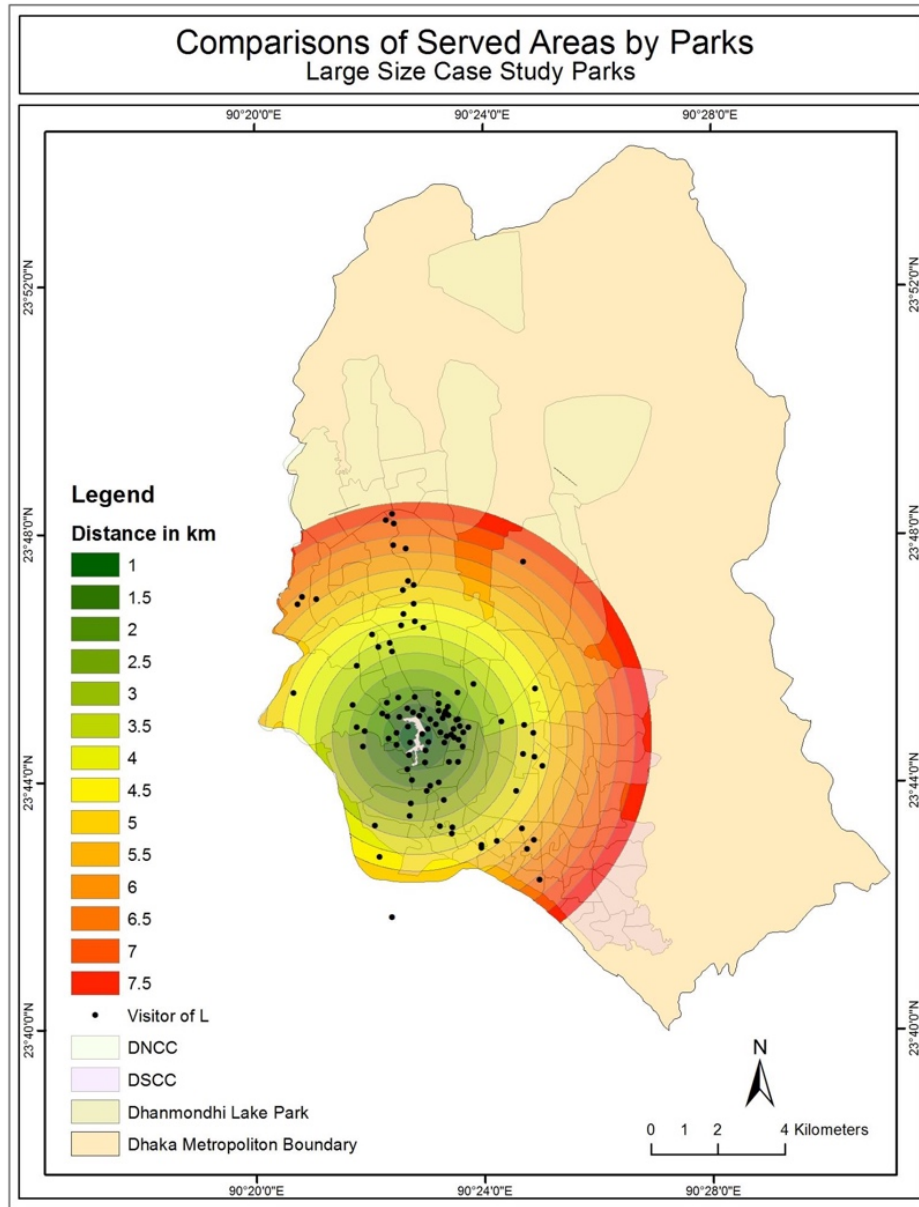


Figure 12: Comparisons of served areas by large size case study park

In figure 12, concentric buffers show the association between distance (km) and spatial accessibility of visitors towards large size case study park of Dhaka city. Buffers were taken at the distance of 0.5 km. In Dhaka city there are four large size parks and all are situated in center of the city. Moreover in large size park famous for different invents and program. Inside the park different facilities also available. People mainly visit monthly to attend all these program. Again like medium size parks, also in Dhanmondi lake park's some people (residence near the parks) also come and use the park as neighborhood park.



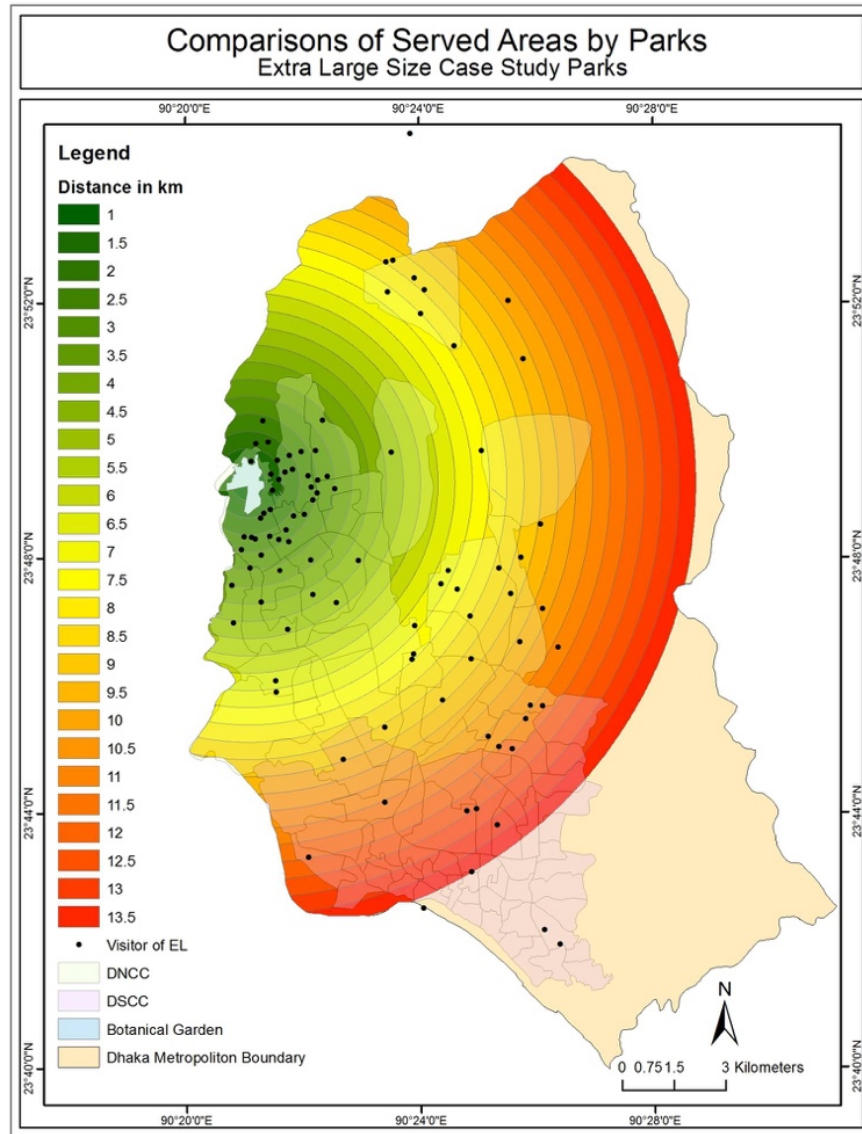


Figure 13: Comparisons of served areas by extra large size case study park

In figure 13, concentric buffers demonstrate the association between distance (km) and spatial accessibility of visitors towards extra large size case study park. Buffers were taken at the distance of 0.5 km. In Dhaka city there are only one extra large park which situated in the city boundary. Most of the visitors visit this parks at weekends or at special events e.g. study tour, picnic, family outing and play sports and games etc. Inside the park (Botanical garden) there are different facilities and well managed. People mainly visit this park once a year and stay whole day long. Because of far from city center people do not visit the park willingly.

## Findings and conclusion

This paper has illustrated the service area of parks and measuring levels of accessibility in Dhaka city, as an example of city of an developing country. In developing countries, service area of parks are different from standard value. In developing countries, city urbanized in an unplanned way. Sometimes because of other land use ignore the importance of park. Again, for over population and encroachment of parks area, also reason to change the land use. As a result, number of parks are lower than the developed countries. Moreover, physical size of parks also influence the service area. After analysis the parks visitor pattern, in this research tried to define a new scale of service area for developing nation.

Again, accessibility of parks depends on distance and size of parks. In small size parks people visited from very near place and they need short time. Again in medium size parks, people who live near the park used as neighborhood parks. But other used the park weekly for leisure purpose. Location of parks and surrounding area also impact on use of parks. In large size park which situated in city center, people visited to attend different program in monthly. But some people who lived near the park used as daily basis like small size park. Only one extra large size park situated city boundary. Distance is very far from city center and people need long time to visit the park. So people selected the park yearly to visit and stay whole day inside the park.

For different size parks people used as different purpose. Again, in different size park, when the distance is low, people visited the park as same purpose. Moreover only one extra large size park has all facilities, but because of long distance and time people are not willing to visit the park. Though in small and medium size parks has lack of facilities, people visited daily to weekly.

Size, location and accessibility, these three are most important factors to control the use of parks. Parks are one element of urban environment that is of great importance in daily life as well as social life for people who live in urban areas like Dhaka. At dense urban area parks should be the most vibrant and accessible space. But somehow their importance is often forgotten in the debate of population needs. In Dhaka rapid growth of urban population has caused the huge encroachment of green space due to increasing demand on land for housing and other urbanization need. But still there is enough scope, to rectify the wrongs with planning and design, and thus enhance the accessibility and use of the parks.

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## Particulate Matter Concentration Dynamics in the Air: Study from Sylhet City, Bangladesh

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**Abstract:** Air quality of the urban areas has been deteriorating rapidly in developing countries. It is considered as a threat to the environment as well as human health for the urban areas. This research focuses on the status and trends of Particulate Matter with an aerodynamic diameter  $\leq 2.5 \mu\text{m}$  (PM<sub>2.5</sub>) and aerodynamic diameter  $\leq 10 \mu\text{m}$  (PM<sub>10</sub>) in Sylhet City in 2017 and 2018. Data has been collected from Sylhet Continuous Air Monitoring Station (CAMS) which is operated by the Department of Environment (DoE), Bangladesh under the project of Clean Air and Sustainable Environment (CASE). The study analyzes the concentration of Particulate Matter (PM) specifically PM<sub>2.5</sub> and PM<sub>10</sub> and it has been compared with National Ambient Air Quality Standard (NAAQS) and the World Health Organization (WHO) standard. The study reveals that the maximum annual mean concentration of PM<sub>2.5</sub> was  $45.5 \mu\text{g}/\text{m}^3$  and  $50 \mu\text{g}/\text{m}^3$  whereas PM<sub>10</sub> was  $90.5 \mu\text{g}/\text{m}^3$  and  $97.6 \mu\text{g}/\text{m}^3$  in 2017 and 2018 respectively. Moreover, during the winter, monsoon, pre-monsoon and post-monsoon these concentrations were found to be very significantly.

**Key Words:** Particulate Matter, Concentration, Variation, Pollution.

### Introduction

Bangladesh is the most densely populated country in the world, due to the accelerating rate of urbanization. Bangladesh facing different types environmental problem in which air pollution in the top position (Rouf *et al.*, 2011). Emissions from various kinds of diesel vehicles and badly maintained automobiles, biomass/coal burning for cooking and in the brick kilns, huge number of construction works, re-suspended road dust etc. are making most polluted cities in the world. Air pollutants are attributed to natural or man-made sources and may take the form of solid particles, liquid droplets or gases (Begum *et al.*, 2005). Particulates alternatively referred to as particulate matter (PM) or aerosols are tiny particles of solid (a smoke) or liquid droplets (an aerosol) suspended and dispersed into ambient air. It includes dust, dirt, smoke, soot and liquid droplets comes from a variety of natural and anthropogenic sources. The atmospheric particulate matter also defined as a multiphase system containing gases with suspended particles participates in various physical and chemical processes in the atmosphere (Samara *et al.*, 2003). Apart from health impact, particulate matter also responsible for changing the chemical

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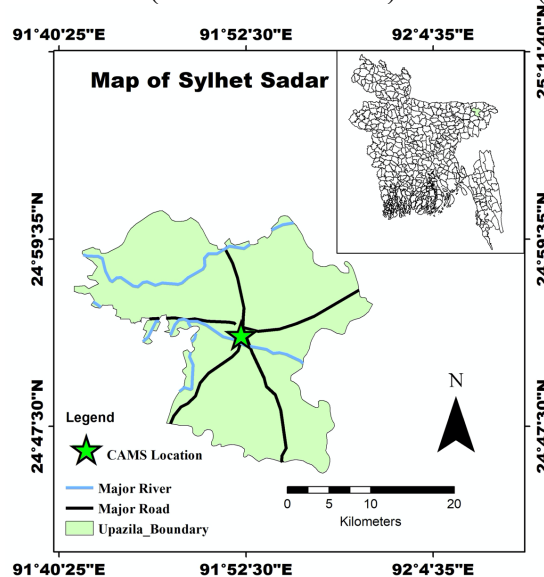
composition of the atmosphere and causes numerous environmental effects (Samara *et al.*, 2003).

The less developed countries are suffering more PM exposure which is four to five times higher than developed countries (Hossain *et al.*, 2019). Recently, Dhaka became one of the worst cities in the world in terms of air pollution (Alam *et al.*, 2018; Hossain *et al.*, 2019). Beside Dhaka, there are some others major cities in Bangladesh which are also experiencing the severe problems of air pollution. So, the present study aims to assess the monthly and seasonal variation as well as the trend of particulate matter between 2017 and 2018 in Sylhet city.

## Methodology

### Study Area

The Sylhet metropolitan area ( $24^{\circ}51'$  and  $24^{\circ}55'$  north latitude and  $91^{\circ}50'$  and  $91^{\circ}54'$  east longitude) is situated in the north-eastern region of the country (Figure 1). It's located on the bank of Surma river and topography of the city characterized by hills and basin. The CAMS is located just beside the Surma River at the roof top of the district Red-Cross office building. The location is characterized with moderate traffic. The sampling inlets are placed on the flat roof of the CAMS housing constructed over the district Red-Cross building. The roof height is about 12 m above the ground and the intake nozzle of the sampler is located 1.8 m above the flat roof. The climate in Bangladesh is characterized by high temperature and high humidity most of the year with a seasonal variation of rainfall (Salam *et al.*, 2003; 2008 and 2013). There are four seasons in Bangladesh which can be divided by the pre-monsoon (March-May), monsoon (June-September), post monsoon (October-November) and winter (December-February).



**Figure 1:** Location of CAMS Site in Sylhet City

## Data Collection and Analysis

Hourly PM data has been collected from Sylhet Continuous Air Monitoring Station (CAMS) which is operated by Department of Environment (DoE) under the CASE project. The beta gauge instrument is designed to provide a mass concentration of particulate matter. The instrument measures the volume of gas extracted through the stack/duct for each sample interval and calculates mass concentration in the specified units (e.g.,  $\mu\text{g}/\text{m}^3$ ). All collected data were analyzed with SPSS 20. Microsoft Excel 2010 was also used for data presentation as well as for making tables and graphs.

## Result and Discussion

### *Monthly Average Concentration of Particulate Matter*

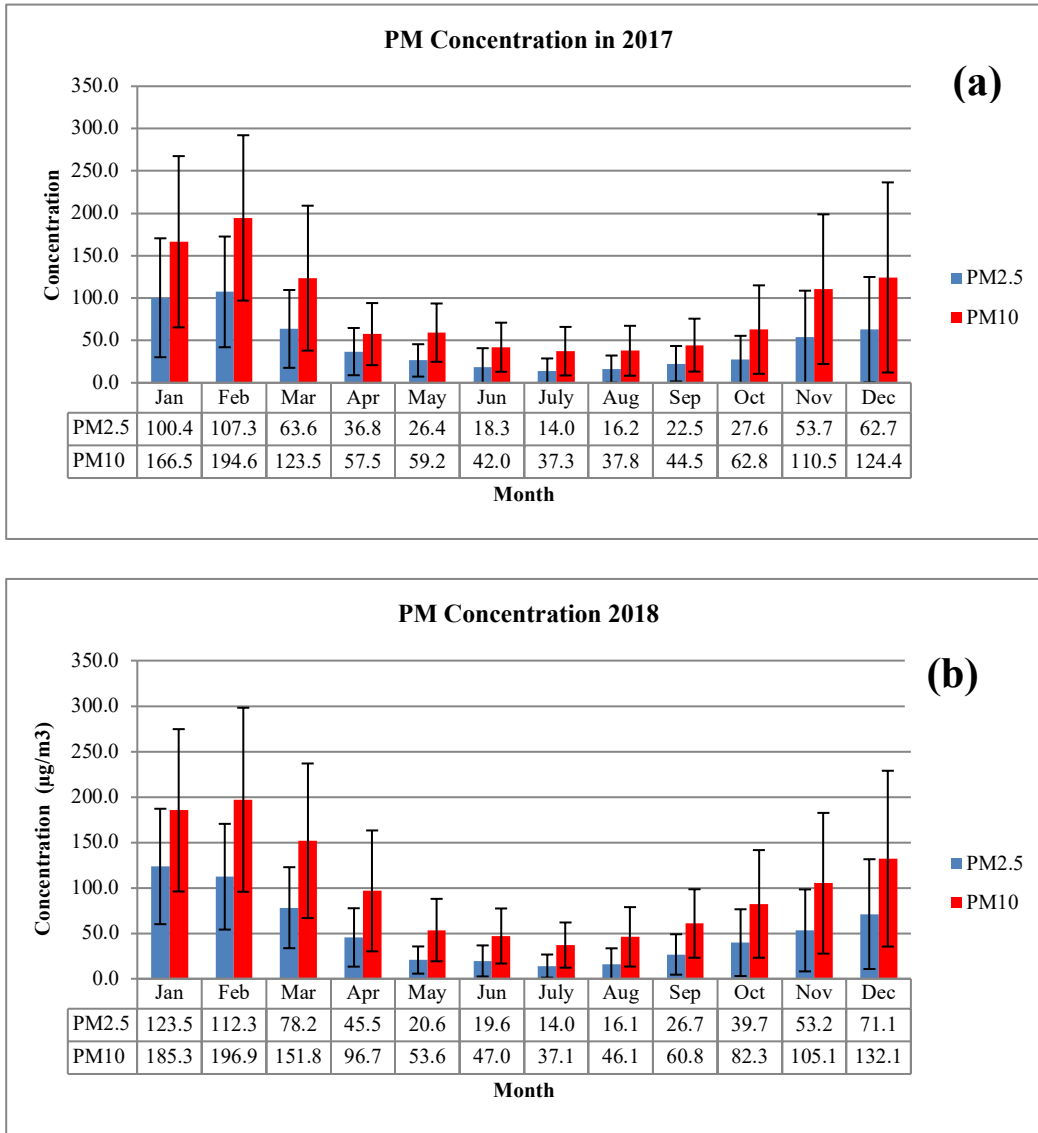
This study found considerable changes in monthly average concentration of particulate matter (Table 1). It indicates that, almost all of the months in a year, the PM concentrations exceed the annual average standard of Bangladesh ( $\text{PM}_{2.5}$ - 15  $\mu\text{g}/\text{m}^3$ ,  $\text{PM}_{10}$ - 50  $\mu\text{g}/\text{m}^3$ ). In addition, monthly average concentrations in dry months exceed the 24-hour average standard  $\text{PM}_{10}$ - 150 $\mu\text{g}/\text{m}^3$ ,  $\text{PM}_{2.5}$ - 65  $\mu\text{g}/\text{m}^3$ ).

Table 1: Monthly Average Concentration of Particulate Matter

Month	Year	$\text{PM}_{2.5}$ ( $\mu\text{g}/\text{m}^3$ )			$\text{PM}_{10}$ ( $\mu\text{g}/\text{m}^3$ )		
		Mean	Min	Max	Mean	Min	Max
January	2017	100.3±70.2	14.1	434.9	167±101.1	41.3	856.1
	2018	123.5±63.5	23	347.1	185.3±89.3	55.0	766.1
February	2017	107.3±65.3	17.3	465.10	194.6±97.6	24.5	656.6
	2018	112.2±58.2	17.2	360.9	196.9±101.2	29.3	808.7
March	2017	63.6±45.9	3	338.9	123.5±85.5	8	618.5
	2018	78.1±44.6	18	339.4	151.8±85	28	863.9
April	2017	36.8±27.9	2	166.8	57.4±36.6	8	258.3
	2018	45.5±32.1	3.1	209.8	96.7±66.5	12.3	585.3
May	2017	26.4±19.1	0.1	176.2	59.2±34.4	8	250.2
	2018	20.6±15	0.1	132.0	53.6±34.3	11	333.8
June	2017	18.3±13.5	0.1	264.00	41.9±29	5	231.0
	2018	19.6±17.1	0.1	107.0	47±30.3	2.1	167.8
July	2017	14.0±12.7	0.1	123.8	37.3±28.6	2.1	223.2
	2018	14±12.7	0.1	120.7	37.1±24.9	0.1	204.0
August	2017	16.1±16	0.1	125.6	37.8±29.5	1	195.3
	2018	16.1±17.4	0.1	165.0	46.1±32.7	6	227.1
September	2017	22.5±20.9	0.1	123.6	44.4±31.2	6	177.7
	2018	26.7±22.2	0.1	148.1	60.8±37.7	9	306.6
October	2017	27.6±27.8	0.1	199.4	62.8±52.2	7	439.2
	2018	39.7±36.7	0.1	495.4	82.3±59.2	3	457.2
November	2017	53.7±55	2	413.2	110.5±88.3	13.2	646.0
	2018	53.2±45.1	2.1	331.5	105.1±77.4	23.3	624.6
December	2017	62.7±62.2	0.1	397.6	124.3±112.2	6	800.4
	2018	71.1±60.4	5.3	385.5	132.1±96.7	17.9	754.0
Annual	2017	45.5±40.1	0.1	465.1	90.5±87.5	1	856.1
	2018	50±42.8	0.1	495.4	97.6±84.1	0.1	863.9



Figure 2 (a) showed the monthly variation of PM in 2017. It is revealed that PM is high in the month of January, February, March, November and December while rest of the months had lower concentration. On the other hand, in 2018 (Figure 2b) the concentration of PM was higher than 2017. A number of study has been conducted to investigate particulate pollution in Dhaka and Chittagong and found that December and January are the most polluted months in a year (Biswas et al., 2003; Boman et al., 2005; Begum et al., 2004, 2005, 2007, 2009; Ahmed and Hossain, 2008; Guttikunda, 2009).



**Figure 2:** Particulate Matter Concentration: (a) in 2017; and (b) in 2018

**Seasonal and Shifting Variation of Particulate Matter****Table 2:** Seasonal Variation of Particulate Matter

Seasonal Variation of Particulate Matter							
		PM <sub>2.5</sub> (µg/m <sup>3</sup> )			PM <sub>10</sub> (µg/m <sup>3</sup> )		
	Year	Mean	Min	Max	Mean	Min	Max
Pre-Monsoon	2017	42.2±36.4	.10	338.9	85.8±69.2	8.0	618.5
	2018	48.2±40.5	.10	339.4	100.7±76.9	11.0	863.9
Monsoon	2017	17.8±18.9	.10	264.0	40.2±29.7	1.0	29.7
	2018	19.2±18.4	.10	165.0	47.8±32.9	.10	306.6
Post-Monsoon	2017	40.9±45.7	.10	413.2	86.6±76.3	7.0	646.0
	2018	46.4±41.6	.10	495.4	93.4±69.5	3.0	624.6
Winter	2017	88.4±68.7	.10	465.1	160.9±107.7	6.0	856.1
	2018	98.9±64.6	5.30	385.5	169±99.42	17.9	808.7

Table 2 shows the, concentration of PM in different season in Sylhet city. PM<sub>2.5</sub> concentration was 42.2 µg/m<sup>3</sup> and 48.2 µg/m<sup>3</sup> in pre-monsoon; in monsoon 17.8 µg/m<sup>3</sup> and 19.2 µg/m<sup>3</sup>; Post-monsoon 40.9 µg/m<sup>3</sup> and 46.4 µg/m<sup>3</sup>; in winter it was 88.4 µg/m<sup>3</sup> and 98.9 µg/m<sup>3</sup> in 2017 and 2018 respectively. Maximum concentration of PM<sub>2.5</sub> was found 88.4 µg/m<sup>3</sup> in the year of 2017 and 98.9 µg/m<sup>3</sup> in 2018. It revealed that PM<sub>2.5</sub> concentration was higher in the winter season while minimum was found in the wet season (Figure 3a). Maximum concentration of PM<sub>10</sub> was 169.9 µg/m<sup>3</sup> in the winter where minimum was 40.2 µg/m<sup>3</sup> in the wet season (Figure 3a).). Winter had the maximum concentration of PM due to less of rainfall and temperature rate. But wet seasons (June-September) has the highest rainfall rate which can lead to fall down the PM to the ground.

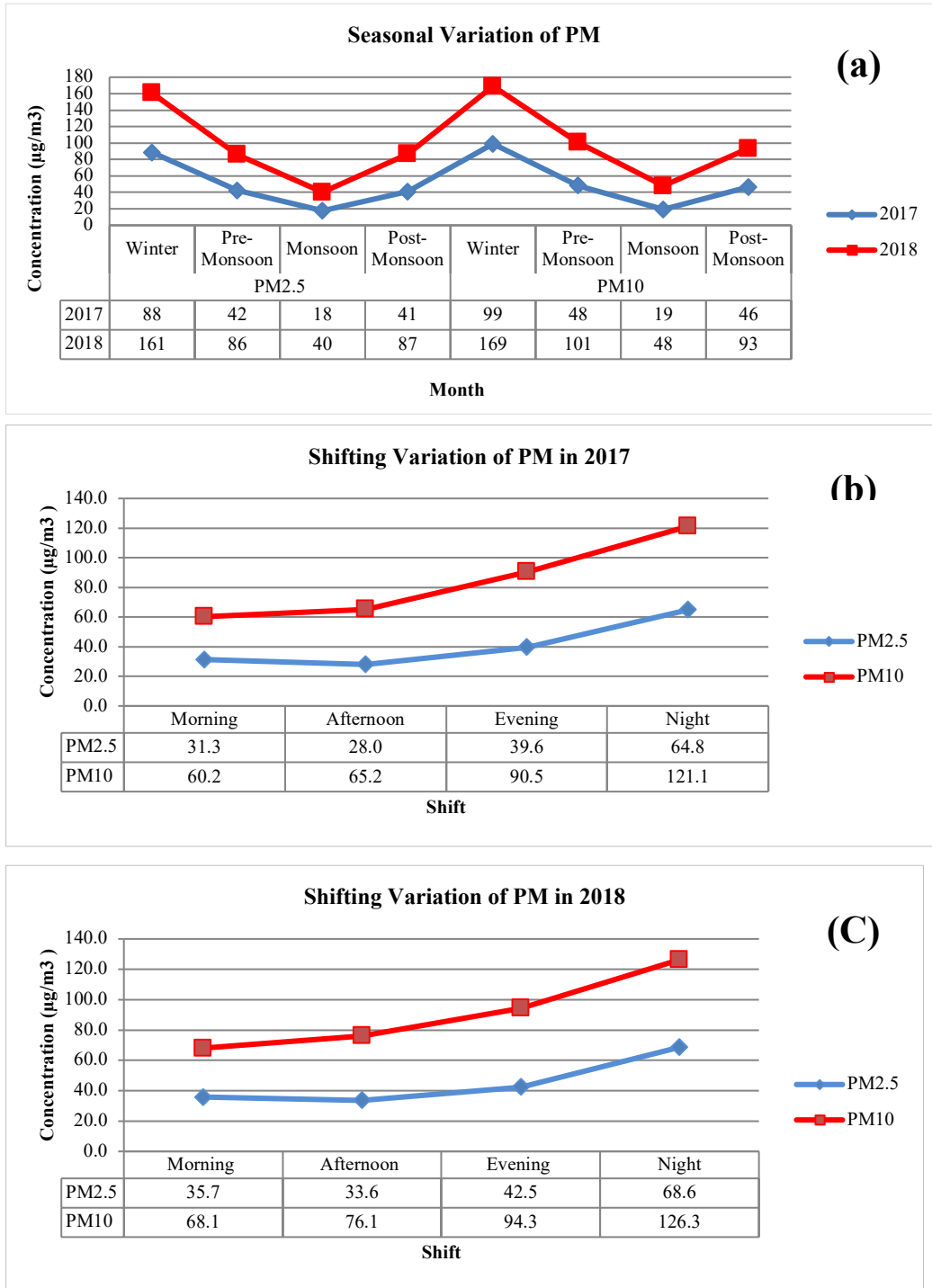


Figure 3: Variation of PM in Sylhet City: (a) Seasonal; (b) Shifting in 2017; (c) Shifting in 2018

Figures 3 (b) and 3 (c) shows the concentration of PM in term of shifting variation. It has been found that in 2017, the maximum concentration of  $PM_{2.5}$  was found to be  $64.8 \mu\text{g}/\text{m}^3$  during the night time (8 PM-6AM) time while the minimum was recorded for  $28 \mu\text{g}/\text{m}^3$  during afternoon (12 PM-5 PM). Same scenario has also be found for the  $PM_{10}$  concentration. It is found that, night time was the peak for  $PM_{10}$  concentration while morning has the less concentration than night. In 2018, maximum concentration of PM was also found in during the night time while morning and afternoon has the less concentration. The heavy vehicles such as trucks are allowed in the night time to enter into the city which can be a reason for peak concentration of PM in night time.

### Annual Concentration of Particulate Matter in Sylhet City

Figure 4 shows the annual concentration of PM in Sylhet city. It has been found that  $PM_{2.5}$  concentrations recorded for  $45.5 \mu\text{g}/\text{m}^3$  and  $50 \mu\text{g}/\text{m}^3$  and  $PM_{10}$  concentrations found to be  $90.5 \mu\text{g}/\text{m}^3$  and  $97.6 \mu\text{g}/\text{m}^3$  in 2017 and 2018 respectively. The  $PM_{2.5}$  concentration is almost three to four times higher than both Bangladesh National Ambient Air Quality Standard (BNAQS) ( $15 \mu\text{g}/\text{m}^3$ ) and WHO standard ( $10 \mu\text{g}/\text{m}^3$ ). Besides,  $PM_{10}$  concentration is also two times higher than BNAQS and almost four times higher than WHO annual standard.

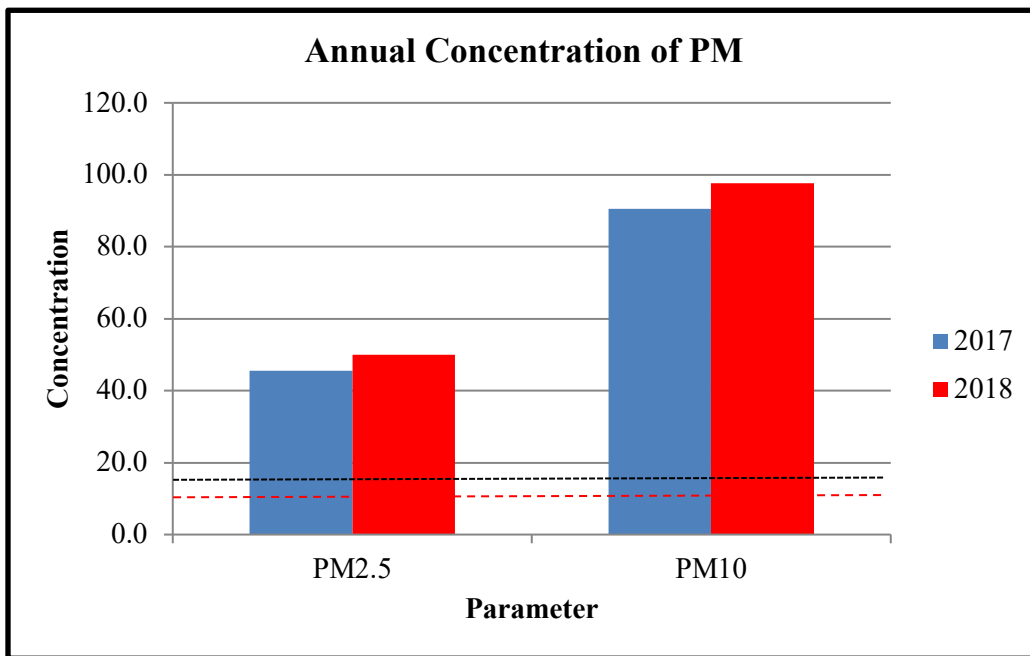


Figure 4: Annual Concentration of PM in Sylhet City

### Conclusion

Air pollution in Bangladesh is a high priority concern as it is seriously affecting the quality of life in the city and represents a major public health issues. The high

concentration of PM<sub>2.5</sub> was 123 µg/m<sup>3</sup> in January 2018 while minimum concentration was in July. Maximum PM<sub>10</sub> was 196 µg/m<sup>3</sup> February 2018 as well as July was the less concentrated month. During the seasonal variation, it shows that winter season had the maximum concentration of PM<sub>2.5</sub> and PM<sub>10</sub> for both years. During the winter season brick kilns start their production which contributes to total air pollution beside the other sources in Dhaka city (Guttikunda *et al.* 2013). In addition, meteorological phenomenon has the great factor to influence the concentration of PM<sub>2.5</sub> and PM<sub>10</sub>. This study also found that, during the shifting variation night time (8:00 PM to 6:00 AM) is leading hour for peak level of PM concentration. Overall, it can say that, annual average particulate matter concentration in Sylhet city roughly 4 to 5 times higher than the national and WHO standard. It is not possible to eliminate the particulate pollution completely from developing country like Bangladesh. Institutional mechanism be overhauled to stop issuing fitness certificate to vehicles identified as gross polluters. Regular inspection and enforcement programs should be conducted to audit the emission compliance of the brick kilns. Public awareness campaign should launch about the causes and source of air pollution through the initiation of both government and non-government sectors. Further study and research should be conducted to Conduct further to identify the specific sub fraction(s) of PM which are mostly contributing towards adverse effects on respiratory health.

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## Climate risks for girl-focused development initiatives in Bangladesh

Huraera Jabeen\*

**Abstract:** Climate risks for identifiable and marginalized population groups raise particular concerns about disproportionate effects, with particular reference to future pathways for development initiatives. The double jeopardy of adolescent girls brought on by gender and age affects their attitudes, mobility and access to different financial, human and social assets. Climate risks for adolescent girls are also influenced by their roles, division of labour, difference in decision-making ability within the household and society. Acknowledging them as a vulnerable group is not enough to make any effective change. With deepening poverty in relation to changing climate, girl-focused initiatives have to evaluate existing inequalities to design future activities and programs. The essence of the argument is that impacts of climate hazards exacerbate existing risks and vulnerability, and tend to eradicate development achievements gained with adolescent girls over the years. Based on such arguments this paper reviews secondary data and sets out how to learn from accessible knowledge to explore challenges for future girl-focused development initiatives in Bangladesh.

**Key words:** Adolescent girls; Climate risks; Girl-focused initiatives; Bangladesh

### Introduction

Climate change, with similar exposure to variability and extremities, poses differential risks to different groups of population based on wealth and education, disability, and health status inequalities, as well as gender, age, class, and other social and cultural characteristics (IPCC 2012). Among different groups, adolescent girls are considered vulnerable to climate risks on two counts: because they are *female* and because they are *young* (Gaag 2013). Research evidence that links gender and climate change emphasizes the social construction of gendered vulnerability, in which women and girls are typically marginalized from decision-making fora, are often (although not always) at greater risk of dying in disasters, and are discriminated against in post-disaster recovery and reconstruction efforts (IPCC 2012). Similarly, due to their youthfulness and, specifically for their lack of social power, children and adolescents are often among the most severely affected by environmental degradation, poverty, forced migration and household conflicts (Boyden & Mann 2005).

Vulnerability is often seen superficially, overly generalized and deterministic rather than specifying the underlying mechanisms that create vulnerability (Schensul & Dodman 2013). Evidence-based knowledge generated by the specific study of the relationship between climate risks and adolescent girls are scant; many are extrapolated from relevant girl-focused programs and activities. This paper examines available literature to trace the pathways of influence and better understand the nature of disproportionate vulnerability

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for adolescent girls to both direct and indirect impacts of climate change. The essence of the argument is that impacts of climate hazards exacerbate existing risks and vulnerability, and tend to eradicate development achievements gained with adolescent girls over the years. Reviewing secondary data, the paper aims to identify the risks for girl-focused initiatives; examine how those initiatives can evaluate or integrate climate risks in their activities and programs; and generate evidence-based knowledge in their future explorations.

The geographical focus of the discussions remains on Bangladesh — a country widely recognized to be highly vulnerable to climate change and disasters. Changes in temperature and precipitation; sea-level rise and saline intrusion; heat and cold wave; extreme rainfall and pluvial flooding; fluvial flooding and droughts; tropical cyclones — all of these climate variables are evidently impacting the population of the country both directly and indirectly. Again, the extent and type of the impacts varies between rural and urban areas; and of course, among different age and sex groups. In Bangladesh 21.8 per cent of the estimated 149.8 million population belong to the age group 10 and 19; the proportion of adolescent girls (32.4 per cent) is more than that of boys (21.2 per cent) (National Institute of Population Research and Training et al. 2013), making them a significant group in the population. Many development initiatives focus on adolescent girls with interventions in education, sexual and reproductive health and rights considering their vulnerability and potential for the future.

The paper is organized in five sections. The following sections two and three describe the methodology and rationale of linking climate risks with adolescent girls; section four forms the main findings of the paper summarizing possible impacts of severe weather conditions and extreme climate events on adolescent girls in Bangladesh. Drawing from these understanding the conclusion synthesizes the climate risks for girl-focused initiatives and indicates some directions to address those risks.

## Methodology

The review of secondary data focused on different impacts of climate change with possible implications for adolescent girls. Two premises guided the review:

- a. One of the key objectives was to assess the vulnerability (a *state* or an *outcome*) of adolescent girls. Vulnerability is a function of three factors: exposure, sensitivity, and adaptive capacity (Parry et al. 2007). Sensitivity denote the degree to which individual or population groups is adversely affected by any climate related hazards; while adaptive capacity is defined as an inherent capacity to undertake actions that can help avoid loss and speed recovery from any impact of climate change by both adjusting behaviour and resources (IPCC 2007). While physical exposure to different hazards may be similar for different population groups, vulnerability to these hazards may vary according to different degrees of sensitivity and adaptive capacity. Knowledge, skills, power relations, gender roles, health, wealth, age, physical and (dis)ability— factors like these shape an individual's and a group's differential sensitivity and adaptive capacity. This study explores both the sensitivity and adaptive capacity of adolescent girls.

- b. Sensitivity and adaptive capacity may be assessed in two possible contexts: less dramatic, incremental and often unnoticed severe weather conditions, not necessarily causing a ‘disaster’; or extreme climate events that do cause disasters. The gendered nature of vulnerability to natural disasters is a well-researched topic (for example, see Ikeda 1995; Enarson 2004; Neumayer & Pliimpert 2007; Sultana 2010). Similarly, some recent publications have examined the vulnerability of adolescents to both natural and man-made disasters (for example, see Plan International 2011; Bradshaw & Fordham 2013; Gaag 2013). This paper takes into account both groups of findings; in addition, it explores the non-disaster contexts that affect the overall well-being of adolescent girls and the cumulative effects that exacerbate the impacts of disasters.

The literature review included book chapters; peer-reviewed journal articles; national and international survey data; and reports published by organizations and institutions working on climate change and on improving adolescents’ well-being. A wide variety of topics has been covered by this literature. The publications on climate change included evidence of the impact of climate-driven phenomena on rural and urban areas; future predictions; the concepts of adaptation and adaptive capacity; climate induced disaster and disaster risk reduction; and gendered vulnerability to climate change and natural disaster. The reviewed literature on adolescents discussed their physiological and psychological development, division of labour, access to education, health and nutrition, household dynamics and violence. Literature and reports from girl-focused initiatives guided the criteria for the inclusion of topics from discussions on climate change and adolescents’ well-being. Most of the literature reviewed discusses Bangladesh; however, relevant publications from other contexts helped in triangulating the possible implications.

### **Rationale for assessing climate risks for adolescent girls**

Climate risks for adolescent girls are multi-dimensional. In some global contexts, it is argued, extreme climate events and disasters may instigate early marriage for adolescent girls (see CCC 2008; Deen 2010; Alston et al. 2014) and this carries the possibility that the support provided by girl-focused initiatives is eradicated or at least undermined. Even less dramatic, often overlooked severe weather conditions may create local crises, deepening the level of poverty, creating food shortage and disrupting the fabric of everyday life. Such conditions influence an adolescent girl’s workload, time management and sensitivity to diseases. In addition, deteriorating environmental and social conditions limit the ability of households to afford education for their children (especially girls, whose access to education is typically given a lower priority than that of boys) resulting in the failure of programs that concentrate on sending more girls to school ( see Johnson et al. 1995; CCC 2008; Gautam & Oswald 2008; UNDP 2004). Thus, three arguments may be drawn in favour of exploring climate risks, especially, for adolescent girls.

#### ***a. Adolescents are missing from disaggregated vulnerability assessment***

There is a growing body of literature on climate change and vulnerability, but little disaggregated data reflecting specific implications for identifiable population groups. As mentioned in the introduction, adolescents’ vulnerabilities are determined both by sex or

gender, and age. Discussions on gender and climate change tend to focus on women with reproductive and productive roles; while discussions on children tend to focus on the under-fives considering their lower immunity and increased health risks arising from changing climate. None of these groups of literature uniquely captures adolescent girls, or the social construction of vulnerability that is associated with their age, assets and decision-making ability. Adolescence is a period of life transition when girls, apart from their physiological and psychological changes, try to develop their capacities through education, and gaining skills, attitudes and habits which will determine their adaptive capacities. These adolescent girls, in addition to developing their own identity and their relationships with parents, when given the opportunity add new elements of identity and build new extra-familial relationships and skills.

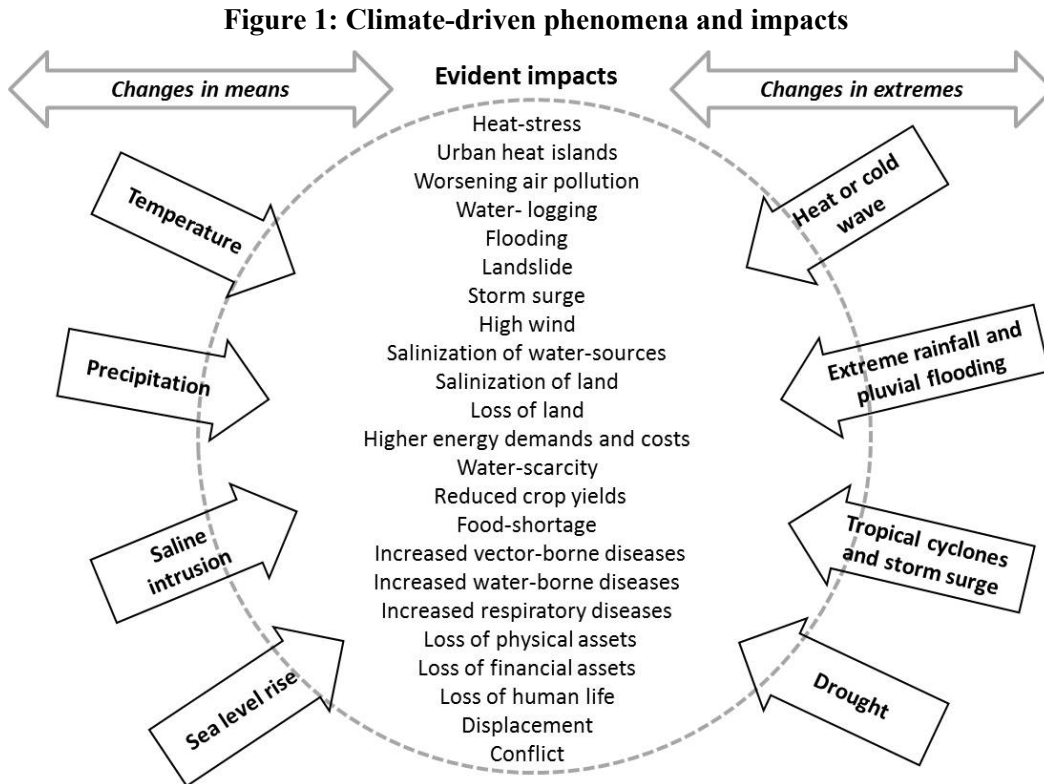
***b. Adolescent girls are poorly prepared for future adaptation***

Experts predict that even if measures are taken to reduce future carbon emissions, because of the levels already accumulated the climate will anyway continue to change for decades. Let us look at two implications — first, adolescent girls and boys, like all population groups, are exposed to present climate hazards; and second, adaptation is essential for future planning rather than focusing on the mitigation of current effects, an approach adopted by countries such as Bangladesh. An adolescent, who is growing up now, even if s/he survives the present impacts of severe climate change, will suffer the extreme ‘burn’ of any future changes. But there are more adverse effects for adolescent girls to cope with in comparison with boys. Seventy four percent of the girls in Bangladesh are married by their 18<sup>th</sup> birthday and they usually are married to more aged and mature males (National Institute of Population Research and Training et al. 2013). As a consequence, a girl takes on household and household responsibilities at a much earlier age than does a boy; imbalance due to age and responsibilities make them poorly prepared to cope with the future climate risks for themselves and the households she plays an important role.

***c. Benefiting from girls’ potential to be agents of change***

With findings on disproportionate discrimination of girls in comparison with boys, there are evidence-based arguments for investing in adolescent girls’ education and health, building assets, increasing participation in household and community decision-making and ensuring safety. Investment in education has several benefits: i) an increase in economic ability and the development of skills; ii) delaying early marriage, early pregnancy and bearing a high number of children; iii) an increased chance of intergenerational access to education; and iv) breaking the cycle of poverty. Specific information on health risks prepares adolescent girls to change their behaviour. Assisting in building economic assets contributes towards empowerment of the girls; ownership and control over productive assets increase their decision-making abilities. Participation in economic activities and community-based development programs in many cases changes societal attitudes towards the aspirations of adolescent girls. Success stories reinforce considering adolescent girls as agents of change for development. With their potential to build human, financial and social capital adolescent girls can be significant actors for transformative adaptation planning.

Therefore, evaluating climate risks, and in turn looking at opportunities for building adaptive capacities for adolescent girls could be considered as a pre-emptive approach — preventing something anticipated by acting first. Climate risks for adolescent girls in Bangladesh may be assessed using the list of evident impacts shown in Figure 1.



### Possible impacts of climate change on adolescent girls

Differential risks from the list of impacts illustrated in figure 1 is argued to be shaped by the differences in vulnerability that arise from non-climatic factors and from multidimensional inequalities (IPCC 2014). Different physiological, socio-cultural and economic factors influence an adolescent girl's overall well-being. Physiological factors, discussed in the following sub-section, mostly influence exposure to climate hazards while socio-cultural and economic factors, elaborated in the subsequent subsections, influence sensitivity and adaptive capacity as defined in the methodology section.

#### *a. Physiological factors*

##### *Age and health*

Global surface temperature has been increasing in the last decades and this trend is likely to continue (IPCC 2013). Increased temperature associated with changes in precipitation increases the incidence and range of various vector- and water-borne diseases; increases the possibilities of respiratory diseases associated with air pollution from forest fires, the

pollen count, fungal growth and moulds (Bartlett 2008). Children and adolescents are more vulnerable to heat stress than adults because they produce higher levels of metabolic heat during physical activity (Committee on Sports Medicine and Fitness 2000). Many boys and girls of resource-poor regions of the world like Bangladesh enter adolescence undernourished (WHO 2002); their physiological development and health conditions influence how prepared they are to cope with the impacts of increased temperature and occurrence of diseases.

On the other hand, pathogens of water-borne diseases spread easily during water-logging and flooding — two significant climate risks for Bangladesh — through contaminated water and inadequate sanitation (Hashizume et al. 2008; Hashizume et al. 2012; UNDP 2012). A study of rural Bangladesh reported a six per cent increase in cholera incidence with a minimum air temperature increase of one degree centigrade while the same increase of sea-surface temperature caused 25 per cent increase in chances of cholera incidence (Ali et al. 2013). Hospitals in Bangladesh report their concerns about the increasing number of patients during heat waves and floods (icddr,b 2011; icddr,b 2009). Children and adolescents, having a less-developed immune system, are more vulnerable to increased levels of water-borne diseases.

Water-logging and pluvial flooding in settlements without drainage facilities and waste management may also result from intense and irregular rainfall inundating houses, courtyards, toilets and streets. Women and adolescent girls who help in cooking either have to wade through stagnant water or tolerate cooking inside the house amidst smoky conditions. It is estimated that globally indoor air pollution causes 36 per cent of all lower respiratory infections and 22 percent of chronic obstructive pulmonary disease (WHO 2002). People living in flooded areas in Bangladesh in previous incidences complained about skin and fungal infections on their legs and feet (Rashid 2000). ‘Rough and unattractive’ skin from using saline water in southern parts of the country is claimed to impact on decisions of establishing a marital relationship with the girls (CCC 2008). Hence, adolescent girls’ workload exposes them to increased occurrence of respiratory and skin diseases.

#### *Physical abilities and differences*

Physiological and biological changes during adolescence influence girls’ sensitivity about their own body and perception about their own vulnerability. In a focus group discussion about the effects of increased heat in an urban informal settlement, adolescent girls reported being teased by men and boys on their way to school because their clothes were drenched in sweat (Jabeen 2012). The girls preferred to miss school rather than sweat and be teased. Biological and physiological differences — in terms of physical ability, immunity to diseases — are widely cited as key contributors to higher mortality rates among females during natural disasters (Neumayer & Pliimpert 2007). In Bangladesh, however, higher female mortality during disasters has been attributed to dress codes and reproductive responsibilities that restrict their mobility and survival options rather than to physiological factors (Ahmad 2012; Neumayer & Pliimpert 2007; Ikeda 1995). Similarly, conservative values rather than innate inabilities prevent girls from learning basic life-saving skills like swimming, climbing or even running.

All these physiological factors influence a girl's degree of exposure to climate hazards — water-logging, flooding, storm surges, heat-wave, drought and salinity.

***b. Socio-cultural factors***

Socio-cultural factors – for example, age and bias in decision-making, gender roles and division of labour, asset-ownership pattern and negotiating power – affect attitude, mobility, access to education and information and, thus, influence the adaptive capacity of adolescent girls. The following discussion explores some of the socio-cultural factors that explicitly or implicitly influence adolescent girls' entitlements, agency and capacity to take actions to reduce risks and recover from impacts.

*Being neither children nor adult*

Adolescents and young women fall between the broader categories of 'children' or 'women' – they are not simply categorized as 'children' like girls and boys, or 'women' with reproductive and productive roles. To consider them as children would transfer the responsibility of ensuring their well-being to the parents, whereas being seen as women would have given them some power to take actions (Gaag 2013; Plan International 2011). Being 'old enough' as women to take care of responsibilities shapes their roles within the household – including workload, food-consumption patterns and access to education – that in turn influences their exposure and ability to manage risks (elaborated in the following sections). Being 'too young' on many occasions restricts their personal mobility, access to information and participation in decision-making.

A muddled perception by household members about their role can become most detrimental for adolescent girls during disaster situations. The shock and distress following 'extreme events', as well as the deprivations and humiliations of displacement or slow recovery from disasters, can be profoundly debilitating partly because of how household members perceive adolescent girls' roles. Evidence from disaster situations in other countries show that many adolescents are forced prematurely to take on adult roles, just at the point where people and structures that are normally in place to advise and protect them are absent (Bradshaw & Fordham 2013; Gaag 2013). Although such evidence has not been reported in Bangladesh, future disasters could create such a situation where adolescents, having a lack of cognitive, emotional and psychological maturity as adults, may not be able to cope in the same way as adults can. However, it is worth noting that adolescents give energy, enthusiasm and openness to ideas that can be crucial to helping their households and wider community to recover after a disaster.

*Gender-based discrimination in food consumption and education*

Gender-based discrimination can influence the sensitivity – the degree to which adolescent girls are adversely affected by food shortage— one of the indirect impacts of climate change. Most low-income households whether in urban or rural areas in Bangladesh, spend a high proportion of their income on food. Any loss of household income or increase in food prices after a crisis makes it almost impossible to adequately feed both adults and children, thus children remain hungry all the time. They become exposed to long-term repercussions that result from intensified poverty and the difficult choices that low-income households make to adapt to more challenging conditions

(Bartlett 2008). A household reduces either food consumption or non-food expenditure such as education, or both (Raihan 2009; Ahmad 2012).

A study showed that over 40 per cent rural and 85 per cent of urban households withdrew their children from school during disasters. For rural households, these withdrawals tended to be permanent while urban households were more likely to do so temporarily (Ahmad 2012). Educational gender gaps have long existed in Bangladesh for reasons of poverty, low monetary returns from girls' education, safety concerns and negative social stigma against educating girls based on culture, ethnicity, religion and race (Shafiq 2009). Although the country has recently achieved gender parity in education, there remain significant differences at key junctures. A recent demographic survey shows that the 81.2 per cent school attendance rate of girls between age 11 and 15 drops alarmingly to only 29.2 per cent for the group aged between 16 and 20 (National Institute of Population Research and Training et al. 2013).

Gender-based discrimination is also evident in food consumption; household food hierarchies exist placing females below male members in Bangladesh as in many other contexts (Nelson et al. 2002). As a consequence they are likely to have a poorer nutritional status and a lower resistance to disease making them more vulnerable than boys and men during any crisis and food shortage (Wisner et al. 2004). The prevalence of malnutrition is alarmingly high among female adolescents of low-income rural and urban households in the country; the average per-capita energy intake by rural adolescent girls in the country is 81 per cent of the recommended dietary allowance for age (Akhter & Sondhya 2013). Thirty per cent of adolescents aged 15 to 19 began childbearing in Bangladesh (National Institute of Population Research and Training et al. 2013); the malnutrition and food shortage can become even grave for pregnant or breastfeeding adolescent mothers (Gaag 2013). Persistent food shortage and associated malnutrition also have long-term health impacts with the possibility that cognitive abilities may also be impaired.

#### *Responsibilities and workload*

The loss of livelihood opportunities, houses and other assets resulting from any severe condition or extreme event eventually affects a household's income. Girls often are the first to be pulled out of school either to help supplement the household income or to take over an adult's responsibilities who takes on additional income-generating activities. Girls are expected to take over their mother's tasks, care for the sick or care for younger siblings when their parents are obliged to spend more time earning a living or travelling to collect aid or food. In addition, young girls and women in many parts of Bangladesh are responsible for collecting water and fuel; they have to spend more time and energy than usual to look for and collect clean water and fuel during scarcity resulting from increased heat or flooding. The demands on time for additional work entail opportunity costs in terms of attending school and participating in income-generating activities (Modi et al. 2006; Kundzewicz et al. 2007).

Adolescent girls also lose time, energy, and the ability to concentrate to carry out other daily activities, for example bathing or washing clothes. Increased demand for time leaves less time to socialize, disconnecting them from their social networks. Even when

girls are able to continue school, the difficulties of managing an increased workload causes them to do badly, sometimes bringing punishment that undermines their desire to continue (Jabeen 2012). If they have to discontinue school for the period of crisis or a disaster, it becomes challenging to catch up with the class when they return so they are more likely to drop out. When a girl is forced to leave school, not only is her education in jeopardy, but she faces increased risk of early marriage and unintended pregnancies. Such risks follow the argument that extreme and non-extreme events modify the resilience, coping, and adaptive capacity of individuals and communities affected by such events, and thus exacerbate vulnerability to future risks (IPCC 2012).

Increased time demands and the burden of extra work exacerbate married adolescent girls' vulnerability as well. As a wife, she is expected to spend more time to supplement the household income; in addition, she has to manage household chores within limited resources while taking care of her own children, if any. Again, water scarcity is suggested to be detrimental to pregnant women in the southern part of Bangladesh affected by salinity who are forced to fetch water irrespective of the distance between the source and their dwellings (CCC 2008). It is speculated that in the long run the result of taking on extra work hurdles in their daily life and using saline water during menstruation may be contributors to the alarming number of premature births, abortions and still births (blue-baby syndrome) in these areas (ibid).

#### *Fear of exploitation and abuse*

The responsibility of collecting water and fuel during a heat-wave and drought, or during water-logging and flooding increases risks for adolescent girls. Travelling longer distances away from home exposes unaccompanied and separated girls to harassment and sexual abuse.

Adolescent girls remain at risk of sexual abuse, harassment or even rape and abduction on the way to emergency or temporary shelters during disasters, when going out on their own to find work, or simply finding somewhere to go to the toilet in private while staying in a shelter (CCC 2008; Bartlett 2008; Demetriades & Esplen 2008). Assessments of gender responsiveness of cyclone shelters in Bangladesh identified 'insecure environment' as one of the key reasons for being considered unfavourable by female shelter seekers (BRAC 2013; Paul 2012). Inadequate lighting at night, unhygienic conditions in toilet and bathing facilities, social stigma, and lack of privacy are contributing factors to this negative perception. Because of concern for safety both enroute and in the emergency shelter some households decide to leave girls at home during disasters, consequently increasing their risks.

In another scenario, many male members leave their households in search of employment opportunities during severe weather conditions or after disasters. The women of these households are burdened with additional responsibilities to 'take care' of all the members; they have to remain alert for their daughters' security as well. A study reported that professional gangs take advantage of disaster situations and lure young women into prostitution with promises of jobs and a better life elsewhere (CCC 2008). After cyclones Sidr (2007) and Aila (2009) mostly due to economic reasons there was an increase in trafficking from the affected southern part of Bangladesh (Gaag 2013). In addition, it is



argued that the incidence of acute poverty forces women into anti-social work as a desperate bid just to feed their children and family (ibid). Naturally the adolescent girls within these households remain more vulnerable to abuse and exploitation.

### *Early marriage*

Bangladesh has one of the highest rates of early marriage. The economic and social burden of on-setting changes may increase a girl's risk of early forced marriage. As discussed earlier, severe weather conditions or an extreme climate event add pressure to a household's livelihood opportunities, workload and food consumption. For over-stretched households getting their daughters married means one less mouth to feed. When girls fail to attend school in order to take on additional responsibilities or supplement the household income they often lose an academic year and then increase their chances of getting married earlier. Early marriage has a strong correlation with lower educational attainment (Jensen & Thornton 2003); on the other hand, access to formal education increases choices to adopt numbers and types of coping strategy that can address different risk factors (Wamsler & Brink 2014).

Some reports indicate a strong relationship between early marriage and natural disasters. Concern for insecurity and lack of privacy within temporarily displaced households during flooding and cyclones or long-term water-logging often encourages parents to marry off their daughters. A report described early forced marriage as a common phenomenon during a post-flood rehabilitation phase, especially amongst the poorest of the society in Bangladesh (CCC 2008). An interviewee of another study reported a very high number of school dropouts after cyclone Sidr in 2007 (Plan International 2011). The households usually argue that early marriage ensures a girl's security, reduces household expenses, and reduces pressure on households for dowry payments, as these are traditionally lower for younger brides (Alston et al. 2014; Ahmad 2012). These findings reflect the post-tsunami situation of 2004 in India, Sri Lanka and Indonesia where many girls and young women were married off because their parents regarded marriage as the only protection against rape (Felten-Biermann 2006).

### *c. Economic factors*

Previous discussion of socio-cultural factors such as food shortage, dropout from school, early marriage, indicated strong relationships with economic factors. However, the discussion did not elaborate two specific factors — the early involvement of adolescent girls in economic activity to support household earnings, and migration. Diversification of livelihood opportunities and migration are considered as adaptation strategies for managing climate risks better. The following discussion examines their relevance for adolescent girls.

### *Supporting additional earnings*

Some adolescent girls, during or after any crisis or disaster, get involved in income-generating activities to supplement the household income. The most prevalent option for those living in rural Bangladesh is to work as a household-help either in a wealthier household in a near-by village or to migrate to urban centres. Working in garment factories is another popular choice in the country since girls can start working there at the

age of 14 (Weiss 2013). These working girls send money back home to contribute to the household income. Many households depend on this additional income from working girls to supplement a critical need, such as paying emergency medical expenses during a heat-wave (Jabeen 2012). Also households use their regular income to become members of saving groups in order to be able to manage future risks (Jabeen & Johnson 2013). In most cases working girls never return to school thus abandoning their chances to improve their well-being through acquiring skills and knowledge.

### *Migration*

Recent studies show that a large number of young single women and adolescent girls are migrating to urban centres worldwide (Ahmad 2012; Temin et al. 2013). Whether there is any link between their migration decisions and climate change is still an under-researched topic in Bangladesh. Migration is argued to boost adolescent girls' human capital through access to information (Temin et al. 2013). Single migrant girls are less socially constrained and enjoy greater mobility. Managing their own activities makes them more self-reliant and independent. Making a financial contribution to the household allows them to exercise agency in meeting their basic needs, planning for the future and influencing decision making. Migration leads them to new social networks and exposure to different ideas and norms. Their increased human capital and economic empowerment results in changed perception about girls' roles and social position (ibid). All these qualities are considered crucial in developing capacity to take any anticipatory and reactive actions for managing climate risks.

Nevertheless, migration does not bring opportunities to all these girls (ibid). Some can find themselves marginalized, vulnerable, and unable to take advantage of resources. Migrant girls without social networks are vulnerable to violence and abuse. There are various pressures and stresses that migrants have to face including poverty, joblessness, and changing social norms. The extent to which the urban health system is monetized also affects migrant girls' access to health-care using cash (ibid). Often adolescent girls, particularly those who have fewer skills, are limited to work in the informal sector where wages are low. With limited earnings they have no other choices but to live in informal settlements located in hazard-prone areas with poor living conditions.

All these impacts of severe weather conditions and extreme climate events along with the implications for adolescent girls and underlying factors affecting their sensitivity and adaptive capacity are summarized in the following Table 1.

Table 1: Climate variables, impacts and vulnerability of adolescent girls in Bangladesh

Climate-driven phenomena	Evidence of impact		Implications for adolescent girls	Underlying factors affecting sensitivity and adaptive capacity
<b>Changes in means</b>				
Temperature	Direct	Heat-stress	Physiological discomfort from exhaustion, fatigue, nausea, dehydration etc. associated with heat-stress Increased morbidity and mortality from respiratory and vector-borne diseases Food insecurity Malnutrition with long-term implications Increased workload for collecting water and fuel Insecurity while travelling for collecting water and fuel Loss of school-days	Age related physiological factors Nutrition level and health Gender role and division of labour
	Indirect	Urban heat islands Worsening air pollution Higher energy demands and costs Reduced crop yields Increased vector-borne diseases Increased respiratory diseases Water-scarcity Food-shortage		
Precipitation	Direct		Increased morbidity and mortality from water- and vector-borne diseases Reduced mobility Food insecurity Malnutrition with long-term implications Drop-out from school Early involvement in income earning activities Loss of social network Neglect and abuse associated with household stress Insecurity in temporary/emergency shelters	Age related physiological factors Nutrition level and health Gender roles and cultural patterns
	Indirect	Water- logging Damage to crops Poor water-quality Loss of physical assets Loss of livelihood Increased water-borne diseases Temporary displacement		
Saline intrusion	Direct	Loss of agricultural resources Salinization of water-sources	Increased morbidity and mortality from water-borne diseases Increased workload in collecting water and fuel Food insecurity Water insecurity Early involvement in income earning activities Migration	Age related physiological factors Nutrition level and health Gender roles and cultural patterns Gender division of labour
	Indirect	Loss of livelihood Water-scarcity		
Sea level rise	Direct	Loss of land Salinization of land Salinization of water sources	Migration Discontinued education Loss of social network Neglect and abuse associated with household stress	Gender roles and cultural patterns Asset-ownership Gender bias in power and
	Indirect	Loss of livelihood		

Climate-driven phenomena	Evidence of impact		Implications for adolescent girls	Underlying factors affecting sensitivity and adaptive capacity
		Displacement Migration Conflict	Insecurity	decision-making
<b>Changes in extremes</b>				
Heat or cold wave	Direct	Heat-stress	Physiological discomfort Increased morbidity and mortality from respiratory diseases Increased workload for collecting water and fuel Insecurity while travelling for collecting water and fuel Loss of school-days	Age related physiological factors Gender role and division of labour Asset-ownership and decision-making ability
	Indirect	Air pollution Higher energy demands and costs Increased respiratory diseases Water-scarcity Food-shortage		
Extreme rainfall and pluvial flooding	Direct	Flooding Landslide Water-logging	Insecurity and hazards living in flooded house Increased health hazards using water-logged toilets Food insecurity Reduced mobility Drop out from school Early marriage Neglect and abuse associated with household stress	Age related physiological factors Gender role and division of labour Asset-ownership and decision-making ability Life-saving skills and physical ability
	Indirect	Water-scarcity Food-shortage Displacement Loss of livelihood		
Tropical cyclones and storm surge	Direct	Storm surge High wind	Increased mortality Disruption of education Drop out from school Loss of social network Early involvement in income earning activities Insecurity of living in emergency shelters Exploitation Early marriage	Knowledge of disaster risk reduction Access to information Life-saving skills and physical ability Decision-making ability Household dynamics and social support
	Indirect	Loss of physical assets Loss of financial assets Loss of human life Displacement Water-scarcity Saline-intrusion in water sources		
Drought	Direct	Water scarcity	Food insecurity Malnutrition with long-term implications Increased workload for collecting water	Age related physiological factors Gender roles and cultural patterns
	Indirect	Loss of livelihood		

### **Conclusions: Climate risks for girl-focused initiatives and possible interventions**

Two themes emerge from this discussion. First, climate extremes and disasters magnify risks present in “normal” times, to some degree, especially (but not exclusively) when the events are rapid and on-setting. Second, because of the impacts accompanying such events, and household and community responses (for example withdrawal of girls from school) the ensuing effects threaten girls’ human capital and other assets and influence their long-term capacity. The multidimensional nature of vulnerability and exposure for adolescent girls is significantly influenced by the social dimensions of education, health and well-being, and demography.

The United Nations Adolescent Girl Task Force consider the well-being of adolescent girls to be the key to eliminating poverty, achieving social justice, stabilizing the population, and preventing foreseeable humanitarian crises (UNICEF 2011). Following their suggestions most girl-focused initiatives in countries like Bangladesh identify five priorities to mobilize financial and technical resources for fulfilling the rights of adolescent girls. The priorities include improving i) girls’ access to education, ii) the ability of girls to stay healthy, iii) opportunities for young women to earn a living, iv) young women being able to live freely of violence and abuse, and v) girls’ ability to participate as active citizens in their societies (ibid). Summarizing from the previous discussions the followings can be argued to be at risk for girl-focused initiatives in the country from the predicated changes in climate variables.

Ensuring *access to education* for adolescent girls will be challenged by climate risks. Usually girl-focused initiatives organize activities and programs to improve girls’ skills, provide incentives to encourage households to send their daughters to school and stay there. Impacts of climate change increase the workload for adolescent girls that demand time and energy and this affects their willingness to go to school and their performance in class if they do go. Discontinuing school because they find it difficult to catch up later or losing an academic year will increase their chances of being married off early; post-disaster crisis situations may encourage early marriage as well. Most married adolescent girls may not continue their education leaving them less able to develop through access to formal education and development of skills. Climate risks will influence adolescent girls’ willingness and ability to participate in different activities and programs to improve access to education in the country.

The direct and indirect impacts of climate change will be most visible in the adolescent girl’s *ability to stay healthy*. Increased temperature and resulting heat-related diseases affect their personal ability to study, work and play. As discussed, their physiological attributes and work-load pattern within the household expose them to increased vector- and water-borne diseases. Long-term water-clogging or flooding, especially in areas affected by salinity can be detrimental for their sensitive skins that, as the example speculated, may even influence their acceptance in society. Food shortage and food hierarchy within the household may lead to malnutrition and affect their long-term cognitive development. Girl-focused initiatives in Bangladesh will have to increase

support for improving health in the context of accelerating climate risks. In addition, more resources will be needed to support activities and programs during crisis periods.

More effort will be needed to ensure that adolescent girls *live freely of violence and abuse*. Disaster conditions will severely aggravate risks of harassment, sexual abuse, rape and abduction. The girl-focused initiatives in the country have to work closely with disaster risk reduction activities to ensure more gender-sensitive designs for emergency shelters and individual houses. They will need more activities and programs to address the issues of trafficking in environmentally vulnerable areas. Similarly, girls can be exposed to domestic violence during severe weather conditions; unaccompanied and separated girls collecting water and fire-wood will be prone to abuse and assaults. Ensuring safety and comfort en route to school will be challenging as well. Adolescent girls' mobility, if not considered during the design of the initiatives, will impact on goal achievement.

More adolescent girls may have to start *earning a living* to supplement income from the deteriorating environment and social conditions of households in Bangladesh. Heat-stress, intense rain and water-logging will make it difficult for them to go to work; they will have to spend extra on transportation to avoid inconvenience. Severe weather conditions will affect their working hours. They will lose income from loss of working hours; in many instances young women may also lose a job for not showing up on time. Livelihood programs within girl-focused initiatives will either have to reinforce social protection mechanisms or train working girls on sustainable livelihood options. Similarly, separate activities and programs will have to be designed for the migrant girls who live in informal settlements located in hazard-prone areas of the city without proper access to water, sanitation, roads and services.

Finally, girl-focused initiatives may aim to increase adolescent girls' *participation as active citizens in their societies*. In Bangladesh, an adolescent girl's lack of access to information, knowledge and skill along with being weak and unhealthy reduces her chances of survival during severe weather conditions or extreme climate events. Physical ability and dual identity of being a child and adult are perceived as a barrier to participate in preparing for and managing risks. Climate risks will only increase the marginalization of adolescent girls unless they are integrated with the disaster risk reduction and climate change adaptation activities in the country. Figure 2 illustrates the possible direct and indirect linkages between the diversified impacts of climate change and factors influencing the vulnerability of an adolescent girl.

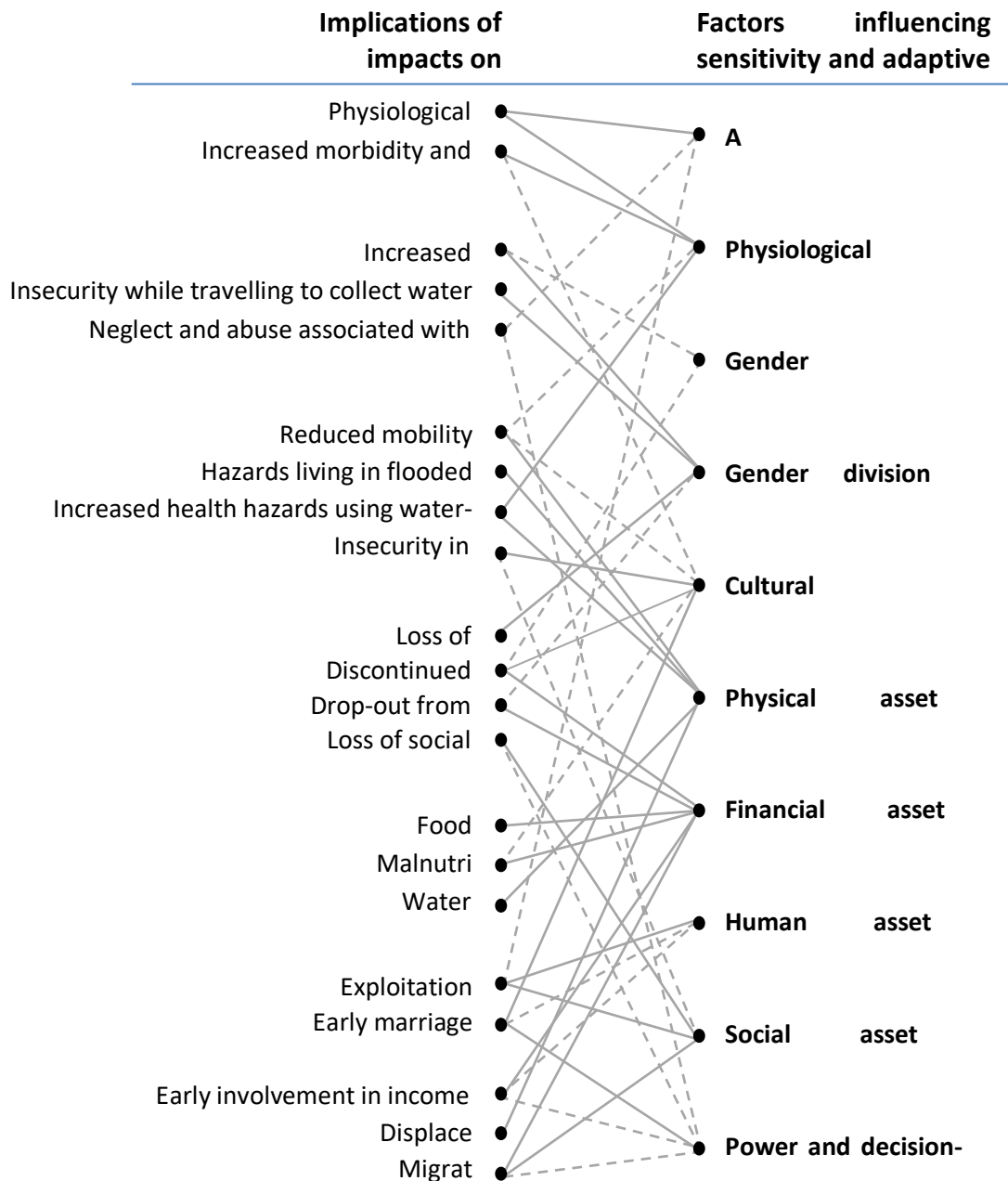
Climate risks deepen the poverty of households and increase marginality. The double jeopardy of adolescent girls brought on by gender and age affects their attitudes, mobility and access to different financial, human and social assets. Similar to gender-based climate vulnerabilities climate risks for adolescent girls are influenced by their roles, division of labour, differences in asset-ownership and decision-making ability within the household and society. Acknowledging them as a vulnerable group is not enough to make effective change. With deepening poverty in relation to changing climate, girl-focused initiatives have to evaluate the existing inequality around access to education and skill

development; food consumption and healthcare; economic empowerment and agency over decision-making to integrate climate risks within their activities and programs.

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Figure 2: Linkages between climate impacts and factors influencing vulnerability



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## Variations in Soil Horizons of Point Bars of Bangshi Floodplain

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**Abstract:** Bangshi floodplain is one of the important floodplains for human habitation and various ecosystem services. This floodplain is formed due to the deposition of various soil layers by the Bangshiriver. This study illustrates the variation of the physical properties of the soil horizons of the selected six samples (A1, A2, A3, B1, B2, and B3) from the two-point bars (Northern and Southern) of Bangshi floodplain. This study conducted mainly based on primary data which are collected from the field by sample collection, observations, and some other secondary sources. Bouyoucos Hydrometer method used to find out the physical properties of soil particularly soil types of each layer. From the data analysis, it reveals that different types of soils are available in the study area such as sand, sandy loam, loamy sand, sandy loam, silt, silt loam, and clay. Besides, there is a close relationship between the river and its adjacent soil formation of the Bangshi floodplain. Soil deposited layer by layer and large particles of soil have been deposited near the river and with the increase of distance from the river deposited particle size is becoming finer. Furthermore, soil particle of the upper part is finer than the lower part and with the increase of depth soil particle size also increases. Therefore, the soil horizon differs from one sample point to another sample point. Moreover, the Agricultural cropping system depends on sedimentation characteristic, consequently, wheat is cultivated near the river and paddy is cultivated at the area of the last two sample points of the Bangshi floodplain.

**Keywords:** Soil, Soil Profile, Point Bar, Floodplain, Bangshi

### Introduction

Bangladesh is a depositional landform country where numerous rivers are flowing over the country (Baqee, 1993; Alam, & Nazrul, 1998). The major three river systems Ganga, Brahmaputra, and Meghna shaped this country as a big delta of the world (Rashid, 1991). This country is divided into three major physiographic divisions such as hill, terraces and depositional plain land (Brammer, 2012). Almost every year riverine flood causes huge sedimentation adjacent to the river, approximately every year deposited combination of three distinct soils or one or two types of soil, as a result, various depositional landforms formed in this region (Zamman, 1989; Kholiuzzaman, 1994; Hussain, et.al, 2002). These depositional features named as an alluvial fan, point bar and delta which are very significant for human settlement and livelihood (Lewin, 1978).

Agricultural activities, flora, fauna, biodiversity as well as human habitation depend on soil quality (USDA, 1975; Ali, 2003). There are different types of soil from a different point of view, in the term of soil particles size soil can be divided into major three types

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such as sand, silt and clay (Brammer, 1996; Bissonnais, 1998; Bowman, et.al, 2001). Soil profile means the vertical section of the soil that depicts all of its horizons and extends from the soil surface to the parent rock material (Gee and Bauder, 1986; Brady, 1990). By examining a soil profile, it is possible to determine the valuable insight into soil fertility. As the soil weather and organic matter decompose, the profile of the soil changes (Mondal, 2008). For instance, a highly weathered, infertile soil usually contains a light-colored layer in the subsurface soil from which nutrients have leached away (Ahlf et.al, 2002;). On the other hand, highly fertile soil often has a deep surface layer that contains high amounts of organic matter (FAO, 2006).

Bangshi floodplain is one of the important floodplains for human livelihood and various ecosystem services. This floodplain is formed due to the alluvial deposition of the Bangshiriver which flowing as a distributary of the Old Brahmaputra river (Islam, 2003). Over the many years this Bangshi floodplain formed by the sedimentation processes of various soil layers. As soils are deposited slowly over time consequently it deposited layer by layer and deposition rate of all places are not the same. Therefore, the soil layer or horizon differs from place to place. Various types of soil are using for diverse purposes, for this reason, it is very necessary to know about the soil profile of the specific areas to decide which soil is perfect for particular purposes. In this context, an attempt was made to explore the sedimentary environment and find out the variation of soil horizons in the Bangshi river floodplain in this study.

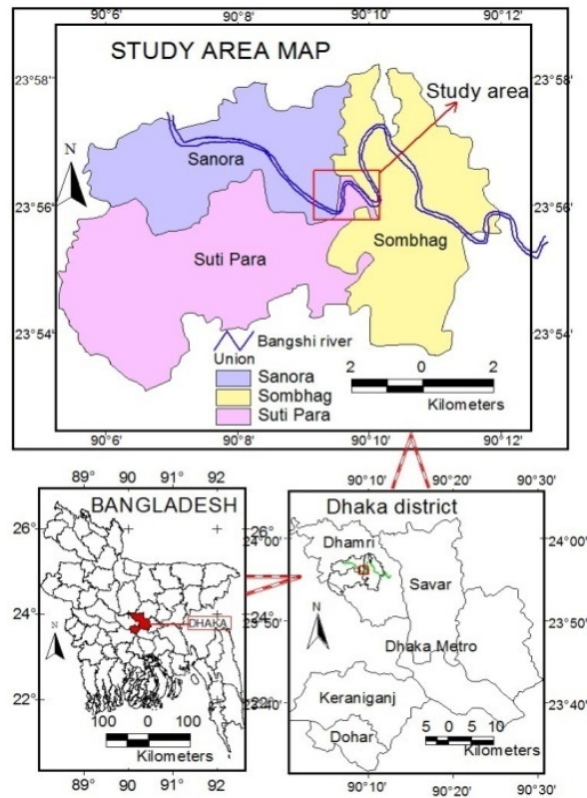
### **Aim and Objectives**

The main aim of this study is to explore the sedimentary conditions and variations in soil horizons of point bars in a floodplain. The specific objectives of this study are the following:

- a) To identify the soil horizon characteristics of the point bars in the Bangshi floodplain; and
- b) To analysis the physical properties of soil horizons at the study point bars.

### **Study area**

Bangshi floodplain near Kalampur Bazar is selected as the study area. The study area is occupied by Sanora in the north, Sutipara in south and Sombag in the east under Dhamrai Upazila of Dhaka district. The absolute location of the study area is 23°56'N to 23°55'N latitude and 90° 9'E to 90° 9'E longitude (map 1). The Bangshiriver, a distributary by nature, originates in Jamalpur, from the course of the Old Brahmaputra and flows pass the Madhupur tract. It flows through Tangail and meets the Tongi in Ghazipur. It passes near Jatiyo Smriti Soudho in Nayarhat and falls into the Dhaleshwari River at 10 km down near Hemayetpur (Banglapedia, 2018).



Source: BCA; Prepared by Authors, 2018

Map 1: Location of the Study Area (Bangshi floodplain near at Kalampur Bazar, Dhamrai)

### Sources of Data and Methodology

This study is mainly based on primary data sources. Among the wide range of issues, such as a physical component of soil, sedimentary condition, pH, temperature, time and level of inundation, cropping pattern, etc, only physical components of soil at Bangshi floodplain are analyzed in this study. The soil sample is collected randomly from six points of two-point bars from Bangshi floodplain near Kalampur Bazar of Dhamrai Upazila. Three points (A1, A2, and A3) from the northern point bar and other three points (B1, B2, and B3) from the southern point bar are selected for collecting a soil sample and each point of these bar are 500-meter distance one to another. All points are dug 80 centimeters and records the layer of soil, measure temperature of top and bottom, etc in January 2018. The other data are collected from related books, articles, journals, etc. After collecting the soil samples, samples were analyzed in the laboratory of the Department of Geography and Environment to separate the soil particles to identify the variation of soil particles according to the difference of space and height (Table 1). Bouyoucos Hydrometer method used to find out the physical properties of soil particularly soil types of each layer. Analyzed data have been presented by the table,

graph, bar diagram, etc. Finally, Geographic Information System (GIS) has been adopted for mapping the study area.

Soil texture measurement technique according to Bouyoucos (1962) Hydrometer method:

- a) 50 sec. correct Hydrometer reading (Sediment or blank solution cylinder) = 50 sec. Hydrometer reading + (50 sec temperature-19.4)×0.03
- b) 5 hours correct Hydrometer reading (Sediment or blank solution cylinder) = 5 hours Hydrometer reading + (5hours temperature-19.4) ×0.03
- c) % (Silt+Clay) = {50sec.correct Hydrometer reading (Sediment)- 50sec.correct Hydrometer reading (Blank) }/Weight of sediment(40g) ×100
- d) % Clay = {5 hours correct Hydrometer reading (Sediment) - 5 hours correct Hydrometer reading (blank)} Weight of sediment (40g) ×10
- e) %Silt = % (Silt+Clay) - % Clay
- f) % of sand = 100 - %( Silt+Clay)

Table 1: Characteristic of soil horizons at Bangshi floodplain.

Point	No. of horizon	Horizon	Distance(cm)	Depth(cm)	Soil type	Color
A1	3	A	0-6	6	Sandy loam	Gray
		B	7-47	40	Loamy sand	Gray
		C	47-80	43	Loamy sand	Below
A2	4	A	0-2	2	Clay	Reddish
		B	2-9	7	Loamy sand	Black
		C	9-19	10	Loamy sand	Slightly brown
		D	19-80	61	Sandy	White
A3	4	A	0-11	11	Clay	Slightly dark
		B	11-35	24	silt	Gray
		C	35-52	17	silt	Gray
		D	52-80	28	Silt	Brown
B1	5	A	0-13	13	Sandy loam	Gray
		B	13-30	17	Loamy sand	Gray
		C	31-54	24	Loamy sand	White
		D	55-73	18	Silt	Gray
		E	73-80	7	Sandy	White
B2	3	A	0-25	25	Silt loam	Brown
		B	25-52	27	Sand	White
		C	52-80	28	Sand	Bleak
B3	4	A	0-12	12	Clay	Brown
		B	12-48	36	Silt	Slightly reddish
		C	48-55	7	Silt	Radish
		D	55-80	25	Silt	Gray

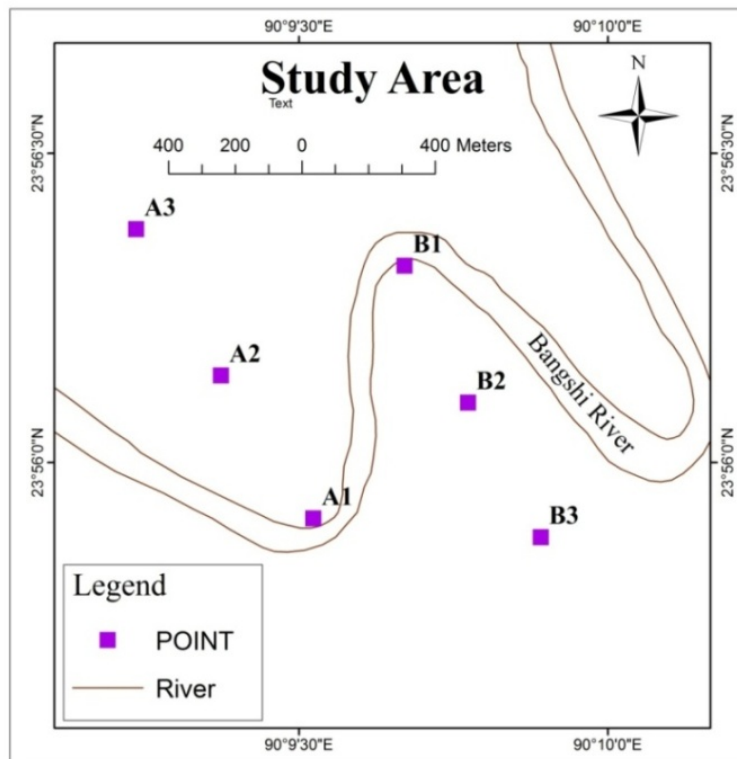
Source: Lab Analysis, 2018

## Results and Discussion

### Soil Horizons of Different Point Bars at Bangshi Floodplain

Soil Horizon is the layer of soils approximately parallel to the soil surface with characteristics produced by soil-forming processes (Courtney & Trudgill, 1984). One soil horizon is commonly differentiated from an adjacent one at least partly based on characteristics that can be seen in the field (Hussain, 1992). A soil horizon makes up a distinct layer of soil. There are 5 master horizons in the soil profile. Not all soil profiles contain all 5 horizons; and so, soil profiles differ from one location to another. The 5 master horizons are represented by the letters as O horizon, A horizon, E horizon, B horizon and C horizon (Pizzuto, 1987; Weil, 1998).

Floodplains generally contain unconsolidated sediments, often extending below the bed of the stream. These are accumulations of sand, gravel, loam, silt, and clay (Steve, 1979). Several soil horizons are found in selected six points at two-point bars in the Bangshi floodplain. Those horizons are differentiated to soil particle size, color, texture, etc. Most of the years all the areas of the study sample points are flooded in the rainy season except two sample points A1 and B1. These two points are high land than other sample areas and near the river which is level as natural levee (map 2). The soil of these points bar is mainly used for agricultural purposes.



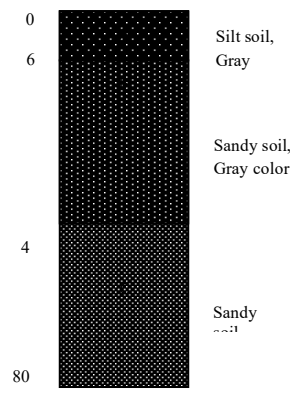
Source: Google Earth Image, Analysis by Authors, 2018

Map 2: Study area map with selected sample points at the Bangshi floodplain.



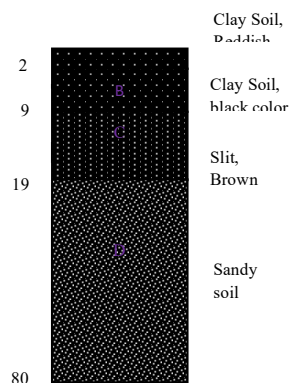
**Sample Point A1:** Sample point A1 is located at 23°55' 52.6''N and 90° 09' 25.6''E which is situated near the river bank and it is cultivable land using as wheat cultivation. This area is known as a natural levee where water drainage is well and accretion nature is vertical. In this A1 station, 80 cm soil has been dug and found three horizons where the upper part temperature was 25°C and the lower part was 27°C (fig. 1).

- Horizon A- depth from 0 to 6 cm. The main characteristic of this soil horizon is silt soil. The color of soil is gray, smooth to touch, dry and roll from hand and broken ribbon.
- Horizon B- depth from 6 to 47cm. The soil of this horizon is sandy, gray in color, dry, gritty to the touch, formed no-ball in palms and crumbles through fingers easily.
- Horizon C- depth from 47cm to below. The soil of this horizon is sandy, the largest particle than horizon B, formed no-ball in palms and crumbles through fingers easily.



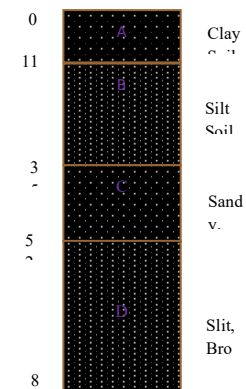
Source: Lab Analysis, 2018

Figure 1: Soil horizon of point A1.



Source: Lab Analysis, 2018

Figure 2: Soil horizon of point A2.



Source: Lab Analysis, 2018

Figure 3: Soil horizon of point A3.

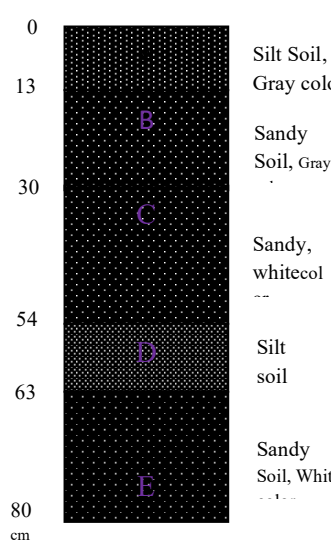
**Sample Point A2:** Sample point A2 is located at 23°56' 7.08'' N latitude and 90° 09' 20.17'' E longitude and it's a low land and suitable for paddy field. This area is known as a back slope where water drainage is poor and accretion nature is vertical and lateral. In this station, 80 cm soil has been dug and found four soil horizons while the upper part and lower part temperatures were 23° c and 25° c respectively (fig. 2).

- Horizon A extended from 0 to 2cm depth. In this soil horizon, clay soil has found which is reddish in color, fine particle, sticky to touch, moist, and able to form a ball.
- Horizon B is found from 2 to 9 cm depth and this soil horizon is identified as clay soil but the color of the soil is black, fine particle, sticky to the touch, moist, and able to form a ball.
- Horizon C is located 9-19 cm depth which is recognized as silt soil, moist, able to form a ball, slightly brown in color and smooth to touch.

- d) Horizon D is extended from 19 to 80 cm depth and the soil of this horizon is sandy, high moisture, able to form a ball, and unable to make a ribbon.

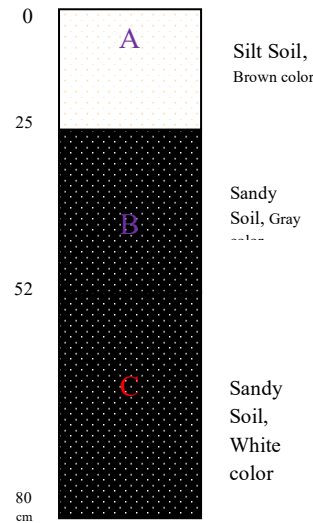
**Sample Point A3:** Sample point A3 located at 23°56' 22.82'' N and 90° 09' 13.76'' E. This sample point is located in low land, fallow land and regularly inundated in the rainy season while the upper part and lower part temperature respectively 25°C and 24°C. This area is known as a Mash land where water drainage is very poor and accretion nature is vertical. In this station, digging 80 cm of four soil horizons have found (fig. 3).

- a) Horizon A is the first horizon of sample point A3 and it stretches from 0 to 11cm depth. Clay soil has found in this horizon where soil color is slightly dark, fine particle, sticky to the touch, moist, and able to form a ball.
- b) Horizon B is the second horizon of sample point A3 which depth is extended from 11 to 35 cm. This soil is identified as silt soil which is moist, able to form a ball, and gray in color.
- c) Horizon C is located from 35 to 52cm depth and soil type is sandy soil which contained high moisture, able to form a ball, and unable to make a ribbon.
- d) Horizon D is the lowest horizon of the sample point A3 which extended between 52-80cm. This soil horizon is recognized as silt soil which is moist, able to form a ball, and brown in color.



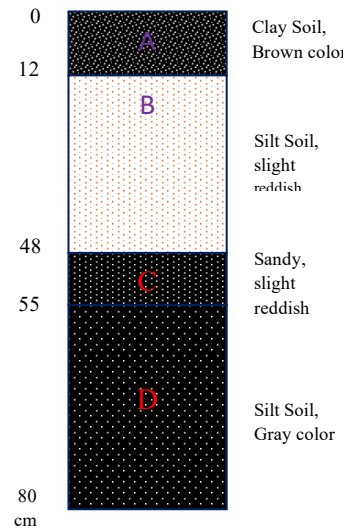
Source: Lab Analysis, 2018

Figure 4: Soil horizon of point B1.



Source: Lab Analysis, 2018

Figure 5: Soil horizon of point B2.



Source: Lab Analysis, 2018

Figure 6: Soil horizon of point B3.

**Sample Point B1:** Sample point B1 is located at the right side of the Bangshi River which latitude is 23° 56' 21.91'' N and longitude is 90° 09' 34.46'' E. This area is known as a natural levee where water drainage is well and accretion nature is vertical. By

digging 80 cm found five soil horizons in this station where the upper part and lower part temperatures were 25° c and 26° c respectively (fig. 4).

- a) Horizon A is from surface to 13cm depth. There is silt soil in this horizon which is very dry, gray in color, smooth to touch, roll from hand, and broken ribbon.
- b) Horizon B is up to 30 cm from the last limit of horizon A of the sample point B1. This horizon of the soil is revealed as sandy soil which is gray in color, temperature 25°c, gritty to the touch, formed no-ball in palms and crumbles through fingers easily.
- c) Horizon C is the third layer of sample point B1 which extends from 30 to 54cm. Soil type is identified as sandy soil in this horizon, which is white in color, dry, roll from hand, and broken ribbon.
- d) Horizon D is started after horizon C which extends from 54 to 73cm depth. In this layer, the amount of sand is less than horizon C, which is gray in color, temperature 25°c, gritty to the touch, formed no-ball in palms and crumbles through fingers easily.
- e) Horizon E is found in the sample point B1 only, it's the lowest horizon which limits from 73 to 80cm. In this horizon, there is also sandy soil and the main difference is in color which is white, dry, roll from hand, and broken ribbon.

**Sample Point B2:** Sample point B2 is located at 23°56' 06.20' N latitude and 90° 09' 40.49' E longitude. It is cultivable land which is using mustard cultivation. This area is known as a back slope where water drainage is poor and accretion nature is vertical and lateral. In this station, 80 cm soil has been dug and found four horizons while the upper part and lower part temperatures were respectively 25°C and 27°C (fig. 5).

- a) Horizon A is up to 25cm depth from the surface of the sample point B2. Silt type of soil has found her. Soil is Brown color, dry, roll from hand, broken ribbon, fine particle, sticky to the touch.
- b) Horizon B is extended from 25 to 52cm depth where sandy soil has found and soil color is white, dry, gritty to the touch, formed no-ball in palms and crumbles through fingers easily.
- c) Horizon C is the lowest horizon of the sample point B2 which is from 52 to 80 cm depth. Sandy soil is also found in this layer, which color is white but some black color layers also found.

**Sample Point B3:** Sample point B3 is located at 23°56' 51.24'' N and 90° 09' 46.36'' E. This sample point is a fallow land which is inundated in the rainy season where the upper part temperature is 25°C and lower part temperature is 27°C. This area is known as a Mash land where water drainage is very poor and accretion nature is vertical. In this station, digging 80 cm of four soil horizons have found (fig. 6).

- a) Horizon A is the first layer that started from the surface to 12cm depth and clay soil has found in this horizon, where color is brown, fine particle, sticky to the touch, moist, and able to form a ball.
- b) Horizon B is extended from 12 to 48 cm in depth. Silt soil is identified which is moist, able to form a ball, slightly reddish in color. With increasing the depth moisture is also increasing in this layer.
- c) Horizon C distance downward is from 48 to 55cm. The soil of this horizon is sandy, color is radish, moist.
- d) Horizon D is between 55 to 85cm depth where has also found sandy soil but soil particle is fine then horizon C and color is gray, high moisture, and able to form a ball.

#### Variation of Soil Particles Based on Two Point Bars

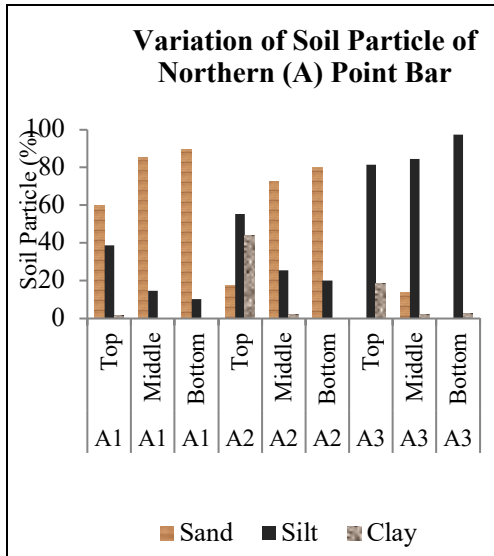
Table 2 represents the variation of soil particles of six sample points such as A1, A2, A3, B1, B2, and B3 according to the depth of horizons such as the top, middle, and bottom of the Bangshi floodplain. Topsoil horizon means 0-10 cm, middle 30-40 cm and bottom means 70-80 cm depth. There is found a little variation of soil physical properties like sand, silt, and clay. Sand particles decrease with the increase of distance from the river. On the other hand, sand is increasing with the increase of depth. Approximately all point's sand particles decrease with the increase of depth. In the last two points (A3 and B3) which are far from the river, the sand particle is approximately zero. It is seen opposite scenario about silt particles. A little number of clay particles are found in all study areas. Silt dominated soil has found in those points. The amount of clay particle is less than other particles in all points and all depth without the topsoil of point A2.

Table 2: Variation of soil particles at Bangshi Floodplain.

Sample Points	Top			Middle			Bottom		
	Sand (%)	Silt (%)	Clay (%)	Sand (%)	Silt (%)	Clay (%)	Sand (%)	Silt (%)	Clay (%)
A1	59.83	40.17	0	85.21	14.79	0	89.57	10.43	0
A2	27.32	70.29	2.39	72.39	25.51	2.1	79.82	20.18	0
A3	0	81.36	18.64	13.58	84.42	2	0	97.47	2.53
B1	69.01	30.99	0	88.5	9.2	2.3	84.85	17.17	2.02
B2	31.72	68.28	0	90.49	9.51	0	92.94	7.06	0
B3	0	88.3	11.7	0	94.73	5.27	0	97.26	2.74

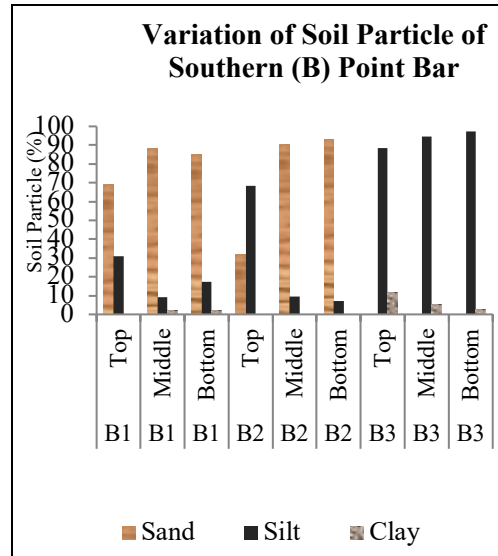
Source: Lab Analysis, 2018

The variation of soil particles of three sample points of northern (A) and southern (B) point bar according to depth (fig.7 & fig.8). A1 and A2 point's sand particles are increase and silt particles decrease with the increase of the depth. Silt particle increases with the increase of depth in A3 point for the distance from the river. Similarly, the sand particle of the first two points (B1 and B2) is higher than the silt and clay in all depth without B2 top. In B3 a large amount of silt particle is found, which increases with the increase of depth. A little amount of clay particle also found here which decreases with the increasing depth.



Source: Lab Analysis, 2018

Figure7: Variation of soil particle of point bar (A)



Source: Lab Analysis, 2018

Figure8: Variation of soil particle of point bars (B)

Besides, three charts show the variation of soil particles based on the difference of point bars at Bangshi floodplain (fig. 9, fig. 10 & fig. 11). A and B are two point bars situated two opposite sides of the river. In those different point bars, it is seen that sand particle has gradually increased with increasing depth and silt particle decrease. There is no clay particle found at A1 but a little amount of clay is found at B1middle soil. A2 and B2 points are situated 500 meters far from the river channel where a sand particle of A2 is less than B2, and a little amount clay particle has found in A2 point but no clay has found in B2 point. Again, the variation of soil particles at A3 and B3 points are situated 1 kilometer far from the river channel where the main variation found at A3 middle soil, 13.58% sand found at this layer but at B3 there is no sand found. At both point bars silt particle is higher at topsoil than middle and bottom soil.

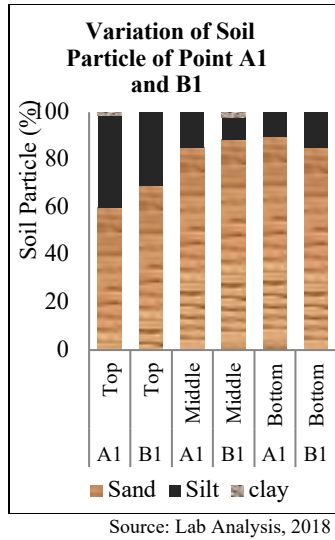


Figure 9: Variation of Soil Particle of Sample Points A1 and B1.

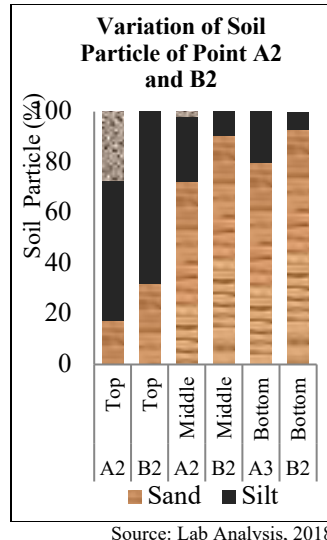


Figure 10: Variation of Soil Particle of Sample Points A2 and B2.

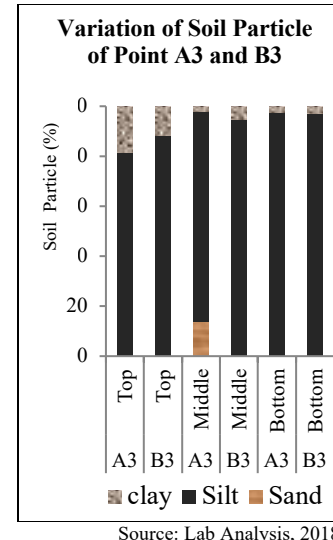
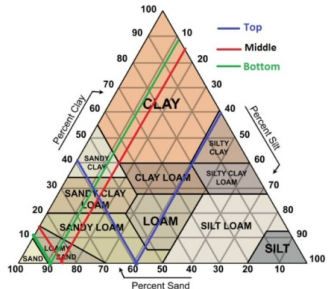


Figure 11: Variation of Soil Particle of Sample Points A3 and B3.

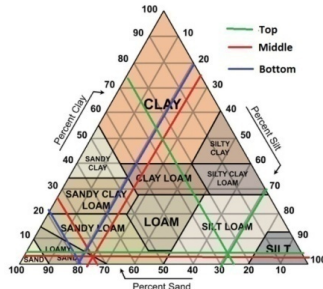
### Types of Soil of Different Layers

The soil texture triangle shows the various combinations proportion of sand, silt, and clay. A coarse-textured or sandy soil is one comprised primarily of medium to coarse size sand particles. A fine-textured or clay soil is one dominated by tiny clay particles. Due to the strong physical properties of clay, a soil with only 20% clay particles behaves as sticky, gummy clayey soil. The term loam refers to soil with a combination of sand, silt, and clay-sized particles (Steve, 1979). There are different types of soil found in a different layer in the Bangshi floodplain.

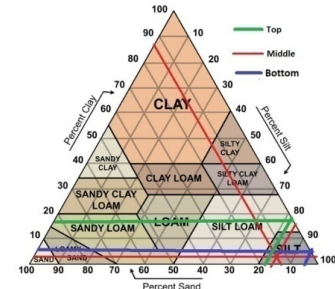
After plotting the data from the data table 2 various types of soil texture triangles have been prepared where blue, red and green color respectively represent the top, middle and bottom soil. Figure 12 depicts the soil texture triangle of the sample point A1 where topsoil is a combination of 59.83% sand, 40.17% silt which builds up sandy loam soil. 85.21% sand, and 14.79% silt found at middle soil which is loamy sand soil and bottom soil also loamy sand soil where sand 89.57%, and silt 10.43%. At A2 point, topsoil is silt loamy where sand 27.32%, silt 70.29% and clay 2.39% but in middle and bottom soil both are loamy sand soil with the variation of some soil proportion (fig.13). Again, at A3 point, middle and bottom soil is loamy sand soil but topsoil is silt soil where sand 18.64% and silt 81.36% (fig. 14).



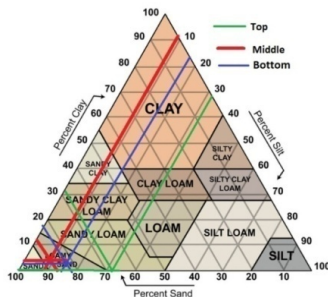
Source: Lab Analysis, 2018  
Figure 12: Soil Textural diagram for the sample point A1



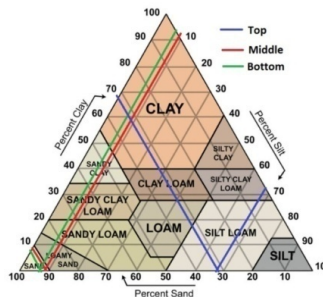
Source: Lab Analysis, 2018  
Figure 13: Soil Textural diagram for the sample point A2



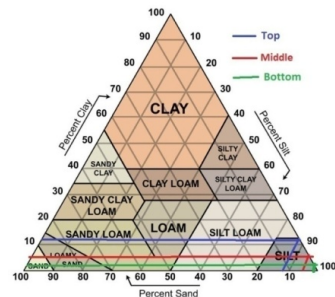
Source: Lab Analysis, 2018  
Figure 14: Soil Textural diagram for the sample point A3



Source: Lab Analysis, 2018  
Figure 15: Soil Textural diagram for the sample point B1



Source: Lab Analysis, 2018  
Figure 16: Soil Textural diagram for the sample point B2.



Source: Lab Analysis, 2018  
Figure 17: Soil Textural diagram for the sample point B3.

B1, B2, and B3 sample points are located at the southern point bar of the Bangshi floodplain. Topsoil is the combination of 69.01% sand and 30.99% silt which is sandy loam soil at sample point B1. 88.5% sand, 9.2% silt, and 2.3% clay combined build up loamy sand soil at the middle whereas bottom soil is also loamy sand soil (fig. 15). This soil triangle at B2 sample point, topsoil is silt loamy where sand 31.72% and silt 68.32%. However, in middle soil sand 90.49% and silt 9.51% made up sand soil and bottom soil is also sand soil (fig. 16). Again, at point B3 topsoil is a combination of 88.3% silt and 11.7% clay which builds up silt soil, similarly, at middle and Bottom soil also silts soil (fig. 17).

### Conclusion

From the overall analysis and discussion, it is found that different types of soils are revealed from this study such as sand, sandy loam, loamy sand, sandy loam, silt, silt loam, and clay. There is a close relationship between the river and its adjacent soil formation of the Bangshi floodplain. Soil deposited layer by layer in this study area. Large particles of soil have been deposited near the river and with the increase of distance from the river deposited particle size is finer. Also, the soil particle of the upper part is finer than the lower part and with the increase of depth soil particle size also increases. Furthermore, the sand particle is higher adjacent to the river and with the increase of the distance, it has decreased gradually. And in the last sample point of both point bars silt particle is higher than sand. Therefore, the soil layer or horizon differs

from place to place. Moreover, the agricultural cropping system depends on sedimentation characteristic, consequently, wheat is cultivated near the river and paddy is cultivated at the area of the last two sample points of the Bangshi floodplain.

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## Theorizing land value capture for TOD financing: Empirical attention on Hong Kong's (R+P) model

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**Abstract:** A good public transport system is often one of the defining features of a city. However, even in the world's great public transport systems, fares do not fully cover infrastructure project costs, substantial government subsidies are required to build, maintain, and operate. One of the challenges faced by cities is where this money should come from. While urban rail transit has gained increasing popularity, there are still many problems regarding financial resources. Land Value Capture (LVC) can be a solution of that. Each of the LVC mechanism comes with its own opportunities and shortcomings, and the success rate depends on local context, policy environment and market forces. This paper aims to review the concept of LVC to provide an insight about the LVC's notion and practice, uses the case of R+P model of Hong Kong that is one of the world's successful LVC mechanisms for exploring new financing mode of urban rail transit.

Key words: Transit Oriented Development, Land value, Transport economics, R+P model.

### Introduction

City and regional planners are firmly devoted to the current popular concept of TOD, that is, the creation of transit-oriented development, or compact, mixed-use activity areas centered on transit stations that by design encourage residents, workers and shoppers to walk and to ride transit (Calgary, 2004; Calthorpe, 1993; Cervero and Kockelman, 1997; Dittmar and Poticha, 2004). It is one thing to designate TOD communities, but quite another to implement them (Curtis, Renne, and Bertolini, 2009; Renne, 2009). Desired development will not occur simply based on its classification as an allowable use, financial inducements are needed to prompt timely development (Olajide, 2015; Suzuki, Murakami, Hong, and Tamayose, 2015). Public agencies occupied with the complexities of plan implementation, often found that in addition to capital funding, regulatory and financial incentives will be needed to achieve these ambitious plans (Suzuki et al., 2015).

Implementing the region's transportation plans will require substantial public investments in new infrastructure, and sizable increases in program funding to meet TOD objectives (Belzer and Autler, 2002). These public sector commitments, in the form of approved detailed plans, land use regulations, and capital funding, will stimulate private sector

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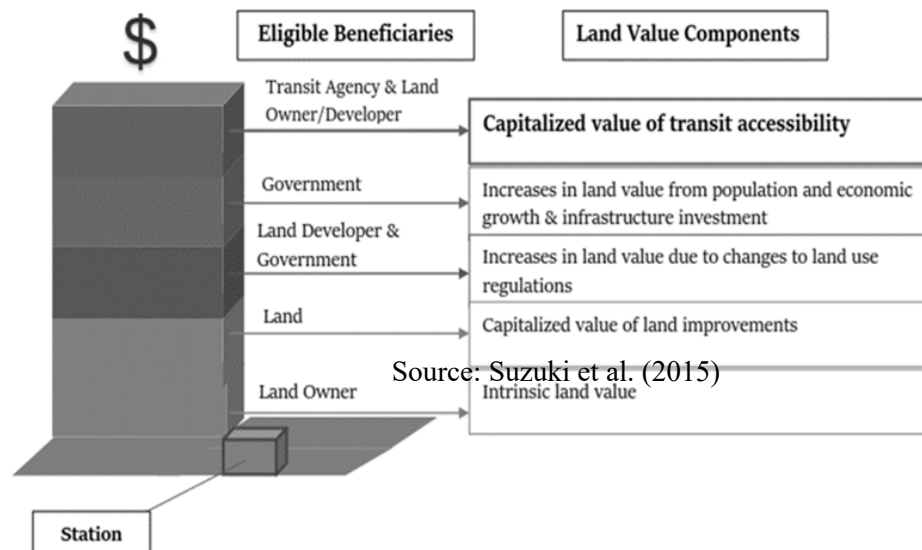
investments in business activity and housing. This economic activity will result in the growth of “land rents”, or rising land values in designated locations (Bocarejo, Portilla, and Pérez, 2013; Cervero and Duncan, 2002b; Cervero and Kang, 2011; Higgins and Kanaroglou, 2017; Sagar, 2010). In the North American and European context, the impact of public transport on land values is usually found to be positive, with the magnitude of this effect influenced by the presence of complementary policies to encourage coordinated land use or to discourage car use (Duncan, 2008; Gatzlaff and Smith, 1993; Hess and Almeida, 2007). Rail systems have a much larger effect on land values ranges from 5% to 45% (Cervero and Duncan, 2002a; Gatzlaff and Smith, 1993; McDonald, Osuji, and economics, 1995). In the Asian context, the estimated magnitude of this effect is remarkably consistent across cities and studies (Sagar, 2010; Tang, 2017). The hypothesis that even incremental changes in transport infrastructure may encourage both land development and economic growth stems from the concept of the “accessibility” of locations (Gihring, 2009). The more easily people and goods can access a given location, the more desirable that location is for both people to live and for businesses to locate (O'sullivan, 2007). This added increment of location desirability should lead to development in public transport station areas -both physical land development and redevelopment as well as economic development (Debrezion, Pels, and Rietveld, 2007; Hess and Almeida, 2007; Yeh, Wu, Huang, and Tasi, 2005). Land rent is surplus value, and is the product of location advantages, natural amenities, government actions, and collective private capital investments in the nearby vicinity (Gihring, 2009). This surplus value, reflected in land value assessments, can either be retained by individual owners as a capitalized asset, or captured by the public sector to be redistributed as public benefits formally labelled as land value capture (LVC). Goal of this paper is to use findings from the existing literature to shed light on value capture practices and mechanisms around the world. This will help to investigate under which circumstances value capture could and should be used to finance public transport systems. This paper examines the proposition that LVC is an effective method to promote transit-oriented development (TOD) and raise revenue to finance public improvements and empirically help the policy makes in TOD planning.

### **Concept of Land Value Capture (LVC)**

Given expanding demand for new transit infrastructure and scarce financial resources, transit authorities around the world are increasingly looking toward innovative funding sources and strategies (Olajide, 2015). Land value capture (LVC) is one of these innovative strategies. Value capture refers to a range of strategies for providing funding to infrastructure projects (such as transit projects) from value induced by the project (London, 2017 ; Suzuki et al., 2015). Value capture is the public recovery of a portion of increased property value created as a result of public infrastructure investment (Mathur and Smith, 2013; Olajide, 2015; Z. Zhao, 2012). Common value capture mechanisms are impact fees, joint development, sale or leasing of air rights, land value taxation, station naming rights, negotiated exactions, parking fees, sales taxes and special assessment districts (SADs), and tax increment financing (TIF), etc.

LVC is not a new concept. The Romans may have assessed wealthy homeowners to finance aqueduct improvements (Z. J. Zhao and Larson, 2011). In 1427, Henry VI adopted an act assessing differential tax rates on those “whose property derives benefit from the works” related to sewage and sea defenses (Connellan, 2004). John Stuart Mill proposed taxation of the “unearned increment” in 1858. New York City levied special assessments in 1691 to finance drainage and street improvements. In the early 1930s, New York adopted special assessments, successfully and unsuccessfully, to capture part of the value created by the subway system extension (Raskin, 2013). In the modern time public sector investments in transit infrastructure are often considered external drivers of land values because transit investments create access to employment and amenities for surrounding private properties, which in turn increases their value (Mathur and Smith, 2013; Petite, 2001). Increase in the values of surrounding properties is called Transit Induced Land Value Capitalization (Cervero and Landis, 1997; Suzuki et al., 2015). Transit agencies and governments acting on behalf of the public are creators of the land value uplift by virtue of their investments in urban areas and are entitled to a portion of the value gains to fund transit investments which can be illustrated as figure 1, adopted from Suzuki et al. (2015).

Figure 1. Transit induced land value capitalization mechanism



### Transit Induced Land Value Capture Instruments

Suzuki et al. (2015) argue that by applying the “beneficiary pay principle” to transport finance, transit agencies stand to recover the cost of transit infrastructure from property owners and developers - the main beneficiaries of transit induced land value uplift. International literature and practices discovered two types of LVC instruments for transit finance:

- i. Development Based Land Value Capture (DBLVC)
- ii. Taxation Based Land Value Capture (TBLVC)

### **Development Based Land Value Capture (DBLVC)**

Development based Land Value Capture (DBLVC) is the type of LVC mechanism where transit agencies or transit investors are directly or indirectly involved in the delivery of development on land around transit stations (Consultancy, 2013). “Transit investor” implies any of the following (Suzuki et al., 2015):

- i. Special Purpose Vehicles/Enterprise (SPV/SPE) set up between governments, transit agencies, and private sector investors for joint transit project development
- ii. Independent private transit developers and operators.

Transit investors assemble more land than is required for station development for the future development of high-density properties (residential, commercial, and office) around station areas (within 500 metres) (Cervero and Murakami, 2008). By leveraging their ownership of excess development rights (land and air rights) around station areas, transit agencies can be direct beneficiaries of the significant transit induced land value gains (Suzuki et al., 2015). Such financial gains can be used by transit agencies for transit investment cost recovery or reinvestment in transit construction, operation, and maintenance (Smith and Gihring, 2006).

#### ***Direct Property Development***

This form of DBLVC entails the direct involvement of public transit agencies in property development on excess land around transit stations (Consultancy, 2013). Direct property development has the potential to generate significant and lasting revenues for transit agencies. However, there are significant financial costs and risks associated with real estate development projects (Olajide, 2015).

#### ***Joint Property Development***

This form of DBLVC is where public transit agencies are directly involved in transit station development and adjacent property development in partnership with private developers (Gihring, 2009; Suzuki et al., 2015). Private developers make significant contribution towards the construction and financing of station facilities (Medda, 2012). The potential land value gains generated by the transit project incentivizes private developers to enter into joint development ventures with transit agencies on transit adjacent properties (Suzuki et al., 2015). Joint development usually involves a cost and revenue sharing arrangement between public and private entities (Mathur and Smith, 2013). Cost and revenue sharing in joint development usually occur in different forms including:

***Incentive-based agreements:*** Special privileges such as a density bonus are granted to the developer by the government and transit agency in exchange for financial contributions towards transit infrastructure construction (Mathur and Smith, 2013) or the construction of transit station(s) as part of their development (Salon and Shewmake, 2011).

***Voluntary agreements (including construction cost sharing and operations cost sharing):*** Developers and transit agency venture into agreements that reduce the infrastructure and property development costs and risks borne by both parties. Transit agencies and developers, for example, can enter into agreements to manage and finance the

planning, construction, operations, and maintenance of transit infrastructure and adjacent real estate (Mathur and Smith, 2013).

***Equity participation and revenue sharing:*** Contribution towards construction costs is required of the transit agency and the developer(s). Revenues from development are shared between both parties based on the percentage of equity contributed or the amount of risk borne by each party (Mathur and Smith, 2013). For this reason, joint development is the most compatible LVC instrument in Public Private Partnerships (PPP) transit finance agreements because of its ease of implementation under PPP contractual frameworks (Medda, 2012; Medda and Modelewska, 2011).

### ***Land Sales***

The public transit agency sells excess acquired land or development rights around transit infrastructure at appreciated (post rail investment) land prices to developers to raise significant upfront revenues to finance transit investments. However, supportive land use regulations are necessary for the agency to sell the property at high market value (Medda and Modelewska, 2011; Suzuki et al., 2015).

### ***Air Rights Sale***

The transit agency sells the development rights above stations and transit adjacent land to developers to raise funds to finance transit investments (Levinson and Istrate, 2011). The developable space above station and station-adjacent land is increased beyond the allowable floor space ratio (FSR) in the land use designation to unlock additional financial land value, which is then captured by the transit agency through sales to developers (Suzuki et al., 2015).

### ***Lease Agreements***

The transit agency or investor leases valuable land, or space above or below the land adjacent to transit stations to developers in return for annual land rents and or a single leasehold payment (Levinson and Istrate, 2011; Mathur and Smith, 2013; Suzuki et al., 2015). This includes air rights leases, ground leases, or subterranean leases.

### ***Land Readjustments***

This is a DBLVC mechanism whereby individual land owners in a transit investment area (station area) pool their land together into a large site for redevelopment and in the process donate a portion of the assembled land to the government in exchange for zoning relaxation on the consolidated site (Smolka, 2013). More specifically, land readjustment schemes in transit finance are used by government and transit agencies to assemble excess right of way for transit projects at little or no cost (Ingram, 2012). A portion of the land is used for transit station development, while the remainder is sold at market value or developed – both actions allow transit agencies to defray the high land acquisition and construction cost of transit infrastructure (Suzuki et al., 2015). Land readjustments schemes have been used extensively by transit agencies and governments in Japan, Korea, Taiwan, and India for non-transit purposes (Ingram, 2012; Suzuki et al., 2015).

### ***Urban Redevelopment***

This is a unique DBLVC mechanism for transit finance where transit agency and government increase the allowable floor space in a newly assembled redevelopment site and then sells excess floor space to new property owners to fund transit infrastructure in the area (Cervero and Murakami, 2009; Olajide, 2015; Suzuki et al., 2015). The consolidation of individual parcels into a large redevelopment site by group of individual land owners in a transit investment area in partnership with a developer is a prerequisite for the approval and sale of excess floor space to fund transit infrastructure (Cervero and Murakami, 2009). To facilitate the redevelopment process, the partner developer can temporarily take on responsibility for all the land owners and tenants during the approval and transaction process. This type of DBLVC mechanism is used primarily in Japan (Suzuki et al., 2015).

### **Taxation Based Land Value Capture (TBLVC)**

Taxation based land value capture (TBLVC) is the type of LVC instrument that is used to recover transit induced value gains by imposing taxes or fees on existing developments located in ‘transit investment benefitting areas’ established by the transit agency (Medda and Modelewska, 2011). TBLVC mechanisms can be used to recover as high as 60 percent of land value gains, and they are used alongside traditional transit funding sources (Suzuki et al., 2015). In most cases, public transit agencies require legislative authority to use TBLVC except if it is conducted through voluntary compliance (Consultancy, 2013).

### ***Tax Increment Financing (TIF)***

TIF is a funding mechanism that uses predicted future growth in annual property tax revenues triggered by transit induced property value increases, to finance current transit infrastructure investments in a development area (Gihring, 2009; Zhirong Jerry Zhao, Das, Larson, and Use, 2012). Bonds are issued to borrow against anticipated growth in property tax revenues and are retired in phases as the tax increments are generated and collected (Levinson and Istrate, 2011)). As a value capture funding source, TIF also uses fiscal incentives (tax breaks, tax reliefs, etc.) to encourage urban development in specific areas; and it is capable of financing part of the costs of transit investments (Medda and Modelewska, 2011).

### ***Special Assessments***

Special Assessments are fees levied by transit agencies on properties that directly benefit from transit induced land value gains, which is used to finance transit (Gihring, 2009; Zhirong Jerry Zhao et al., 2012). In principle, the direct special benefits of the transportation investment enjoyed by properties within a Special Assessment District (SAD) exceeds the benefits enjoyed by the general public and must be clearly identified and measured (Z. Zhao, 2012). In transit value capture, SADs are also referred to as transportation improvement districts (TID), benefit assessment districts (BAD), local improvement districts (LID), or business improvement districts (BID) (Z. J. Zhao and Larson, 2011).

### ***Land Value Taxes (LVT)***

LVT or “split rate property taxes” are imposed by governments for the sole purpose of capturing land value gains created by transit investments (Gihring, 2009; Zhirong Jerry Zhao et al., 2012). They are levied in addition to property taxes, which apply to all properties (Smolka, 2013). The broader definition of land value tax makes it difficult to be used to fund transportation projects solely because they are included in the general pool of tax revenues used for all types of public investment (Levinson and Istrate, 2011).

### ***Betterment Charges and Contributions***

Similar to special assessments, betterment charges are surtaxes on the estimated benefits of transit investment assessed by government and levied on property owners who directly benefit from transit investments, to fund transit infrastructure costs (Medda and Modelewska, 2011; Smolka, 2013; Suzuki et al., 2015).

### ***Impact Fees***

Impact fees are LVC instruments that are used to ensure that new development bears the full capital cost of any new infrastructure that is required to support it (Levinson and Istrate, 2011). Impact fees are specifically imposed on new development that will benefit from transit investment in an area. They can be used by transit agencies and government to defray the cost of extending transit infrastructure to new development area (Gihring, 2009). Furthermore, a key requirement for imposing impact fees is that they must be backed by legislation that ties the need for new transit infrastructure to the new development (Ingram, 2012).

### ***Station-connection Fees***

Station connection fees are levied by transit agencies on property owners or leasers in a transit benefitting area to cover the associated costs of providing transit station accessibility through station construction, which in turn increases their property values (Mathur and Smith, 2013). Table 1 shows the major feature of each development-based value capture mechanism.

Table 1: Land value capture mechanism (LVCM) and their significant features

LVCM	Advantages	Pre-conditions
Direct Property	Significant and long-term revenues from development ventures	Requires zoning regulations that permit highest and best use land development
Joint Property Development	Most compatible for PPP financed transit projects with risk and benefits sharing	Partner agreements over cost and revenue allocation as well as requires zoning regulations that permit highest and best use land development
Land Sales	Significant upfront revenues and low financial risk	Revenues dependent on the amount of land development rights, the nature of land use regulations and urban land market activity; although high land acquisition is needed.
Air Rights Sale	Significant upfront revenues and low financial risk	Zoning relaxation is required to increase allowable floor space area above ground.



LVC/M	Advantages	Pre-conditions
Lease Agreements	Generation of upfront and recurrent revenues and low financial risk	Low revenue in comparison to other DBLVC instruments and the sheer cost of urban transit investments
Land Readjustment	Zero land acquisition due to land contribution from land readjustment and revenues or cost savings for transit project development	Highly dependent on private land owners consent and support; Financial risk associated with post Readjustment transit agency led property development; Feasible on land located in the urban fringe; Highly dependent on local planning and urban development policy.
Urban Redevelopment Schemes	Proceeds from the sale of increased development right accrue to the agency and local governments for transit investment.	Land Assembly and Land Contribution are highly dependent on cohesion between the private landowners and developer(s); Zoning relaxation is required to increase allowable floor space area above ground developer and individual landowners; Highly dependent on local planning and urban development policy; Suitable on urban land or built up areas
Tax Increment Financing (TIF)	High propensity to trigger redevelopment and low political risk as additional property tax is not required	Strong urban land and real estate market is required; Interest costs and financial risk associated with borrowing against future increments in property values; Potential costs associated with land acquisition, debt servicing, and direct payments to developer
Land Value Tax	High revenue yield as the taxable geographic area is typically large	Difficult to dedicate revenues solely to transit Investments; Delineation of transit induced value increments from non-transit induced land value increments; High political cost as a result of public opposition
Special Assessments, Betterment Charges and Impact Fees	Efficient LVC tools as they are levied on individual properties that benefit directly from transit Infrastructure, revenues generated can be put towards transit investments alone, if needed can be negotiated and paid as voluntary contributions to the government by land owners and developers	Revenues generated from property owners are highly dependent on local economic conditions; Interest costs associated with borrowing funds for project before revenues are collected at year end; Collection of revenues in a benefitting area is typically limited to a specific period of time; High political cost (public opposition) associated with imposing fees and taxes; Revenue size is affected by the level of economic activity: employment levels and income levels affect the demand for properties and the price (value) of properties

Source: Author, adapted from (Cervero and Murakami, 2009; Consultancy, 2013; Gihring, 2009; Ingram, 2012; Levinson and Istrate, 2011; Mathur and Smith, 2013; Medda, 2012; Smolka, 2013; Suzuki et al., 2015; Z. Zhao, 2012; Z. J. Zhao and Larson, 2011).

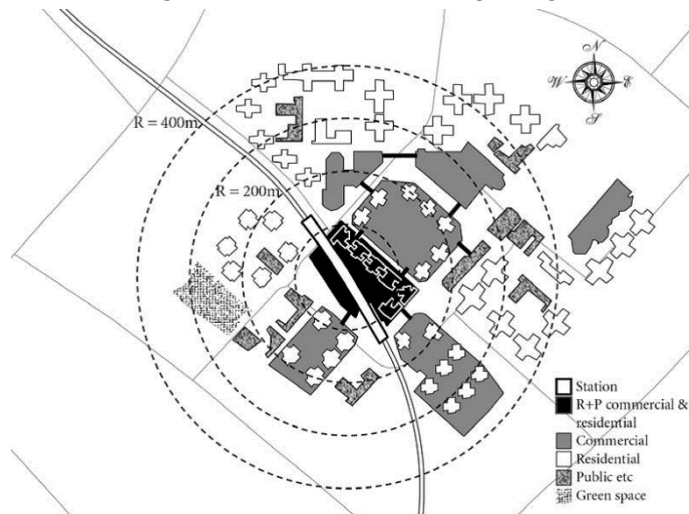
### **Development and Taxation Based Land Value Capture: A Combination**

It is important to note that land value capture mechanisms are flexible in that they can be designed to include development-based land value capture (DBLVC) instruments and taxation-based land value capture (TBLVC) instruments (Consultancy, 2013). A major advantage of such a combination is that it focuses on the core strengths of DBLVC and TBLVC in a way that offsets the weaknesses of both types of instruments, in order to achieve a transportation funding objective (Olajide, 2015).

### Notion of Railway plus Property Model of Hong Kong: Empirical Study

Hong Kong is internationally known for its successful integration of rail transit investments and urban development (Xue and Sun, 2018). The city's exceptionally high densities, and the many agglomeration benefits that have resulted, could not have been achieved without world-class railway services (Tang, 2017). A railway network on the scale of Hong Kong's is a prerequisite for achieving 'global city' status. Presently, more than 90 per cent of all motorized trips in Hong Kong are by public transport, the highest market share in the world (MTRC, 2014). Hong Kong is one of the few places in the world where public transport makes a profit. Joint development of real property and the metro rail, known as 'rail plus property (R+P)' model as value capture mechanism has contributed enormously to urban growth and spatial; transformation of Hong Kong over the past four decades (Tang, 2017). Historically, MTRC was one of two rail operators that served Hong Kong, the other being the Kowloon-Canton Railway Corporation (KCRC). In late 2007, the two companies merged under the name of MTRC. This merger created a 168 directional-km network of high-capacity, grade-separated services that run through the densest parts of the territory - the northern shoreline of Hong Kong island, the Kowloon peninsula, the Northern Territories (to the China border) and, most recently, to Hong Kong's new international airport (MTRC, 2014). The Hong Kong Mass Transit Railway (MTR) Corporation has long utilized DBLVC in addition to other funding mechanisms to finance capital and operating transit investments (Cervero and Murakami, 2009; Tang, 2017; Xue and Sun, 2018). The granting of exclusive development rights is what fuels MTRC's R+P program. MTRC does not receive any cash subsidies from the Hong Kong government to build railway infrastructure; instead it receives an in-kind contribution in the form of a land grant (in greenfield price) that gives the company exclusive development rights for land above and adjacent (within 500 m) to its stations, shows in figure 2. These grants relieve MTRC from purchasing land on the open market. To generate income, MTRC capitalizes on the real estate development potential of its stations.

Figure 2: R+P model of Hong Kong



Source: Adapted from (Cervero and Murakami, 2008; Tang, 2017)

Through the Rail plus Property (R+P) program, MTR primarily engages in property development and management with preferred private developers (Joint development) on acquired excess public land and airspace adjacent to stations on its extensive rail transit network – 218 kilometers in length (Yeung, 2004 ). Key stakeholder for this model is The Government of Hong Kong Special Administrative Region (SAR), Mass Transit Railway (MTR) Corporation and Private Developers. As a policy, MTR does not often sell excess acquired land and development rights to private developers in order to retain full control of development and sale of completed units. However, the difference between pre and post rail investment market land prices in Hong Kong are often significant and sufficient to cover rail transit investments. Accordingly, MTR sells development rights to private developers at post rail investment market prices in return for a negotiated share of property development profits and/or joint ownership of the development. MTR's share of R + P development profits generated before and after the completion of a rail project need to be sufficient to cover the project funding gap estimated by MTR and project surveyors. For R+P to be financially viable ventures for transit finance, MTR typically require a minimum floor space ratio (FSR) of 4.0. Critical to the success of MTR's R+P program are Real Estate Portfolio Diversification and Project Phasing (Suzuki et al., 2015). MTR invests in the development of different type of properties – residential, retail, office commercial, and industrial - to hedge against potential declines in the demand profile, price, and rent of a specific type of property (He, Tao, Hou, and Jiang, 2018). It also adopts a phased approach to property development to offset the financial risks associated with real estate market cycles. It is estimated that between 1980 and 2005, the Hong Kong Government and the public directly earned an estimated \$18 billion in net financial returns (nominal value) from MTR 's R+P program. In 2014, MTR Corporation real estate ventures generated the following revenues in 2014 (MTRC, 2014):

- Hong Kong Station Commercial Business: \$640 million dollars (8% increase from 2013)
- Property Rental and Management: \$540.3 million dollars (11% increase from 2013)
- Property Development: \$544 million dollars (202% increase from 2013)

Passenger ridership and fare box revenue on the MTR's transit network has increased significantly overtime due in no small part to the agency's strategic investment in high-density mixed-use developments with valued destinations around rail stations and along rail corridors. Revenues from MTR's Transit Operations for 2014 was \$2.09 billion dollars, a 7% increase from 2013 revenues (MTRC, 2014). MTR currently enjoys a farebox recovery of 186 percent – one of the highest in the world.

## **Conclusion**

LVC is an institutional arrangement that can effectively coordinate actions of government, railway operators, developers and other market players in transforming the urban built environment (Tang, 2017). Successive implementation of the model requires supportive land use and transport strategy of government, complementary project planning and development process, competent and responsible organizations that strive towards making the best use of urban space, high quality urban infrastructure and land development for

public interest. There are two prerequisites to being able to finance a public transport system using value capture (Gihring, 2009; Medda, 2012; Z. Zhao, 2012). First, the system must actually generate sufficient value to be captured. Second, the institutional context must enable the local government or the public transport authority to capture this generated value. For value capture mechanism, solely transit cannot uplift property value to capture that much rather needs policy support, institutional capacity, strong real-estate market and other social and market forces to work collectively. Subject to market constraints, new transportation capacity and access create opportunity for increased real estate development. Developers respond to transit agency investment in infrastructure by evaluating market opportunity for value creation created by new transportation capacity (Babsin, 1997; Becker, Bernstein, and Young, 2013). Such value creation can be directed and encouraged through coordinated partnership between transit agencies, local governments, developers, and other entities. Value associated with the transit service and other amenities common to high-quality TOD, becomes capitalized into the market price of real property (Cervero, 2004). Dhaka the capital city of Bangladesh is going to experience first mass transit soon. MRT line 6 is in construction and another two-line MRT line 1 and line 5 are going to join the network within short time period (RSTP, 2015) which will obviously upsurge development along the corridors. Dhaka is a city of 14 million population (BBS, 2011); characterized by spontaneous development, traffic congestion, high population density, land market under private control (B. Ahmed, Hasan, and Maniruzzaman, 2014; S. Ahmed and Bramley, 2015; Kabir and Parolin, 2012; Khan and Siddiqua, 2015; Mowla, 2012) and weak planning practices. Draft Structure plan of Dhaka has addressed TOD along MRT line 6 (RAJUK, 2016) without any specific guideline for shaping the mutual interplay of transport and land use as well as financial sources. Therefore, this is the high time for the planning authorities, policy makers to put their attention on international practices or lessons and craft the TOD strategies for bringing the transit-land use synergy along with financial mechanism before it gets too late.

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## Neighborhood Park Facilities in Uttara Model Town, Dhaka: Design Standards and User Perception based Evaluation

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**Abstract:** Neighborhood Park is considered as a key element of neighborhood development and formation of a vibrant community. The purpose of this study is to make a comparison of parks' facilities with standards of American Society of Civil Engineers (ASCE) by identifying the existing facilities of seven neighborhood parks in Uttara Model Town, Dhaka. Furthermore, a comparative evaluation of the parks' facilities is made here based on users' perception by using Consumer Satisfaction Index (CSI). Study results indicated mentionable availability of sitting arrangement, signage, security light and walkway are in all these parks. Litterbin, food and drinking facilities and washroom are inadequate in number as compared with the standards. However, optional facilities such as exercise station, restroom and covered pavilion are literally absent. Values of CSI indicated that sitting arrangements and signage are comparatively better in these parks; whereas the conditions of garbage bins and shelters are not satisfactory.

**Keywords:** Neighborhood Park, Park Facilities, Design Standards, Consumer Satisfaction Index (CSI), Uttara Model Town.

### Introduction

Parks are critical urban spaces of an ideal city. In the concept of “neighborhood development”, park is considered as the core of a neighborhood block, which is one of the basic components of the city (Fan, et al, 2014). Although the importance of neighborhood parks is known, they are ignored and readily sacrificed for developmental projects (Swamy and Devy, 2014). Neighborhood park, typically the simplest form of park within the urban park system; provides spaces and opportunities for both informal active and passive recreation (Walker, 2016). Ecological models which emphasize the significance of the built environment in facilitating and constraining physical activity have been adopted in recent years to promote health (Sallis, et al., 2006). Parks are increasingly recognized as an important component of the built environment for physical activity (Rung, Mowen and Cohen, 2005). Particular types of park features are also related to park-based physical activity. For example, parks with trails, wooded areas, and water features were more likely to be used for physical activity than parks without these facilities (Kaczynski, Potwarka and Saelens, 2008). When designed well, they will also serve as the social and activity core for the neighborhood. Good designs include facilities that encourage use and enjoyment for children of all ages, adults, elderly, and special populations (Walker, 2016). People

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choose to visit or not visit parks not only because of what facilities are available in parks, but also because of the condition of those facilities (Weintraub and Cassady 2002). Poorly maintained park facilities among other concerns contribute to low use of the available parks in one's neighborhood (Dunton, et al 2014).

Though parks in Dhaka provide several natural, economic and social benefits are rapidly disappearing over the periods of time. The disappearance of parks was primarily attributed to a rapid increase in the urban population, mainly driven by rural–urban migration. To accommodate its ever-increasing population, both public and private sectors are continuously developing natural lands within and on the outskirts of the city, without considering the environmental costs of this action (Byomkesh, Nakagoshi, & Dewan, 2012). Consequently, ecological sustainability is at stake, leading to the rapid deterioration of Dhaka's total environmental quality and the landscape became highly fragmented and less connected (Amin et al. 2008). The drastic reduction of parks in Dhaka has been attributed to a lack of policy and poor management. In order to ensure sustainability of parks and greater participation of the citizen, there is an urgent need for strategic park planning and design standards. This study, therefore, aims to identify the existing facilities of the neighborhood parks and make a comparison of these facilities with international standards. An evaluation of all the parks' facilities also has been made based on users' perception.

## Methodology

A check list was prepared to sort neighborhood park's facilities and make a comparative analysis with international standards through literature review. To examine the existing conditions and management of parks' facilities field observation was conducted. Photographs were taken to demonstrate parks' facilities and major problems associated with these facilities. Questionnaire survey through simple random sampling of 280 park users was employed to evaluate parks' facilities. Users were asked to rate each park facility on a scale of 1 to 5. Where rating values 1, 2, 3, 4 and 5 denotes very poor, poor, moderate, good and the excellent condition of a facility respectively. Using Consumer Satisfaction (CSI) (Eq.1) perception score for each neighborhood park have been calculated (Table 6). Higher the CSI score indicates the better condition of park's facility.

$$CSI = \sum_{k=1}^N \frac{S_k}{W_k} \quad (1)$$

$S_k$  is the satisfaction rates expressed by users on the service quality  $k$  facility  $W_k$  (importance weight) is a weight of the  $k$  facility, calculated based on the importance rates expressed by users (Eboli and Mazzulla, 2009). The weight of facility is calculated using importance order of each facility and the cumulative rank value of the facilities. In this study 15 park facilities are considered. Thereby, the cumulative rank value is 120. So, weight of facility gets top most priority (e.g. sitting for P1) is estimated as  $(15/120 = 0.13)$  0.13 and weight of facility get the least priority (e.g. accessibility for P1) is 0.008 (Triantaphyllou et al., 1998). Weights of other criteria have been calculated in similar way (Table 4). Besides, a structured interview has been conducted among the personnel of

Sector Welfare Society (SWS) for collecting information about management of the park. Some measures are recommended for better functioning of these parks considering the comparative analysis with standards, park users' perceptions and opinion of SWS.

### **Literature Review**

Groff and McCord (2011) stated that active recreation facilities such as basketball courts and baseball, football and soccer fields tend to attract a younger crowd. Parks with paths and benches tend to attract more individuals interested in more passive pursuits and parks with playgrounds attract families or parents with younger children. Parks with facilities such as children's playgrounds, fields for organized sports and nighttime lighting should be particularly attractive to conventional users. Weintraub and Cassady (2002) in their study reviewed that people choose to visit or not visit parks depends on facilities are located there as well as the condition of those facilities. Public health research to date has largely been devoted to studying the relationships between physical activity and the presence or absence of facilities, but little work has been done to distinguish among the potentially varying conditions of those facilities. Park users are more likely to visit a park where the facilities are maintained on a regular basis and shun those places containing elements that are in disrepair.

Jamie Rae Walker (2016) in his study has mentioned key features and major design considerations of Neighborhood Park. This study also recommends community participation and their responsibilities in adopting updated planning and to maintain park. Fan et al. (2014) proposed an evaluation system for parks in urban area and conclude that comparative evaluation between the different parks can help in understanding the characteristics and problems of existing information. Mensah (2016) assesses the state of green spaces in Kumasi city, Ghana and found all green spaces in poor condition. An attitudinal change towards the maintenance of green spaces, the application of a collaborative governance approach, and priority giving to green spaces in all development agendas by city authorities are suggested. Dunton (2014) suggested that, though children's use of neighborhood parks was generally low, it increased substantially when parks were closer to children's homes and had greater vegetation density. Swamy and Devy (2014) stated the ecological significance of neighborhood parks and proposed a stewardship framework to manage these parks. McCormack (2010) identified that, poorly maintained park facilities, and lack of safety at parks contribute to low awareness and use of the available parks in one's neighborhood. Bai et al. (2013) investigated associations between perceptions of neighborhood park quality and park-based physical activity. Most studies examined parks characteristics such as proximity or accessibility and usage of parks but ignored perception of quality in terms of condition of parks' facilities. Furthermore, these studies are rare in the context of developing countries and most of these are conducted in developed countries. Consequently, additional research is needed to better understand perceptions of park quality, particularly pertaining to park facilities.

### **Study Area Profile**

'Uttara Model Town', is about 12 km away from the city centre, located in the northern part of the capital city Dhaka (Figure 1). The initial name of the project was 'Dhaka North

Satellite Town', which was renamed as 'Uttara Residential Model Town' in 1980s (Haque, 2016). The project was launched by Dhaka Improvement Trust (DIT, presently RAJUK) to encourage the process of decentralization of some of the functions (Rashid, 2002). It was planned to set up a residential neighborhood in the periphery of Dhaka City during 1960's under sites and services scheme covering 2,484 acres of land with approximately 20,000 plots and flats of different sizes for 1,24,000 population (DIT, 1966). Present 'Uttara Model Town' has been developed in two phases on around 1,388 acres of land (Haque, 2016). Uttara Model Town consists of total 39,123 structures of different types. Among these 36469 residential, 197 institutional and 2457 other structure are found. As per census 2011, Uttara Model Town has a Population of 1,79,907 of which 1,01,349 is male and 78,558 is female with a growth rate of 6.21% (BBS, 2011). The climate is tropical (Sarkar et al., 2009).

Table 1 Brief Overview of the Neighborhood Parks

Park name	Mark	Area (Acre)	Visiting hour	Management staff
Sector 4 park	P1	3.92	6:00 am-10:00 am and 3:30 pm-6:30 pm	2 gardeners, 4 security guards, 3 sweepers
Sector 6 park	P2	1.99	5.30 am-9 am and 4 pm- 9 pm	1 security guard, 5 DNCC sweepers
Sector 7 park	P3	2.53	24 hours 24/7	2 security guards
Sector 11 park	P4	1.44	6 am-10 am and 4 pm- 9 pm	2 gardeners, 4 security guards
Sector 13 park	P5	1.01	6 am-10 am and 5 pm- 9 pm	1 gardener, 1 security guard
Sector 13 lake park	P6	0.31	6 am-10 am and 5 pm- 9 pm	1 gardener, 1 security guard
Sector 14 park	P7	1.24	5 am-9 am and 4 pm- 9 pm.	2 gardeners, 3 security guards

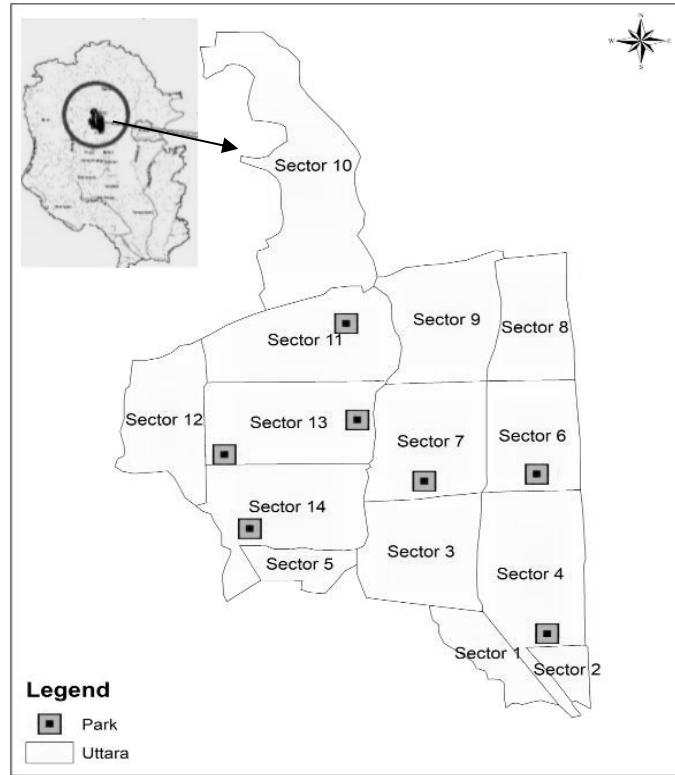


Fig 1: Neighborhood Parks in Study Area

### Neighborhood Parks of Uttara Model Town

In Uttara Residential Model Town, there are seven neighborhood parks (Table 1). These parks are managed by respective Sector Welfare Society. The welfare society collects fee from residence for sector management and the parks are also maintained by the collected fund. All types of people irrespective of ages visit these parks. However, residents aged between 18 and 40 years mostly use the parks. Most of the users (45.7%) come to the park within 1-2 km distances. The proximity of parks augments their visit as well as physical activities.



Fig. 2 Entrance and Play Facilities in P4



Fig. 3 Shelter in P6 and P7

Maximum park users visit their respective sector park. However, P6 and P3 are used by the people of all sectors because lake is one of the main attractions of P6. While entrance of P3 is free and open to all. It is observed that, P1 is the largest park in terms of area followed by P3, while P6 is the smallest one. The visiting hours are confined for all the parks except P3. Though P3 is open for 24/7, merely two security guards are at the service of visitors.

### Site Facilities in Different Parks

Among the site facilities sitting arrangement, light, signage and walkway are available in all the neighborhood parks (Figure 2, 3 and 4). The highest number of benches is found in the P1 followed by P3 and P6 (Table 2). Maximum numbers of signage are observed in the P5 and P7.



Figure 4 Existing Facilities of Neighborhood Parks

Table 2 Existing Facilities of Different Parks

Item	Number of Site Facilities in Different Parks						
	P1	P2	P3	P4	P5	P6	P7
Bench	35	4	23	14	14	15	10
Shaded sitting area	3	0	6	0	0	0	4
Circular sitting area	1	1	1	0	1	0	0
Shelter	3	4	0	0	1	2	0
Litterbin	2	1	0	0	3	2	3
Light	9	5	12	12	16	35	11
Signage	5	1	3	1	8	3	7
Washroom	5	0	0	0	0	0	0
Water tap	0	0	1	2	0	2	0
Swing	3	0	6	5	2	0	0
Slid	3	0	5	4	2	0	0
Seesaw	0	0	2	2	2	0	0
Gymnastic structure	1	0	0	1	0	0	0
Water feature	1	0	0	0	0	1	0
Entrance	3	3	0	0	3	4	2
Designated play area	0	0	1	0	0	0	1
Walkway (meter)	2374.5	809.3	741.8	944.3	1011.7	1956	944.3

P6 is enlightened by maximum number of light (35) followed by P5 (16). Very few numbers of litter bins are found in the parks except P3 and P4. Water tap exists in P3, P4 and P6. Swing and slid are found in P1, P3, P4 and P5. Except P1, no washroom facility is found in any other parks. Facilities like drinking fountain, planter, restroom and bollard are entirely absent in the parks. Walkway area is the maximum in P1 followed by P6 and minimum in the P3.

### Comparison with Standards

Neighborhood parks are designed to serve a small population of 1,000 to 2,500 person. An appropriate standard in relation to size and population for this type of park is 2.5 acres per 1,000 persons. In case of Uttara Model Town, neighborhood park is 0.07 acre per 1,000 persons due to large population with a limited land area. Urban Planning Guide by American Society of Civil Engineers (ASCE) prescribes the standards of neighborhood park's facilities in detail and is practiced globally. Hence, a comparison has been made of

the parks' facilities with the standards prescribed by ASCE (Table 3). It is evident that, park facilities like bench, signage and security lights are somehow provided according to international standards. However, optional facilities such as exercise station, restroom and covered pavilion are literally absent in the parks of study area.

Table 3 Comparison of Park Facilities According to ASCE Neighborhood Park Standard

Standards of Neighborhood Park			Facilities in Different Parks						
Facilities	ASCE Provision/ Unit		P1	P2	P3	P4	P5	P6	P7
Sitting arrangement	2 per acre		More than standard	A	A	A	A	A	A
Shelter	2 per acre		1 per acre	A	N/A	N/A	A	A	N/A
Drinking Fountain	3 per park		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Playground equipment	Serve children	15-20	5-7 children	N/A	13 children	11 children	6-7 children	N/A	N/A
Garbage bin	1 per picnic table		2 in 3 acre	1 in 3 acre	N/A	N/A	3 in 1 acre	2 in 1 acre	3 in 1 acre
Park sign	1 at each major entrance		A	A	A	A	A	A	A
Sidewalk	Along street frontage		A	N/A	N/A	N/A	N/A	N/A	N/A
Exercise facility	Optional		A	N/A	N/A	A	N/A	N/A	N/A
Restroom	Optional		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Covered pavilion	Optional		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Irrigation/watering System	Yes		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Security light	Yes		A	A	A	A	A	A	A
Parking	On-street		Off-street	A	A	N/A	A	A	N/A

Not a single fountain is found in any of the parks though drinking fountain is a vital facility for the park users. In addition, no watering facility is provided to maintain parks' landscape. Play facilities are available in P1, P3, P4 and P5. However, these facilities are not enough to serve standard number of children. Vehicle parking facilities are available in all the parks except P4 and P7. Litterbins are placed in all the parks except P3 and P4; still the number is much less than the standard. The concept of 'Neighborhood Park' is relatively new in Bangladesh and there is no specific planning and design standards to make this particular type of park more functional and attractive. Therefore, a distinct gap is observed between the existing number of neighborhood park facilities and the provision of facilities recommended by the standard.

### User's Perception on Parks' Facilities

Satisfaction level of people about parks' facilities is measured and each park has been ranked on the basis of respective satisfaction score (Table 4, 5 and 6). The higher score indicates users are more satisfied with the parks' facilities.

Table 4 Weight of Neighborhood Parks' Facilities

Types of Facilities	Weight of facilities						
	P1	P2	P3	P4	P5	P6	P7
Sitting Arrangement	0.13	0.04	0.09	0.1	0.1	0.1	0.1
Children Amusement Facilities	0.12	0.12	0.07	0.07	0.07	0.03	0.09
Physical Exercise Equipment	0.09	0.13	0.12	0.12	0.11	0.11	0.11
Garbage bin	0.008	0.02	0.02	0.02	0.008	0.02	0.008
Car Parking Facilities	0.02	0.06	0.05	0.03	0.02	0.008	0.02
Greeneries	0.05	0.07	0.04	0.08	0.06	0.04	0.03
Aesthetic/ Attractiveness	0.06	0.03	0.06	0.04	0.06	0.02	0.02
Walkway	0.03	0.06	0.008	0.05	0.03	0.08	0.08
Security	0.02	0.02	0.1	0.008	0.02	0.06	0.04
Signage	0.08	0.008	0.08	0.06	0.04	0.09	0.06
Lighting Facilities	0.04	0.09	0.03	0.02	0.05	0.05	0.06
Food Facilities	0.11	0.05	0.02	0.06	0.09	0.06	0.07
Drinking Water Facilities	0.1	0.11	0.11	0.11	0.13	0.12	0.12
Washroom	0.07	0	0	0	0	0	0
Shelter	0.06	0.08	0.06	0.09	0.08	0.07	0.05

Table 5 Mean Score of Neighborhood Parks' Facilities

Types of Facilities	Mean Score of facilities						
	P1	P2	P3	P4	P5	P6	P7
Sitting Arrangement	3.58	3.38	2.98	2.83	2.98	2.45	2.33
Children Amusement Facilities	3.38	1.03	2.13	3	3.8	1.08	1.1
Physical Exercise Equipment	1.9	0	0	1.13	0	0	0
Garbage bin	3.13	3.25	0	0	3.43	2.63	2.05
Car Parking Facilities	3.15	3.3	1.93	0	3.75	2.68	0
Greeneries	4.1	3.3	2.85	2.7	3	3.9	3.53
Aesthetic/ Attractiveness	4.45	3.33	2.53	3.28	3.65	3.78	3.5
Walkway	4.4	3.85	3.18	3.58	3.98	3.45	3.05
Security	4.58	4.38	2.85	4.3	4.45	3.58	3.58
Signage	4.6	4.68	2.33	4.45	4.65	3.48	3.4
Lighting Facilities	3.78	3.55	2.88	3.63	3.45	3.38	2.63
Food Facilities	1.85	2.43	2.7	1.6	2.1	2.08	1.13
Drinking Water Facilities	1.08	1.23	1.1	1.15	1.23	1.08	1.03
Washroom	2.35	0	0	0	0	0	0
Shelter	1.5	1.18	0	0	1.18	1.125	0



Table 6 People's Level of Satisfaction about the Park Facilities

Type of Facilities	Consumer Satisfaction Index (CSI) Value						
	P1	P2	P3	P4	P5	P6	P7
Sitting Arrangement	0.46	0.14	0.27	0.28	0.29	0.25	0.23
Children amusement facilities	0.40	0.12	0.15	0.21	0.27	0.03	0.09
Physical exercise facilities	0.17	0	0	0.14	0	0	0
Garbage bin	0.03	0.07	0.04	0.06	0.03	0.05	0.02
Car parking facilities	0.06	0.19	0.09	0.07	0.07	0.02	0
Greeneries	0.20	0.23	0.11	0.22	0.18	0.16	0.11
Aesthetic/ Attractiveness	0.27	0.09	0.15	0.13	0.22	0.07	0.07
Walkway	0.13	0.23	0.02	0.18	0.12	0.28	0.24
Security	0.09	0.09	0.28	0.03	0.09	0.21	0.14
Signage	0.37	0.04	0.19	0.27	0.19	0.31	0.20
Lighting facilities	0.15	0.32	0.09	0.07	0.17	0.17	0.16
Food facilities	0.20	0.12	0.05	0.09	0.18	0.12	0.08
Drinking water facilities	0.11	0.13	0.12	0.13	0.16	0.13	0.12
Toilet	0.16	0	0	0	0	0	0
Shelter	0.09	0.09	0	0	0.09	0.08	0
<b>Total CSI value</b>	<b>2.91</b>	<b>1.88</b>	<b>1.54</b>	<b>1.75</b>	<b>2.07</b>	<b>1.89</b>	<b>1.47</b>
<b>Rank</b>	<b>I</b>	<b>IV</b>	<b>VI</b>	<b>V</b>	<b>II</b>	<b>III</b>	<b>VII</b>

Users' perceptions indicate that, the condition of garbage bin and shelter not satisfactory in the parks. Since washroom facilities are absent in all parks except P1; the CSI values are found 0 in these parks. In contrast, sitting arrangements and signage are relatively better in these parks. According to their response, most of the facilities are comparatively good in P1 except garbage bin. There is no drinking fountain in any of these parks. Evaluation has been, therefore, made for drinking facilities available outside the parks' boundary. Similarly, P5 is ranked II, as garbage bin are less satisfactory to the users and no washroom exist in this park. P7 is ranked in the bottom place as users are not satisfied with the facilities other than walkway and sitting arrangement. Poor management and maintenance mainly catalyze the deteriorating conditions of these facilities. Other neighborhood park related studies merely focus on accessibility, proximity and usage of parks and ignore users' perceptions. In addition, there is scarcity of land to develop neighborhood parks according to preferred standard. Hence, the park facilities need to provide adequately. To attain maximum social, economic and ecological benefits from neighborhood parks, user perception-based evaluation of park facilities is inevitable. CSI rank values indicate which facility/facilities need more attention to reach users' satisfaction level.

## Conclusion

Neighborhood parks are considered as a key element of neighborhood development and formation of vibrant community. This study finds out the existing facilities of neighborhood parks of Uttara Model Town. Comparing with international standards; this is evident that, facilities of these parks are not adequate and in some cases some facilities are totally absent. Values of Consumer Satisfaction Index indicate that, sitting

arrangements are comparatively better in the parks; whereas the conditions of garbage bins and shelters are not satisfactory at all. Irregular maintenance and lack of proper monitoring further deteriorated the condition of parks' facilities. Poor management and maintenance mainly catalyze the deteriorating conditions of these facilities. The concept of 'Neighborhood Park' is relatively new in Bangladesh and no planning and design standards are maintained to make this type of park more functional and attractive. Therefore, a distinct gap is observed between the existing and the standard provision of facilities. The findings of this study are critical in improving the facilities in terms of quantity and quality as well as formulating pertinent native standard.

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## **Household Coping Strategies to Reduce the Effects of Flood on Livelihood Pattern: A Case Study on Sariakandi**

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**Abstract:** Bangladesh is extremely vulnerable to natural disaster. Among the natural disasters, flood being a regular phenomenon has the most widespread, prolonged and damaging impacts that disrupts agriculture, infrastructure, employment, and food distribution systems as well as other aspects of livelihood. Poverty, that force people to live in floodplains is a significant contributor to people's vulnerability to flooding and frequent flood impact leads to increase in poverty and hence vulnerability. Impacts of flood on the poor, especially rural poor living in flood-prone area are more severe and their condition is particularly vulnerable due to lack of assets. Their livelihood strategies are the key to understand the way people 'cope' with floods. Due to frequent floods and its devastating impacts people in the flood prone areas have become habituated to live with flood through innovation of their own mechanism with their indigenous knowledge and efforts to cope with flood. These different mechanisms are sometimes very effective and sometimes people face much hardship to cope with flood. Importantly it is noticed that due to absence of awareness and motivation people induce adverse impacts to the community as well as the environment through their different coping mechanisms. Considering this scenario, this paper examines the nature and extent of household coping strategies of flood affected people in the study area.

### **Background of the study**

Disasters, such as floods, cyclones, tornadoes, and droughts strike in Bangladesh and its population almost regularly and intensively. None of these disasters is new, but in recent years there have been some significant changes in their occurrences. Unfortunately the damage due to such disasters has been increasing, especially due to the fact that increasing number of people are forced to occupy more marginal and disaster-prone locations (Joarder, 2013).

The frequency of natural disasters has been increasing over the years, resulting in loss of life, damage of property and destruction of the environment. The number of people at risk has been growing each year and the majority is in developing countries. High poverty levels is making the poor more vulnerable to disasters (UNISDR, 2004).

Usually a flood is an overflow of water that submerges land, low-lying villages and towns or an unusual condition affected by inflow of the tide. Regular floods are part of people's lives in various regions of the world, recurring with varying magnitudes and frequencies to which people have adapted for centuries. These floods are generally expected and

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welcomed in many parts of the world, since they enrich the soil and provide both water and livelihoods (Rahman, 2014).

In disparity, flooding resulting from extreme hydro and meteorological events and taking place in unexpected magnitudes and frequencies can cause loss of lives, livelihoods and infrastructures. They can also damage the environment (Integrated flood management tools series, 2013). Bangladesh has been declared the second most disaster-risk country in Asia only after the Philippines and sixth in the world after countries like Vanuatu, Tonga and Guatemala (SAARC workshop on flood risk management in south Asia, 2012).

As Bangladesh is mainly an agricultural country and since the river basins as well as floodplains are alluvial, a large number of settlements have been developed along the riverside areas throughout the country. As a result, floods caused by any of the three major rivers can affect a vast number of people. This extreme event affects the whole environment, including human beings, their shelters and the resources essential for their livelihoods. This may affect household food security by disrupting many of the agricultural, employment, and food distribution systems, as well as communication systems and markets (Rahman, 2014).

A large number of people live in flood prone areas in Bangladesh without any effective institutional support for dealing with the natural calamities. As a result, people in rural areas have ascertained their own household coping strategies to lessen the destructive impact of flood. But during recent years, the intensity of flooding has increased, rendering the numerous coping strategies people have developed over the past decades no longer sufficient without effective institutional support. The present study is conducted to understand the household coping strategies of the people at grass root level taken during flood.

### **Objectives and methodology**

The objective of the study is to examine household coping strategies of flood affected people and to do this Chandanbaisha Union Parishad of Sariakandi Upazila of Bogra District is taken as the study area. The most recent devastating flood occurred in 2014 has been considered as baseline for the survey.

Both primary and secondary data collection processes have been carried out to gather required information about the household coping strategies of people living in the study area to mitigate the adverse impact of flood. Primary data has been collected on the basis of the questionnaire survey of 100 households (95% confidence level and  $P = 0.5$  are assumed), Focus Group Discussion (FGD) of 5 group sessions (6-8 members for each session) and key informant interviews of 11 persons.

Photographs are taken to present the visual scenario of the area. Checklist and questionnaires have been prepared with a view to find out information required for this purpose. Understanding the fact that the entire population cannot be covered in one research process due to time limitation and resource constraints, the study adopted the multi-stage sampling approach. The approach is used to select 1 union (Chandanbaisha)

from 12 unions of the Sariakandi Upazilla and to further select 5 villages which were the worst hit settlements and 100 households for questionnaire survey from those 5 villages.

Secondary information has been collected through literature review of relevant published and unpublished materials. Data about the demographic and physical features of the study area has been collected from Sariakandi Upazilla Parishad and Chandanbaisha Union Parishad. Information regarding the activities of different government and non-government organizations has been received from respective officials.

### **Literature Review**

Brouwer et al., (2007) states that, Bangladesh is a highly flood prone country. Eighty (80) percent of the country consists of floodplains and several other minor rivers. These floodplains sustain a predominantly poor rural population. Once every ten (10) years roughly one-third of the country gets severely affected by floods while in catastrophic years such as 1988, 1998 and 2004, more than 60% of the country was inundated. Floods caused social disruptions and resulted in scarcity of drinking water as surface water got contaminated.

Islam (2004) has described the major causes of flood in Bangladesh and its damage effect. According to his research, the major causes of flood in Bangladesh are heavy rainfall during monsoon, climatic condition, over spilling of rivers, siltation problems on the rivers, hydrological nature of the rivers and lack of proper drainage facilities. Due to devastating flood, people of this country have to loss land, home, cattle, livestock and other valuable resources. Often, it has taken away the life of people.

Rahman (2006) in his study has focused on the frequency of flood that occurred in the country in the past. It mainly limited its scope on the Bogra district. The research has identified that heavy rainfall in the month of June to July and siltation in the local rivers are the main reason of frequent flood in this area.

Paul (2006) in his research discussed the major impacts of flood on the socioeconomic and demographic context. According to him, the major impacts are loss of land, home, employment and other valuable assets; death and injury of people and livestock.

According to UNISDR (2004) Household Coping Strategy is the means by which people use available resources and abilities to face adverse consequences that could lead to a disaster. In general, this involves managing resources, both in normal times as well as during crises or adverse conditions. The strengthening of coping strategies usually builds resilience to withstand the effects of natural and human-induced hazards.

Berkes and Jolly (2001) state that coping mechanisms are the actual responses to crisis on livelihood systems in the face of unwelcome situations, and are considered as short-term responses. Adaptive strategies are the strategies in which a region or a sector responds to changes in their livelihood through either autonomous or planned adaptation. Coping mechanisms may develop into adaptive strategies through times.

People in rural area especially flood plain are most familiar with flood. The whole coping process during flood can be divided into four stages which include some specific phases (Baqee, 2001). The stages mentioned by Baqee, are:

***First Stage***

1. Change in food type, frequency and quantity of consumption
2. Change in daily habit
3. Take necessary measures to keep homestead usable
4. Change in occupation

***Second Stage***

1. Skipping meals for entire day
2. Leave homestead and take shelter on safe places
3. Sales of non-productive livestock
4. Sales of jewelry, insurance assets
5. Credit/loans from money lenders

***Third Stage***

1. Sale of all livestock
2. Sale of productive equipment
3. Sale or mortgage of land

***Forth Stage***

1. Permanent migration
2. Dependence on external aid
3. Begging for food/resources

**Study Area**

Most of the area of Bangladesh is affected by flood. Specially, the riverside areas are mostly affected due to flood. Sariakandi Upazilla in Bogra District locating beside the Jamuna River is one of the most severely affected areas in Bangladesh and being scratched by flood almost every year. About 50% area and population of the upazilla is affected by flood almost every year (Sariakandi Upazilla Parishad, July 2015). People living in this area have to live with floods and struggle against the impact of floods on their livelihood by adapting traditional household coping strategies along with institutional supports.

Chandanbaisha Union is the most adversely affected part of Shariakandi Upazilla. Specially, during flood of 2014, it was the most vulnerably affected union in terms of damage, affected area and affected population. The people living here have to pass their whole life stragglng against flood and the riverbank erosion and the most interesting thing is that they have to depend both directly and indirectly on river and flood for their livelihood. Their continuous coping with flood and survival against all these odds have made the life style of these people significant than other areas. Figure 1 shows the map of the study area.



Source: Banglapedia

Fig. 1: Map of the study area

## Household Coping Strategies

Different household coping strategies to reduce the impacts of flood are described below:

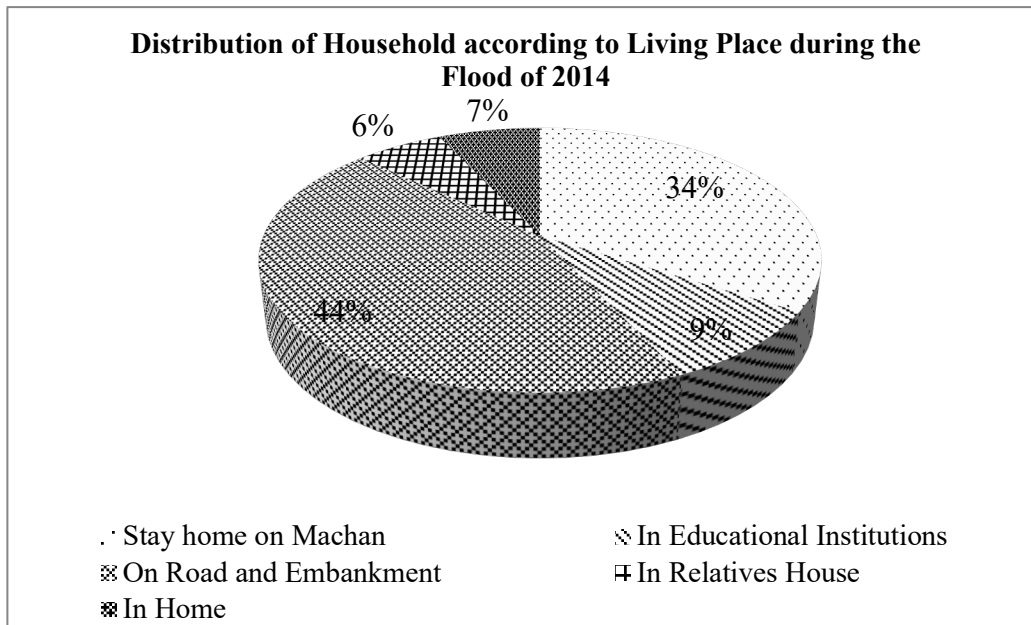
### *i. Coping Strategies Regarding Homesteads*

Like other flood prone areas in Bangladesh, many homesteads in the study area stand on raised embankments. Yet the plinth of maximum houses in the study area submerged during the flood in 2014 and most of the homestead became fully or partially unusable.



### **Place of living**

There is no flood shelter in Chandanbaisha union. In case of higher water level, educational institutions were also submerged (Field Survey, July 2015). At the time of flood of 2014, the scenario of living of people has been shown in Figure 2.



Source: Field Survey, July 2015

Fig. 2: Distribution of households according to living place during the flood of 2014

Similar to most of the flood prone areas of Bangladesh, majority of people (78%) of this study area used to take shelter on roads and embankments and on *machan* (a raised platform) inside their houses. *Machan* are made above the height of flood water. It is to be mentioned that generally all the members of a household do not go to other places leaving their houses in insecure condition, rather one or two elder male member(s) stay there to look after the household possessions (Field Survey, July, 2015).

### **Structural measures for homestead**

Majority of the people of the study area takes different measures regarding homestead to protect them from damage. Most common measure taken for homestead after the flood as a preparedness for the next flood was rising of homesteads above annual flood levels using river-bed mud. Few people also planted trees around homesteads to prevent erosion and secure the surface soil. Table 01 represents the structural measures that are taken by the people of the study area to protect their houses from the bad effects of the flood.

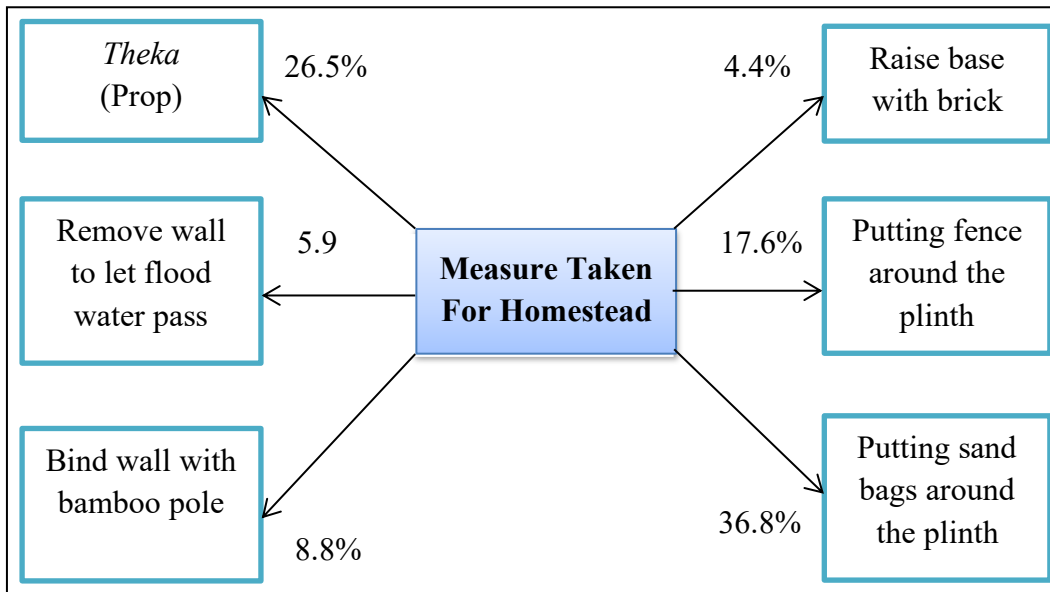
Table 1: Structural measures taken to protect house

Part of Homestead	Measures Taken during Flood	Material Used
Main Structure	<ul style="list-style-type: none"> <li>• Bind with bamboo pole</li> <li>• <i>Theka</i> (Prop)</li> </ul>	<ul style="list-style-type: none"> <li>• Bamboo pole</li> <li>• Wooden pole</li> <li>• Rope</li> <li>• Wire</li> </ul>
Base	<ul style="list-style-type: none"> <li>• Raise base with brick</li> <li>• Plaster the plinth with paste</li> <li>• Putting fence around plinth</li> <li>• Putting fence around homestead</li> </ul>	<ul style="list-style-type: none"> <li>• Water hyacinth</li> <li>• Straw</li> <li>• Banana trunk</li> <li>• Jute stalk</li> <li>• Bamboo stakes, mats</li> <li>• Jute, mud, husk paste</li> </ul>
Wall	<ul style="list-style-type: none"> <li>• <i>Theka</i> (Prop)</li> <li>• Remove wall to let flood water pass</li> </ul>	<ul style="list-style-type: none"> <li>• Bamboo pole</li> <li>• Wooden pole</li> <li>• Rope</li> <li>• Wire</li> </ul>

Source: Field Survey, July 2015

Another widely practiced structural measure was done by using bamboo pole to support the main structure by tying ropes around and linking the main joints. Additional support called *theka* was also given by setting bamboo poles diagonally to support the dwelling units.

During flood, base of house was usually plastered with paste of jute, mud and husk. It protects plinth from direct impact of flood water. The protection of plinth was done by a special measure, placing short bamboo stakes or banana trunk at regular interval along plinth and also putting straw and water hyacinth covering the plinth so that running water cannot hit the plinth directly and thus erosion was minimized (Field Survey, July 2015). Percentage of taking different structural measures regarding homestead is shown by the Figure 3. Here one thing is to be mentioned that many homesteads adapted more than one measures.



Source: Field Survey, July 2015

Fig. 3: Percentage of household taking different structural measures

### Cooking place

Number of households that takes attempt to rais the base of cooking place was very few because portable earthen *chula* is available. So people can manage these at the time of flood and use for cooking. It is found that 92% households used portable earthen *chula* for cooking (Field survey, July 2015).

From the survey (July, 2015) it is found that almost all villagers use to stock fuel, such as dry wood, jute stalks and husks, cow-dung cakes, dry leaves and branches etc. to use during flood. It is found that during last flood 24% people had to consume materials of houses (fencing or roofing materials that are mainly bamboo and straw) as fuel. 76% household stored fuel generally on roof top (Field survey, July 2015).

### ii. Coping Strategies Regarding Water, Sanitation and Health

#### Water source

In the study area, only 7% tube-wells were fully usable as they were placed on elevated base higher than flood level. Following measures are taken regarding water and water source during flood (Field survey, July 2015):

##### 1. Measures with tube-well

- Setting tube-wells on raised base so that these do not sink during flood
- Cementing the base so that polluted flood water cannot enter inside the tube-well
- Increasing the height of tube-wells, those sunk during flood using pipe

## 2. Disinfection of water

- Using water purifying pill was used to keep the tube-well water safe for drinking
- Boiling of flood water before use
- Using alum with flood water before use

## 3. Storing of drinking water

- Storing drinking water in containers

Figure 4 shows the attempts taken by the flood affected people for water source and latrine.

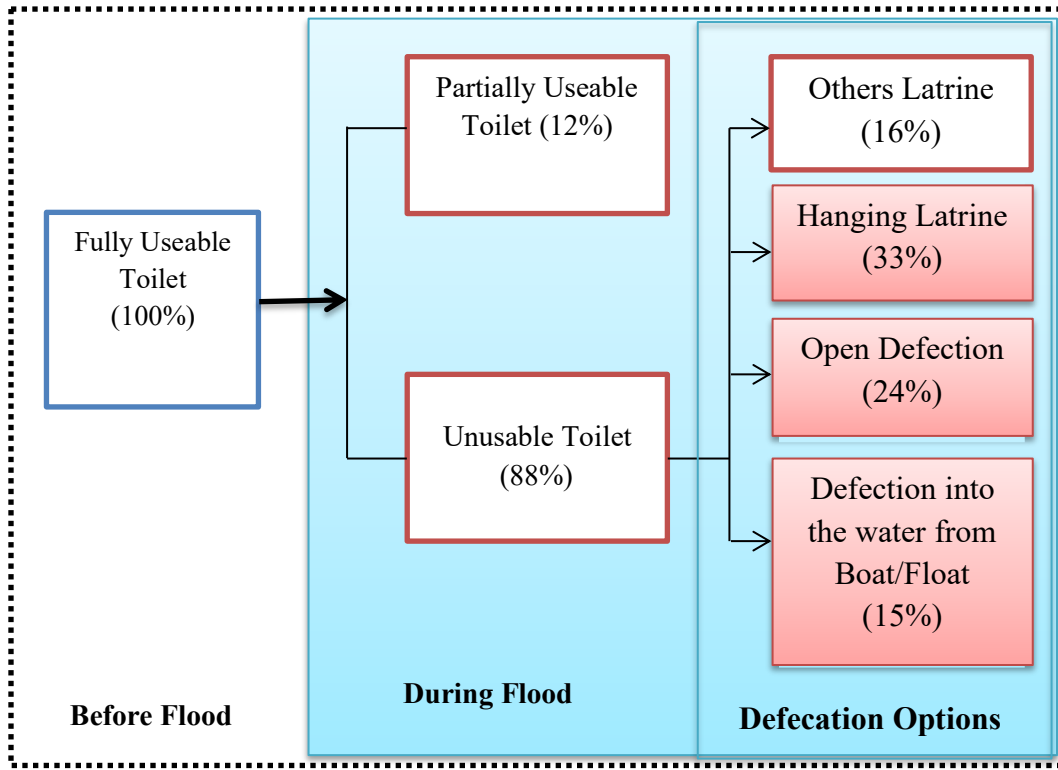


Source: Field Survey, July 2015

Fig. 4: Tube-well and sanitary latrine with higher plinth in the study area

## Sanitation

In the study area only structural measure taken for toilet during flood was raising the base of the toilet with more than one sanitary ring, which raised height about 1.5 ft. In the cases where toilets became unusable and people could not take any structural measure, temporary hanging latrines were constructed. Rest of the people had to use either others people' latrine or defecated openly using boats or floats (Field survey, July 2015). The actual scenario of this is shown in the Figure 5 below.



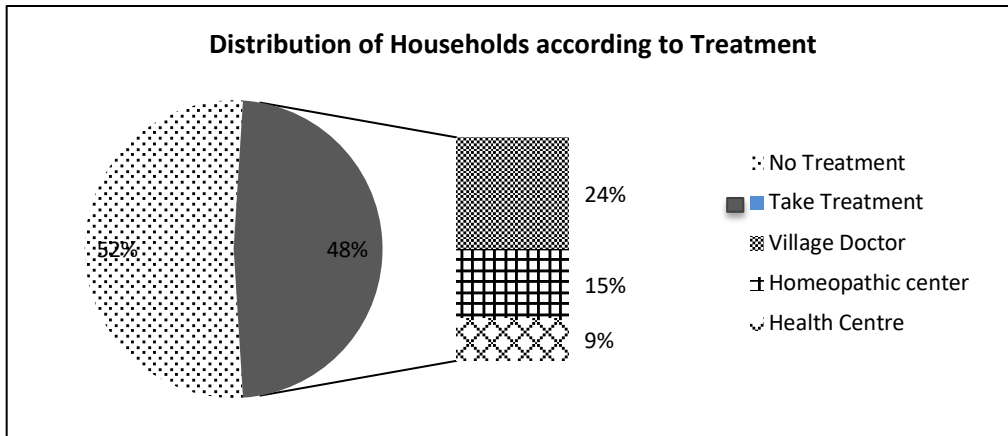
Source: Field Survey, July 2015

Fig. 5: Comparison of defecation practices before and during flood

### Health condition and disease

Coping strategies regarding health and diseases is limited in storing of emergency medicines for common diseases and saline mainly. Though most of the people in this area suffered from diarrhea, dysentery, fevers, eye and skin infections etc. during flood. Maximum household did not store any type of emergency medicine, even saline for flood period. Households stocking emergency medicine was only 34% (Field survey, July 2015).

From the survey it is found that 48% people took treatment during flood (Figure 6).



Source: Field Survey, July 2015

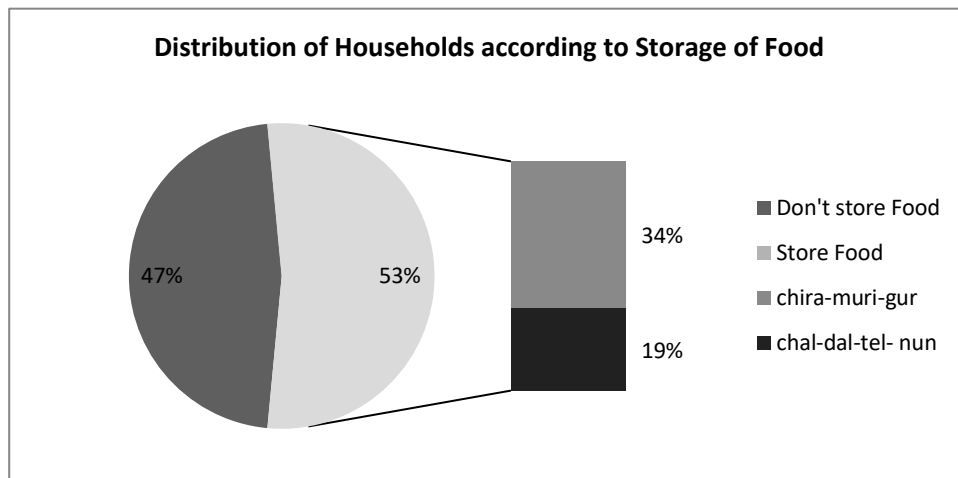
Fig. 6: Distribution of Households according to Treatment

Those who took treatment major portion of them took treatment from village doctor because they could avail this easily during flood. Only 9% was able to afford treatment from health center (Field survey, July 2015).

**iii. Coping Strategies Regarding Food Habit and Daily Activities**

**Changing eating habits**

During flood expenses for food is increased. Generally in every locality of Bangladesh as a preparation for flood, households store dry food such as *chira-muri*, *gur* (Molasses) and *chal* (rice), *dal* (pulse), *tel* (oil), *nun* (salt) etc. Figure 7 presents the percentage of households that store food for flood.



Source: Field Survey, July 2015

Fig. 7: Distribution of Households according to Storage of Food

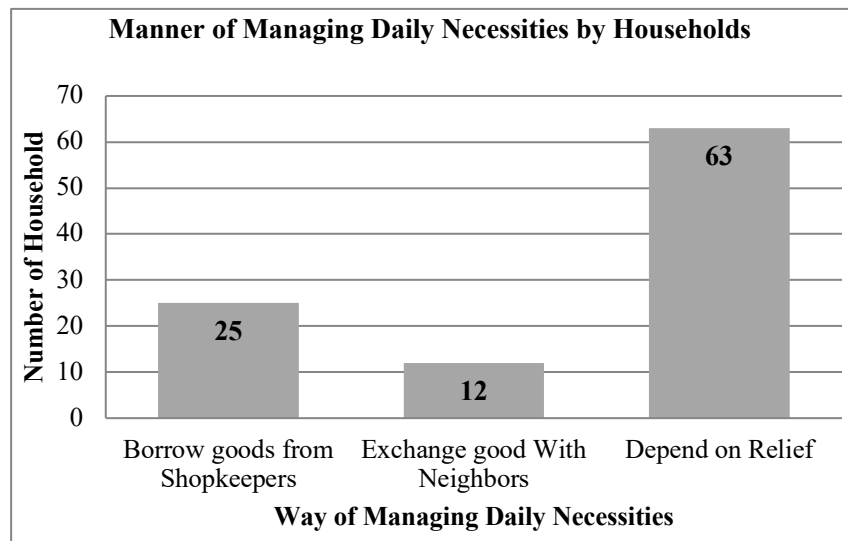
At the time of flood, many people consume their productive assets, mainly poultry as their food. Purchasing of food on credit is a common thing. People purchased food from markets of nearby unions as the local market also affected. (Field Survey, July 2015).

To cope with the increasing severity of flood, people changed their eating habit and reduced the frequency of meal consumption when households suffered income loss and failed to get enough credit to purchase same amount of food as before. This mainly affects the women of the family because for managing food for other members of household, at first they reduce their food consumption. Finally, if there were no alternative means of managing food people had to starve (Field Survey, July 2015).

### Managing daily necessities

Due to scarcity of daily necessities and lack of affordability people also had to bring change in their daily habits. Especially, consumption of toiletries and kerosene reduced to a great extent.

In order to manage daily necessities like kerosene oil (to lighten home at night and cooking), salt and such other needs to borrow goods from shopkeeper, exchange goods with others and depends on relief (Field Survey, July 2015). Figure 8 describes the scenario of this borrowings.



Source: Field Survey, July 2015

Fig. 8: Households according to the way of managing daily necessities

#### *iv. Coping Strategies Regarding Transportation*

All people had to use boat or float for going one place to another as almost whole area was submerged. Poor people had to use float made of banana trunk as they could not afford boat or manage boat fare (Field Survey, July 2015).



Source: reliefweb.int

Fig. 9: Transportation Mode during Flood

#### *v. Coping Strategies Regarding Agriculture*

Agricultural coping refers to the measures taken to protect existing crops in the field as well as alternating cropping practice and taking care of domestic animals. It depends on the nature of flooding. Hereunder, the measures taken by the people of study area during last severe flood have been denoted (Field Survey, July 2015):

##### 1. Change agricultural practices

- Change cropping pattern and take structural measures to protect standing crops
- Use emergency fodder (mustard plaster, rice bran etc.) as an alternative to natural fodder

##### 2. Change agricultural management

- Keep stocked crops to some flood free locations
- Keep livestock and poultry on elevated places
- Sell stocked crops, poultry and livestock

#### **Measures for Managing Crop**

63% households in the study area are engaged in cultivation (Field Survey, 2015). They have to manage their crops being damaged by the flood. Adjustment with respect to crops may broadly be classified into two types-

1. Before Flooding: Measures for saving standing crops in the field
2. After Flooding: Measures that help to initiate agricultural activities as early as possible

During the initial stage of flooding, people of the study area protect standing crops by taking following measures-



- Guard the field by putting low height mud wall in surrounding so that flood water cannot enter into the field.
- Cultivate *Ropa aman*- which can survive within flood up to water level of 4 to 5 ft. if flood water rises slowly.
- Cut crops if the crops are mature enough for an early harvest.

### **Measures for Managing Livestock and Poultry**

96% household possesses livestock or poultry or both (Field Survey, July 2015). During flood livestock and poultry require some kind of temporary shelters. Chickens and ducks were kept on *machan* or rooftops for a certain time. For keeping livestock during flood, floating *machan* or float made of layers of straw and water hyacinth placed over some sort of horizontal structure made of bamboo with banana trunk underneath is made. When the water level was too high, the farmer shifted their animals to higher grounds, mainly on roads and embankments.

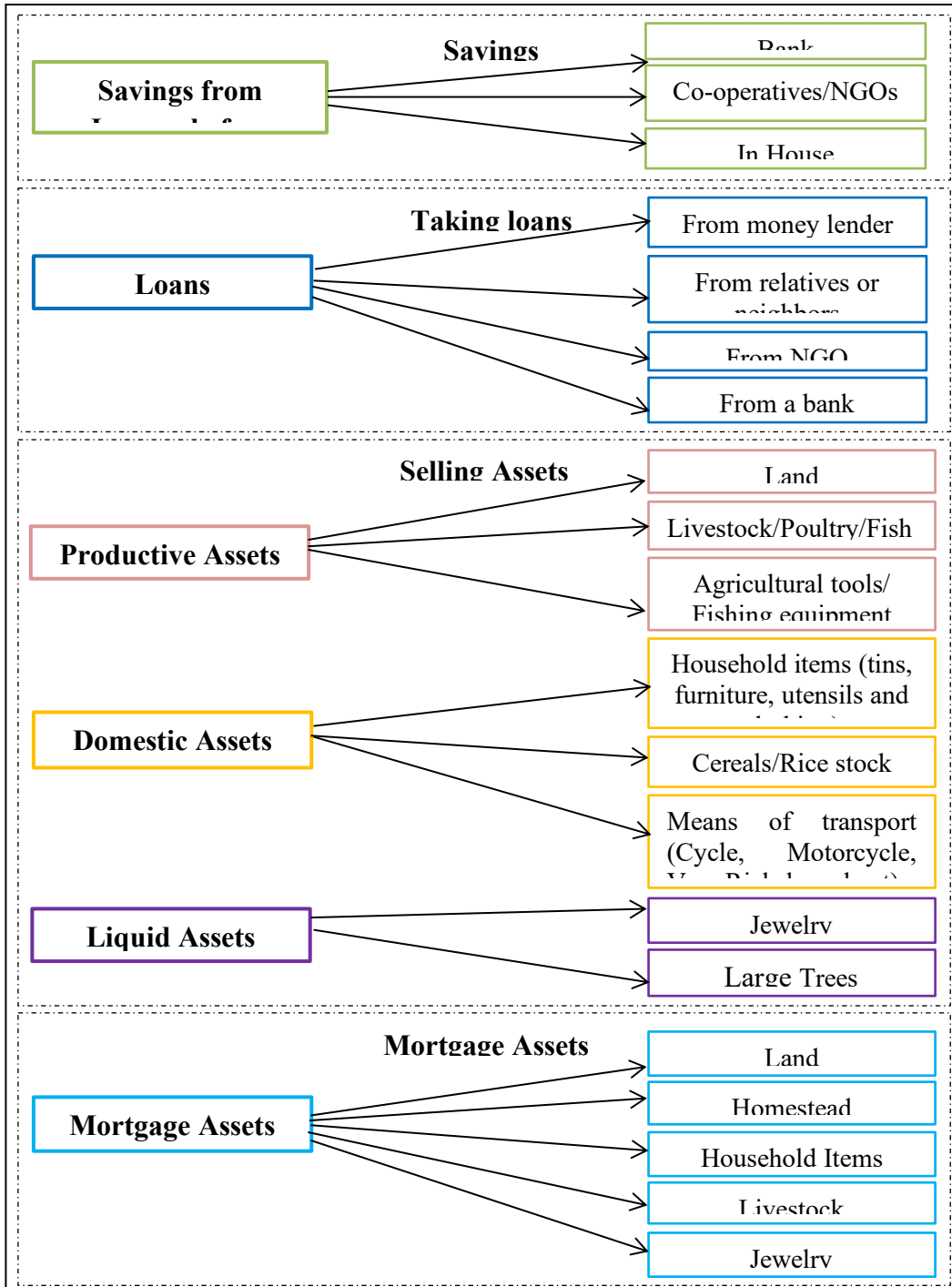
During flood, when grazing lands go under water, type of fodder change and livestock have to live on tree leaves and straw mainly and poultry on husks and food wastages that is also very inadequate in quantity (Field Survey, July 2015).

### **vi. Coping Strategies Regarding Financial Activities**

In the study area, majority of the population was engaged in agricultural occupation before flood and during flood, 34% of these households became jobless (Field Survey, July 2015). In spite of having difficulties, people try to search for an alternative occupation. About 43% had to change their occupation and find alternative forms of employment (Field Survey, July 2015). Not only there was the scarcity of job but also income of the people decreased enormously during flood. People in the study area adapt various financial measures including-

1. Savings
2. Taking Loans
3. Selling Assets
  - i. Productive Assets
  - ii. Domestic Assets
  - iii. Liquid Assets
4. Mortgaging Assets

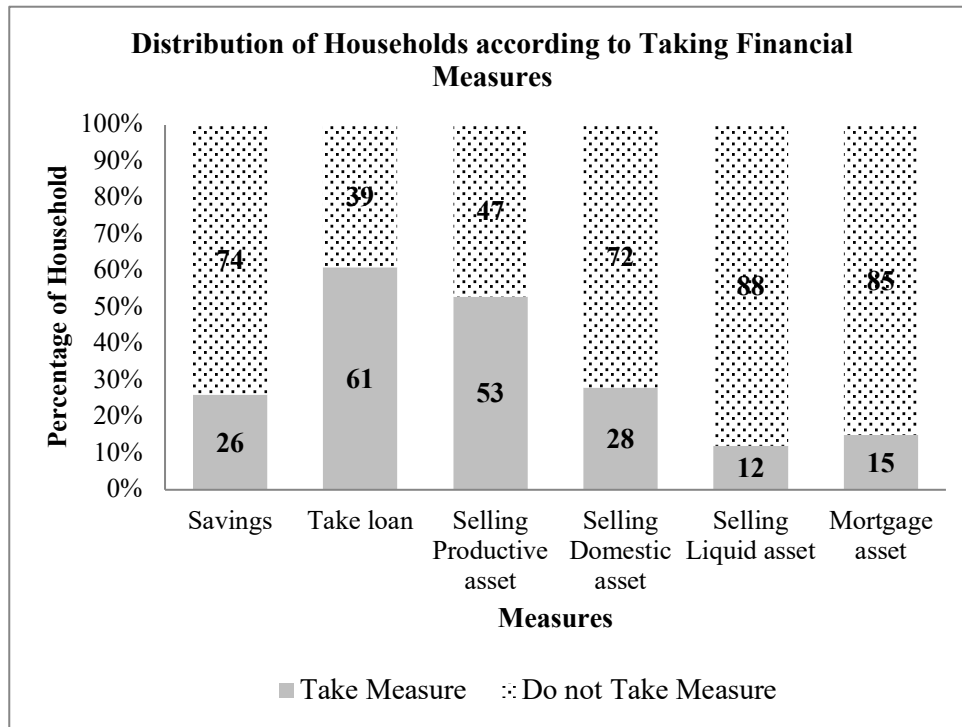
Figure 10 shows different options of financial coping strategies taken by the people of study area.



Source: Field Survey, July 2015

Fig. 10: Different Options of Financial Coping

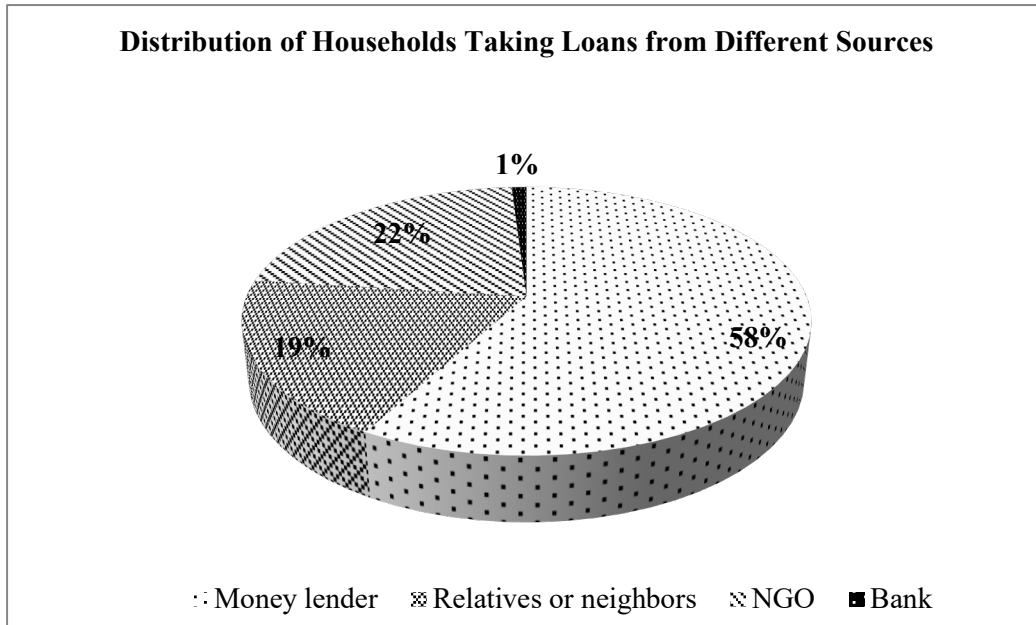
It has been found from survey that a household had to adapt more than one financial measure at the same time to manage the crisis situation. Figure 11 shows the distribution pattern of households whether they are taking financial measures or not and if taking any measure then what is the way to collect the financial help.



Source: Field Survey, July 2015

Fig. 11: Financial measures taken by the households

Borrowing was the main coping strategies used by the households in the study area to response flood. The loans were taken to face financial crisis, especially for purchasing food during flood. Most of the cases they borrowed money from money lender (*Mahajan*) on high interest rate (12-25%) than the other sources of loans such as from neighbors or relatives, NGOs, banks etc. The main reason was the easy availability of the first source as well as inability of neighbors or relatives to pay loans as they also have to face the same crisis during flood and the official formality and complex procedure to manage loans from bank or NGOs (Field Survey, July 2015). Figure 12 describes the percentage of households taking loans from different sources.



Source: Field Survey, July 2015

Fig. 12: Distribution of households taking loans from different sources

## Conclusion

People in the study area have ascertained their own household coping strategies to lessen the destructive impact of floods. The government and other relevant institutions should extend their range of supports to protect the rural community from the disastrous impacts of flood as well as to lead the deprived community to sustainable development through efficient management of floods.

The most important thing is to guide as well as motivate local people to take environment friendly measures, build their awareness for responding accordingly during flood, make their ways easy to cope with flood and thereby, mitigate the vulnerability due to floods. This study will help to understand the related authorities, personnel and people the way to reduce the effects of flood on livelihood through the household coping strategies.

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## **Evaluation of the 'Cluster Village' Projects: A Case Study on Four Cluster Village Projects of Nilphamari District**

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**Farhana Akther\*\***

**Abstract:** Access to land is very important for socially and economically disadvantaged people, from the countries where agriculture is the main source of employment to improve their livelihoods. It brings an opportunity for producing their livelihoods reducing extreme poverty. Land management is a tool being employed by the governments around the world to contribute in this respect. In Bangladesh guchchogram/ cluster village projects are done for rehabilitating rural land less people to reduce poverty. Successful implementation of such projects will help in reducing poverty, migration and improving socio economic condition of rural poor. This paper focuses on evaluating cluster village projects whether they are improving the socio economic status of the people.

### **Introduction**

The number of landless people Bangladesh is growing steadily because of consequent natural disasters like -flood, river erosion, cyclone, etc., poverty, and legal disputes. According to BBS 2010, the Agriculture Census, 2008 revealed that out of 28.67 million households, 4.48 million or 15.62% were absolutely landless (Byron, 2009). Bangladesh is one of the very highly disaster-prone countries in the world. The current rate of increase in landlessness is 12.84 % in rural areas against 10.18% and 8.67% in 1996 and 1983-84 respectively (BBS, 2010, Agriculture Census 2008). Poverty rate for the landless was 57 percent in 2005 compared to 24 percent for small landowners and 13 percent for medium/large landowners (HIES, 2002, 2005)). The phenomenon of “landless farmers” migrating to urban centers is increasingly reported (Rahman and Manprasert 2006; IRIN 2010). In Bangladesh, current urban population growth rate is around 4% per year (World Bank 2016). In Bangladesh, particularly the 25 percent of the population below the lower poverty line consume at very low level (HIES, 2005). Landlessness, homelessness, adverse person-to-land ratio, etc. are the push factors to rural-urban-migration. Poverty ignited from landlessness and lack of wage-earning opportunities in rural areas promotes rushing from rural to urban areas. This badly influences social environment in urban areas especially by increasing slums and informal settlements. This increasing landless families are rushing towards urban areas for livelihoods and creating extra pressure on the major cities. So, the policy makers always think of relocation of such shelter less people and bring them mainstream of the society. The Cluster village project is such a project to rehabilitate landless destitute poor families on khas land. Already about 1761 cluster villages have been established, and more will be done within 2025 (MoL, 2018). It is important to evaluate the rehabilitation projects whether they contribute in socio-economic developments in

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Nilphamari district or not. This study tries to find at what extent these projects can fulfill their theoretical premise and uplift the socio economic condition of rootless families. The study will also find what are the negative factors, and potentials and constraints.

## Objectives and Methodology

The goal of this study is to evaluate how much socio-economic changes have been occurred to the people due to initiating of these projects, thus the objectives were framed such as; to evaluate these projects in socio-economic perspectives and provide some recommendations for ensuring effectiveness of the selected projects. This research was carried out on the basis of exploratory research design. For collecting primary data, individual questionnaire survey and Focused Group discussion has been done. According to the Yamane sampling, 31, 28, 17 and 12 households of Pacharhat, Nijbari, Golna, and Shalhati communities respectably were surveyed. In FGD, both the male and female residents of various age were present. Concerned officials of the regional office of Guchchogram Project and BRDB office were interviewed. Earlier researches both published and unpublished, and govt. and autonomous publications were used as the secondary sources.

## Study Area

According to CARE SDU report, 2003, total amount of Khas land in Nilphamari district is 19,508 acres, where agricultural Khas land is 18,071 acres and non-agricultural Khas land is 1,437 acres and no. of landless household is 50,952 (BBS 2010).

4 cluster villages located in 4 different Upazila of Nilphamari district have been chosen, namely- i) Pacharhat Adarshgram at Dimla, ii) Nijbari Guchchogram at Saidpur, iii) Golna Guchchogram at Domar, iv) Shalhati Guchchogram at Dimla.

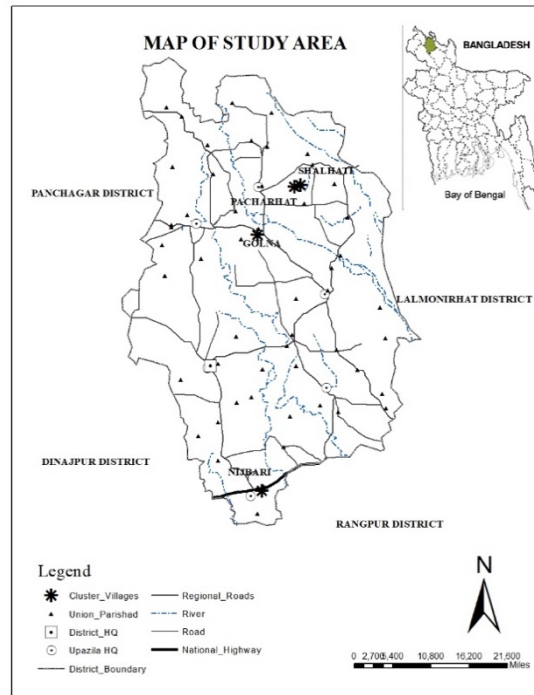


Fig 1: Map of study area  
Source: LGED, modified by authors, 2018.



Fig 2: Pacharhat cluster village



Fig 3: Golna cluster village



Fig 4: Nijbari cluster village

Source: Field Survey 2018

## Evaluation of the Rehabilitation Projects in Socio Economic Perspectives

### Demography

In the first three communities, the landless people were rehabilitated in two steps. At Pacharhat, first 50 families were rehabilitated in 2000 and then 50 families in 2002. Also, at Nijbari Guchchhogram firstly 70 families in 2009 and after four years more 10 families were rehabilitate. At Golna Guchchhogram, 30 and 30 families were relocated in 2009 and 2010 respectably. There should be 60 families, but at present there live only 26. At Shalhati Guchchhogram the rehabilitation project had been completed in 2014 for only 40 families. But at present there live only 14 families. More than 50% households of Golna and Shalhati communities left their community.

Family Type of the households of these communities are-

Nijbari	Before relocation: 42% single & 57% joint.	After: 75% single & 25% joint
Pacharhat	Before relocation: 37% single & 63% joint.	After: 68% single & 32% joint
Golna	Before relocation: 82% single & 17% joint.	After: 94% single & 6% joint
Shalhati	Before relocation: 58% single & 42% joint.	After: 92% single & 8% joint



### Housing Condition and people's perception

At Pacharhat Adarshagram, first relocated 50 families were given 6 dec. & the secondly relocated 50 families were given 8 dec. land. All of them got a two-room home which dimension was more than about 11' x 10' and a kitchen and a toilet. All the homes had identical design and structure from the govt. At Nijbari Guchchhogram, all the 80 families were given a home on 3.25 dec. land, but at Golna and Shalhati Guchchogram all the households were given home on 4 dec. land. In the home there were two attached rooms (11' x 10'), a kitchen, a veranda, a toilet, and the rest area was considered as yard (Field survey, 2018). All the homes had identical design and structure from the govt. At pacharhat, almost all the govt. provided homes collapsed within 10 years. The respondents repaired their homes and added extra rooms within the fixed land area. At Nijbari, about 85% homes started to distort after 3-4 years. Almost all the households repaired their homes at their own cost. More than 90% families had built additional rooms. At Golna and Shalhati guchchogram, more than 75% homes started to distort within 1-2 years. Almost 30% families have built additional rooms. Many couldn't build extra room for the lack of money and some became discouraged for the sandy soil, even all they need extra room. The new rooms were made of bamboo, tin, or clay. Households who couldn't make additional room, repaired their home according to their ability. Besides additional room, they built tin or bamboo shed for multiple usage; sitting, tailoring, keeping livestock and poultry, etc.



Fig 5: Housing deteriorating due to sandy soil at Shalhati Cluster village

At pacharhat, almost all the govt. provided homes collapsed within 10 years. The respondents repaired their homes and added extra rooms within the fixed land area. At Nijbari, about 85% homes started to distort after 3-4 years. Almost all the households repaired their homes at their own cost. More than 90% families had built additional rooms. At Golna and Shalhati guchchogram, more than 75% homes started to distort within 1-2 years. Almost 30% families have built additional rooms. Many couldn't build extra room for the lack of money and some became discouraged for the sandy soil, even all they need extra room. The new rooms were made of bamboo, tin, or clay. Households who couldn't make additional room, repaired their home according to their ability. Besides additional room, they built tin or bamboo shed for multiple usage; sitting, tailoring, keeping livestock and poultry, etc.

Table 1: Number of additional rooms constructed by the households in percentage

No. of Additional rooms constructed	Households in %			
	Pacharhat	Nijbari	Golna	Shalhati
1 room		34	12	60
2 rooms	20	40	26	20
3 or more rooms	67	10		10
Only tin/ bamboo shed	30	16	63	70

Source: Field Survey, 2018

Table 2: Satisfaction level on housing

Satisfaction Level	Pacharhat	Nijbari	Golna	Shalhati
Satisfied	73%	82%	18%	25%
Dissatisfied	17%	4%	50%	58%
No Comment	10%	14%	32%	17%

Source: Field Survey, 2018

Satisfaction level on housing condition were higher in both Pacharhat and Nijbari communities. The significant reason behind this was that, the people could bear the cost of repairing and modifying their homes. Only a few percent households were dissatisfied as the 110sq feet room weren't sufficient for their joint family. But at the Golna and shalhati, more than 50% households were dissatisfied. Besides the reason of tiny room and small homestead area, structures on sandy soil, very poor and low quality of building materials, location on flood prone area, were the prime factor for dissatisfaction and low income. Due to poverty, they could hardly bear the repairing and modifying cost.

### Income Level

There occurred a notable change in monthly income after relocation in consideration of monthly income in before- relocation. Some had changed their occupation after relocation, where the most hadn't, who were relocated from the adjacent areas. Changes in family size after relocation is one significant cause for the change of family income and occupation.

Table 3: Monthly income in US \$.

	Pacharhat		Nijbari		Golna		Shalhati	
	Before	After	Before	After	Before	After	Before	After
Minimum	25.00	90.00	45	80	50	50	50	50
Maximum	60.00	150.00	300	325	150	135	110	135
Mean	39	127	114	135	107	103	87	122

Source: Field Survey, 2018

Table 4: Poverty condition in the study area (% of household)

	Pacharhat		Nijbari		Golna		Shalhati	
	Before	After	Before	After	Before	After	Before	After
<1.9\$ (Extreme poor)	13	0	14	0	18	12	25	9
2-4\$ (Lower poor)	53	17	75	86	29	76	75	58
4-10\$ (poor)	34	63	0	0	53	12	0	33
11-20\$ (Middle class)	0	20	11	14	0	0	0	0

Source: Field Survey, 2018

In every project area percentage of extreme poor household has been reduced and in two project area it totally removed. At Pacharhat cluster village 20% households become middle class people after the land reform project. There is positive impacts on their income though household's opinion on their income level change differed from community to community due to various reasons like distance of nearest working place, availability of land for agriculture etc.

In figure 6 and 7 it has been seen that due to unavailability of job opportunity, unproductive land pull the residence to other places.

Table 5: The change in income level of households (in %)



Fig 6: People left home for unavailability of livelihood at Golna



Fig 7: People left home for unavailability of livelihood at Shalhati

Income level	Communities			
	Pacharhat	Nijbari	Golna	Shalhati
Increased	87%	100%	40%	25%
Decreased	No	No	30%	17%
no change	13%	0%	30%	58%

Source: Field Survey, 2018

Relocation put a significant impact on income and income range of the households. There occurred a notable progress in monthly income after relocation at Pacharhat and Nijbari. Some people had changed their occupation after relocation. After relocation maximum people were engaged in multiple occupations. Two communities, Golna and Shalhati, mixed impacts occurred. At Golna income decreased for 30% families after relocation due to changes in working place and working opportunity. Amongst the 3 extreme poor families only 1 improved after relocation but others remained extreme poor. At Shalhati Guchchhogram, there is a little change in economic condition after relocation. Many people had changed their occupation. After relocation income significantly increased only for the 40% families. About 10% extreme poor families were found after relocation. Even after getting relocation plot about half of the relocated people rushed towards urban areas for income opportunity.

### Employment Sectors

Earlier work in Bangladesh shows that agricultural wage laborers are typically the poorest occupational group (Hossain, 1995); There occurred significant change in income patterns of the male family members (head of the house), who are living in the village. In all the

villages, dependency on agriculture had been decreased. Employment decreased in agriculture as many people rushed towards Dhaka and other urban areas, and some started day laboring. The households, whose income increased, had at least one member working in urban or industrial areas

Table 6: Households (in %) dependency on various earning sources

Projects	Agriculture		Non- agriculture		Labor in outside		Labor in locality	
	Before	After	Before %	After	Before	After	Before	After
Pacharhat	47	27	13	30	10	13	90	87
Nijbari	17	5	21	43	14	7	85	93
Golna	45	12	45	70	7	20	93	80
Shalhati	75	40	30	65	30	40	70	60

Source: Field Survey, 2018

Most of people earned through multiple occupations; sometimes they do rickshaw pulling, do farming or day laboring. They couldn't cultivate land all over the year, most of them had no agricultural land. They had to borrow others' land in terms of condition. So, their income patterns vary from season to season. Laboring in local areas increased only at Nijbari because it is located besides industrial zone, again diversified occupations also found there.

### Training on Income Generating Activities (IGA)

The training for men on income generating activities (IGA) and social awareness is to be done in 3 steps through total 8 days. There must be a gap of 2 month between two each step. We can see that the relocated men were trained on only a very few topics and the most of the people are not satisfied on the training. They claimed that the training was done in a very short time and finished quickly. There was a little gap between the training steps.

Table 7: IGA training occurred in study area

Community	Training topics	Days	Gap between step
Pacharhat	Poultry and cattle farming	2	No gap
Nijbari	vegetable gardening, fisheries and poultry farming	7	2
Golna	Fisheries and livestock farming	2	1
Shalhati	Fisheries, livestock farming and home gardening	2	No gap

Source: Field Survey, 2018

The relocated men were trained on only a very few general topics and the most of the people are not satisfied on the training. There were no effective training on any important subject like non-farming activities. The trainings were done in a very short time and finished quickly. There were little gaps between the training steps. Only at Nijbari, 20 women got training on tailoring for 2 months, and at Pacharhat about 20% women got tailoring training for a week. At Golna, about only 5 women got tailoring training. But, at Shalhati there were no such training.

Table 8: Respondents opinion on IGA trainings

Public Opinion	Communities			
	Pacharhat	Nijbari	Golna	Shalhati
Satisfied	17%	11%	0%	0%
Dis-satisfied	67%	57%	81%	70%
No Comment	16%	32%	19%	30%

Source: Field Survey, 2018

### Micro Credit Loans Facilities

Besides IGA training, all the households were provided micro-credit loan for self-employment and developing living condition. Bangladesh Rural Development Board (BRDB) had been given the responsibility of this work. The relocated people got only 7000- 10000 taka loan with interest. People could not run any livelihood project by this little amount of money, where about 50% people of Golna and Shalhati could not repay the loans due to poverty. Due to isolation and remote location, NGOs and financial organizations don't come to such communities. Thus, the families can't get enough financial help. Most of the families borrow from local moneylenders on too much higher interest rate. People claimed that local authorities hardly provide them govt. financial support like widow allowance, adult allowance etc. as they live in govt. land.

Table 9: Micro financial service opportunities-

Community	Widow allowance	Adult allowance	FFW	VGF	NGO
Pacharhat	YES	YES	YES	YES	YES
Nijbari	YES	YES	NO	NO	YES
Golna	NO	NO	NO	NO	NO
Shalhati	NO	NO	NO	NO	NO

Source: Field Survey, 2018

### Food Security

In a survey conducted by DPHE in 1998-99 in collaboration with the British Geological Survey and Mott MacDonald Limited, Nilphamari was found in the list of the least affected districts (Abedin and 2013). The Bangladesh standard for iron in drinking water is 0.3 - 1.0 mg/L. According to Bangladesh National Drinking Water Quality Survey, 2009, there are some places in Domar, Dimla, Saidpur Upozilla, contaminated with iron (Fe) exceeding .3 and 1.0 mg/L, where Bangladesh standard is 0.3- 1.0 mg/L.

Table 10: Households (in %) on food security levels of the communities

Food options	Pacharhat		Nijbari		Golna		Shalhati	
	Before	After	Before	After	Before	After	Before	After
Rice production	37	47	14	22	18	6	30	10

Vegetable gardening	17	27	43	22	24	0	20	10
Fruit tree	30	47	21	14	24	0	30	0
Safe drinking water	100	36	100	64	35.	29	40	50
Poultry	46	47	54	36	41	18	50	30
Livestock	64	47	29	18	35	12	40	40

Source: Field Survey, 2018

Except Nijbari, in the other three cluster village people cannot cultivate due to soil quality. In golna soil is fragile and sandy, in shalhati soil is totally sandy and have not enough space for gardening. Rice production was seasonal; the households have to rent others land. Here safe water is counted without considering iron (Fe) contamination. Both at Golna and shalhati, before relocation some families jointly installed deep tube well in their previous houses. It was an easy source of safe drinking water. After relocation, joint families separated and many single families can't bear the cost of installing personal tube well in this sandy soil. Contamination of iron (Fe) is also a common problem here.



Fig 8: Vegetable gardening at Nijbari

### Distance to the nearest community facilities

Due to locational disadvantages, many households hardly get facilities and deprived of opportunities for developing their status. Sometimes long distance discouraged people of receiving better services. Education is a key determinant of wage rates and household income in both HIES 2000 and 2005 (Al-Samarrai, 2007). Due to long distance children's are discouraged to go for higher education after completing primary level.

**Table 11: Distance of various service centers from the selected communities**

Service centers	Distance of the nearest one (km)			
	Pacharhat	Nijbari	Golna	Shalhati
Primary school	.5	.5	1	1.5
High school	10	3.5	2	6
Village clinic	4.5	4	7	6
Hospital	10	5	15	12
Police station	10	4	15	12
Post office	4.5	4	2	6
Bazar	4	.1	1	5.5
Financial offices	10	4	7	12
Nearest town	10	4	15	12

Source: Field Survey, 2018

### Conflicts Among Neighbors

There were many reasons for conflicts among the neighbors. Many respondents answered single reason for conflict, where some answered multiple reasons.

**Table 12: The reasons of conflicts (where one household might show multiple reasons)**

	Reasons of conflicts (in %)				
	Waste management	Tubewell & washroom	Used water management	Poultry & livestock	Others
Pacharhat	27	57	10	27	9
Nijbari	20	65	18	25	6
Golna	30	60	0	20	23
Shalhati	10	40	30	0	30

Source: Field Survey, 2018

Conflicts mainly occur for tubewell & washroom sharing. Immediately after relocation, as multiple families used only 1 tube well (installed by the project), in some cases, the sharing family number vary from 8 to 12. 10 tube wells for 80- 100 families including about 400 persons was pathetic, especially embarrassing situation for the women.

### Availability of Sanitation Facilities

All the household families were provided with a personal toilet (pit latrine) by govt., typically about 7 feet deep and the rings were made of cement concrete, and the surrounding wall is made of tin. Almost 65% toilets were damaged within 5 years due to poor materials and weak construction.

Table 13: Statistics of households having toilet facilities

	Pacharhat		Nijbari		Golna		Shalhati	
	Before	Present	Before	Present	Before	Present	Before	Present
Households having personal latrine	20%	97%	33%	100%	29%	68%	30%	50%

Source: Field Survey, 2018

Sanitation condition significantly developed in first two communities. In the other communities the situation is not satisfied due to poverty and lack in knowledge.

### Education Facility

The educational facilities within or near the communities were somewhat dissatisfying. Again, poverty was a vital obstacle for education. Only a few could study after class-v. In some families, all the children were deprived of basic education due to poverty. There were

many families, where at least one child can't go to school due to poverty, again, in many families at least one child drops out after class-v.

Table 14: A short statistic of households dropping out from education

Community	Dropped out After Class-V	Not Going to School
Pacharhat	40.00%	20.00%
Nijbari	25.00%	10.71%
Golna	43.75%	18.75%
Shalhati	40.00%	20.00%

Source: Field Survey, 2018

Rate of deprivation from education is higher at Golna and Shalhati because of poverty and lack of employment.

### Conclusion & Recommendation

The cluster village projects is contributing significantly to provide shelter to the landless families. But, there need of some necessary supports to the beneficiaries for increasing their livelihood security. As govt. wants to bring them to the mainstream societies, there are lacking in some strategies like- selection of place, homestead area, employment opportunities, vocational training, supervision etc. Due to corruption in implementing and creating such villages, the theoretical objectives have become difficult to achieve. The newer proposed cluster villages should be planned in a way in which the priority setting should be based on income generation rather than only housing facility. The findings of the study will help in further developing of the landless people and future relocation projects.

This study has tried to evaluate what extent and how much socio-economic condition changed in the selected cluster villages. Again, another objective of this study is to provide necessary guidelines for the perfectiveness of this projects. Only a few communities provide the beneficiaries with potentiality for income generation, where the remote communities can't provide. The following suggestions and ideas are resulted from the study of the research can be executed to ensure better output from the projects. Recommendations have been given on existing state-led approach-

- Location is an important fact for income and other livelihoods. The rootless people should be relocated near economic zone or urban area, so that they can get easily better employment, as well as educational facilities, better health care, and other livelihoods.
- The relocated families should be provided with more effective and better IGA and vocational training. Only 7 days training is not enough for these illiterate people.
- Strong regular monitoring by local administration is needed to check up their regular socio-economic condition up to 5-10 years. Such monitoring will help to reduce various constrains and corruption in the communities.



- In remote areas, where there is little scope for better income, the households should be provided larger amount of homestead land, so that they can earn by small industries or home gardening.
- In the remote and rural areas, the rootless and landless families should be provided cultivable land along with homestead land. Then most of the families will not shift to urban areas for employment.
- Checking the levels of arsenic and iron contamination should be measured according to Bangladeshi standard before installing tube wells, as well as selecting project location.
- When the provided homestead land will be too much little or less than 4 dec., strategic housing type can be followed. Such as- two storied houses (using tin, and RCC pillar) instead of traditional one storied house. In such strategic houses, joint families with a large number of members can easily accommodate in one home.
- They should be provided with necessary utilities like electricity, better road connection, etc. If they have electricity, they can build small cottage industries, launch small businesses easily, or create newer profession.
- Selecting families to be relocated without corruption and nepotism so that no solvent family can't get plot.
- Providing adult allowance card, widow card, and VGF and FFW opportunities.
- Relocation besides previous location with income generation opportunities. Such idea was collected from the recent relocation by Delhi Development Authority.
- Increase awareness and provide basic education can help them uplifting their condition.
- Corruption must be checked during implementation and relocation.
- There needs a provision so that the president and secretary of such community must be responsible to the community dwellers for his management.
- Review of the theoretical premise of such project's accordance with present economic condition of the country.

The cluster village projects is contributing significantly to provide shelter to the landless families. But, there need of some necessary supports to the beneficiaries for increasing their livelihood security. As govt. wants to bring them to the mainstream societies, there are lacking in some strategies like- selection of place, homestead area, employment opportunities, vocational training, supervision etc. Due to corruption in implementing and creating such villages, the theoretical objectives have become difficult to achieve. The newer proposed cluster villages should be planned in a way in which the priority setting should be based on income generation rather than only housing facility. The findings of the study will help in further developing of the landless people and future relocation projects.

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## Urbanization Impact on Wetlands: A Case Study on Dhamrai Paurashava

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Sabrina Sharmin\*\*\*

**Abstract:** Dhamrai Paurashava is a suburban area beside the Dhaka City. As a locational advantage, the growth of this Paurashava is increasing rapidly which is not managing in a planned way. There existed a large number of water bodies including ponds, rivers, khals, lakes and low-lying areas. This study makes an attempt to identify the urban wetlands, emphasizing on the extent of their changes and subsequent impacts on physical environment of the area. For ascertaining the land-use pattern of the Paurashava, this study used Google Earth satellite images and prepared land use map (2004, 2010 and 2017). The study observed that the wetlands of Paurashava are changing very quickly. In 2004, the permanent wetland was 10.01% (174.04 acres) but in 2010 and 2017 this became 7.79% (135.51 acres) and 5.66% (98.35 acres) respectively which indicates that the water bodies continued to decrease. During these 14 years, 43.49% (75.69 acres) permanent wetland has decreased. It also revealed that 24.08% (209.44 acres) of agricultural land has decreased during this time period. This changing trend of wetlands makes the drainage system of Paurashava vulnerable, creating water logging problems and their consequences. The study concluded that there is need for wise use of wetland resources and wetland policies should be fully integrated into the planning process across all disciplines.

**Key words:** Wetlands, Wetland Changes, Water Logging, Environment.

### Introduction

Urbanization is a common process of global social transformations of the present society. From an overwhelmingly rural dominance in 1900, the world has fast transformed itself into an urban society. Today in the world as well as Bangladesh, the process of urbanization is accelerating rapidly (UNFPA, 2016). In 1974, the proportion of the urban area's population of Bangladesh was only 9 percent and it increases to a figure of 28 percent in 2011 (BBS, 2011) which reflects a fundamental change in the nature of the economy and society.

Wetlands are among the Earth's most productive ecosystems. The significance of wetlands lies in their roles in the hydrological cycle, for flood and biomass production. They support biological diversity, water quality, nutrient cycling, flood mitigation, and carbon sequestration. Innumerable species, including rare and sensitive species, depend on wetland environments (Bartzen et al, 2010).

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Wetland ecosystems, including rivers, lakes, floodplains and marshes, provide many services that contribute to human well-being and poverty alleviation (Millennium Ecosystem Assessment, 2005). Despite the significance of wetlands, total global wetland area is decreasing more rapidly than any other type of ecosystem (Ehrenfeld, 2000).

Within a process of rapid urbanization Bangladesh is faced with the constant threat of encroachment to wetland all around the city by the public and private sectors to accommodate housing and commercial facilities to the growing population. (The Daily Star, 2016). Dhaka and its fringe and suburban areas (like Dhamrai Paurashava) are consisting of many wetlands, rivers, and channels. These wetlands, rivers and channels are reducing rapidly due to urbanization (Fazilatunnesa, 2011).

### Objectives of the Study

The overall objective was to determine the impacts of urbanization on wetlands in the study area. Specific objectives include:

- To determine the changing patterns of wetlands in the study area.
- To investigate urbanization effects on wetlands in the study area.
- To identify essential measures to put in the study area to conserve wetlands.

### Methodology

In this study, both primary and secondary sources of data have been used. To fulfill the objective of this study, the Land use maps of 2004, 2010 and 2017 were derived by using Google Earth Satellite images. Google Earth satellite images were digitized by Arc GIS 10.5 software to prepare land use map of the study area. Besides some maps and secondary data were collected from the Paurashava and Upazila Offices. The detail information of used maps and images for this study are listed in the following table.

Table 1: Details of the Collected Google Earth Satellite Image

Respective Year	Date Acquired (Month)	Path/ Row	Resolution
2004	October	Google Earth Explorer	Maximum 1800*2117
2007	October	Google Earth Explorer	Maximum 1800*2117
2017	October	Google Earth Explorer	Maximum 1800*2117

Source: Prepared by Authors, 2018

To fulfill the objectives data was collected from primary sources. Primary data has been collected through reconnaissance survey, observation survey, questionnaire survey, existing land use survey and key personnel interview survey. Around 211 respondents were surveyed. The sampling size was calculated for 90% confidence level. After completion of primary data collection from the field, the interviewed questionnaires were processed using SPSS and Microsoft Excel.

## Geographical Location of Study Area

The study area Dhamrai Paurashava, was established in the year 1999. GOB declared it a ‘C’ class Municipality. Recently it has become “A” class municipality. Dhamrai Paurashava is located within the Dhaka Zila at a distance about 39 km. from G.P.O (zero point) and on the north-west part of Dhaka Zila. It lies between 23°50' and 24°02' north latitude and 90°02' and 90°14' east longitude. The river Bangshi is effluent to the north and east side of the Paurashava. It has an area of about 7.03 sq.km (1738.32 acre).

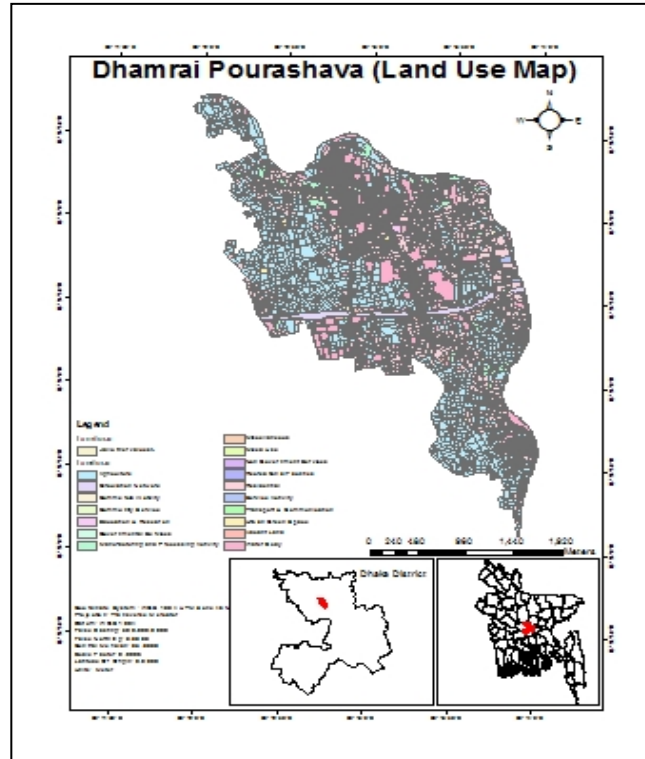


Figure 1: Location of the Study Area (Source: Dhamrai Paurashava Office, 2018)

## Impact of Urbanization on Wetlands

Bangladesh’s environment is under threat from natural causes compounded by man-made excesses owing to the pressure of population. Man-made threats to the environment include deforestation; pollution of air, water, and land; over-fishing; encroachment of rivers; conversion of wetlands into lands for agriculture and construction of buildings; over-utilization of groundwater; obstruction of drainage channels in urban areas; land degradation due to unbalanced use of chemical fertilizers, and also as a consequence of monoculture; and population pressure on land and other natural resources (GoB, 2012).

Urbanization impacts wetlands in numerous direct and indirect ways. For example, construction reportedly impacts wetlands by causing direct habitat loss, suspended solids additions, hydrologic changes, and altered water quality (Darnell, 1976). Indirect impacts,

including changes in hydrology, eutrophication, and sedimentation, can alter wetlands more than direct impacts, such as drainage and filling (Keddy, 1983). Urbanization may affect wetlands on the landscape level, through loss of extensive areas, at the wetland complex level, through drainage or modification of some of the units in a group of closely spaced wetlands, and at the level of the individual wetland, through modification or fragmentation (Weller, 1988).

Rapid urbanization due to large scale land use change, particularly in developing countries becomes a matter of serious concern since urbanization drives environmental change at multiple scales (Dewan et al. 2012). As population concentration in urban areas is growing persistently across the world and putting tremendous pressure particularly on land resources, rich understanding on the history and processes of land use change can help plan for better land management and the reduction of impacts on the environment. Dhaka, the capital of Bangladesh, has been experienced break-neck urban growth through restricted area land filling in the last few decades that resulted many adverse impacts on the land markets and social and environmental arena (Alam, 2018). As like as Dhaka the Dhamrai Pourashava has also been experienced filling on wetlands in the last few years that resulted many adverse impacts on social and environmental effects.

## Results and Discussions

### Land Use Change during 2004-2010

By comparing land use data from the prepared land use map 2004 and land use map 2010 (Figure 2); it can be observed that Residential, Commercial Activity, Manufacturing and Processing Activity, Transport and Communication and Others Built-up Area has increased respectively 82.71 acres (17.35%); 6.81 acres (42.45%); 7.21 acres (12.29%); 8.64 acres (11.88%) and 6.23 acres (24.45%). On the others hand, Agricultural, Vacant Land and Water Body has decreased respectively 57.12 aces (6.57%); 15.78 acres (34.97%) and 38.53 acres (22.14%). These 7 years 38.53 acres (22.14%) permanent water body has decreased which is encroached by residential, Commercial and others activities. The following Table 2 shows the details.

Table 2: Land Use Change during 2004-2010

Land use Type	2004		2010		Changes in Area During 2004-2010 (Acres)	Changed area (%) in context of based year
	Area (acres)	Percentage (%)	Area (acres)	Percentage (%)		
Agriculture	869.75	50.03%	812.63	46.74%	-57.12	-6.57%
Residential	476.70	27.42%	559.41	32.17%	+82.71	+17.35%
Commercial Activity	16.04	0.92%	22.85	1.31%	+ 06.81	+42.45%
Manufacturing and Processing Activity	58.65	3.37%	65.86	3.79%	+ 7.21	+12.29%
Transport and Communication	72.73	4.18%	81.37	4.68%	+ 8.64	+11.88%
Others Built-up Area	25.48	1.47%	31.71	1.82%	+ 6.23	+24.45%
Vacant Land	45.13	2.60%	29.35	1.69%	-15.78	-34.97%
Water Body	174.04	10.01%	135.51	7.79%	-38.53	-22.14%
Total	1738.52	100.00%	1738.68	100.00%	-	-

Source: Google Earth Satellite Image 2004 and 2010, Prepared by Authors, 2018  
 Changed area (%) in context of based year = (Changes in area during 2004-2010/ Area in 2004) \*100

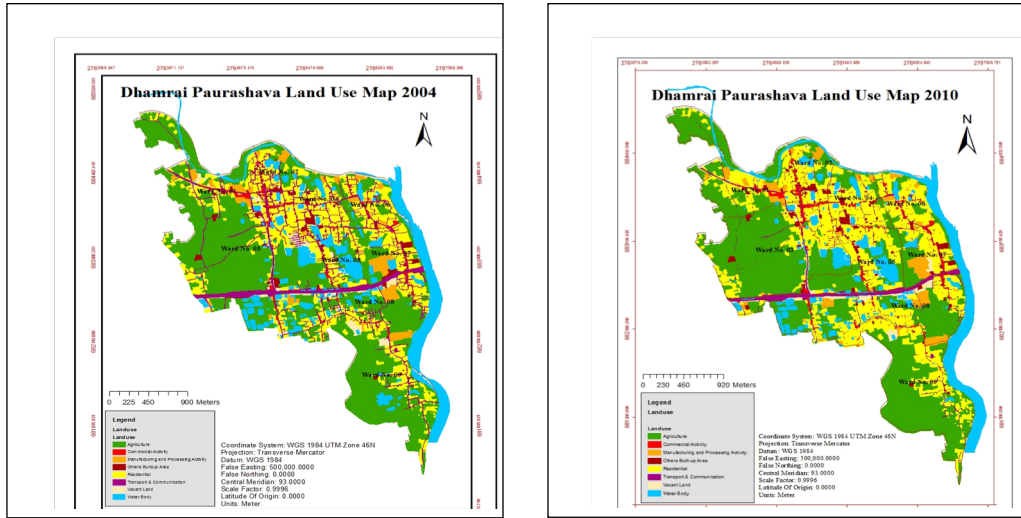


Figure 2: Land Use Map from 2004 to 2010.

Source: Google Earth Satellite Image 2004 and 2010

**Land Use Change during 2010-2017**

Prepared land use map data between 2010 and 2017 (Figure 3) are compared and it was observed that Agriculture and Water Body has decreased respectively 152.32 acres (18.74%) and 37.16 acres (27.2%); while remaining others land use has increased respectively Residential 71.94 acres (12.86%), Commercial Activity 10.80 acres (47.26%), Manufacturing and Processing Activity 29.90 acres (45.40%), Transport and Communication 5.93 acres (7.29%), Others Buildup Area 49.58 acres (156.35%), and Vacant Land 21.33 acres (72.67%). The following Table 3 shows the details.

Table 3: Land Use Change during 2010-2017

Land use Type	2010		2017		Changes in Area During 2010-2017 (Acres)	Changed area (%) in context of based year*
	Area (acres)	Percentage (%)	Area (acres)	Percentage (%)		
Agriculture	812.63	46.74%	660.31	37.98%	-152.32	-18.74%
Residential	559.41	32.17%	631.34	36.31%	+71.94	+12.86%
Commercial Activity	22.85	1.31%	33.66	1.94%	+10.80	+47.26%
Manufacturing Activity	65.86	3.79%	95.76	5.51%	+29.90	+45.40%
Transport and Communication	81.37	4.68%	87.30	5.02%	+5.93	+7.29%
Others Built-up Area	31.71	1.82%	81.28	4.67%	+49.58	+156.35%
Vacant Land	29.35	1.69%	50.68	2.91%	+21.33	+72.67%
Water Body	135.51	7.79%	98.35	5.66%	-37.16	-27.42%
Total	1738.68	100.00%	1738.68	100.00%	-	-

Source: Google Earth Satellite Image 2010 and 2017, Prepared by Authors, 2018  
 Changed area (%) in context of based year = (Changes in area during 2010-2017/Area in 2010)\*100



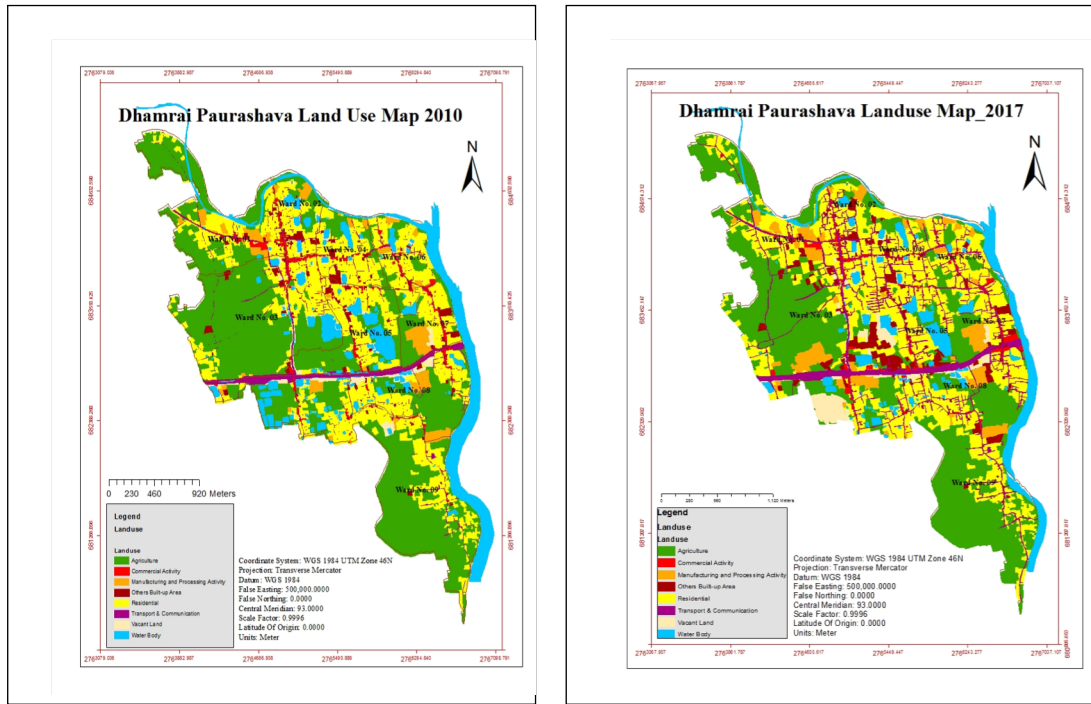


Figure 3: Land Use Map 2010 to 2017.

Source: Google Earth Satellite Image 2010 and 2017.

**Land Use Change during 2004-2017**

Urbanization was expanded rapidly during these 14 years in the study area. It is noticed that Residential, Commercial, Manufacturing, Transport and Others Built-up Area has increased respectively 154.64 acres (32.44%); 17.62acres (109.85%); 37.11acres (63.27%); 14.57acres (20.03%) and 55.80acres (219.00%). In 2004, Agricultural land and Water body was respectively 869.75 acres (50.03%) and 174.04 acres (10.01%). But in 2017 Agricultural land and Water body was found respectively 660.31 acres (37.98%) and 98.35 acres (5.66%). During this period of time total agricultural land has decreased 209.44aces (24.08%) and water body has decreased 75.69 acres (43.49%). The following Table 4 shows the details.

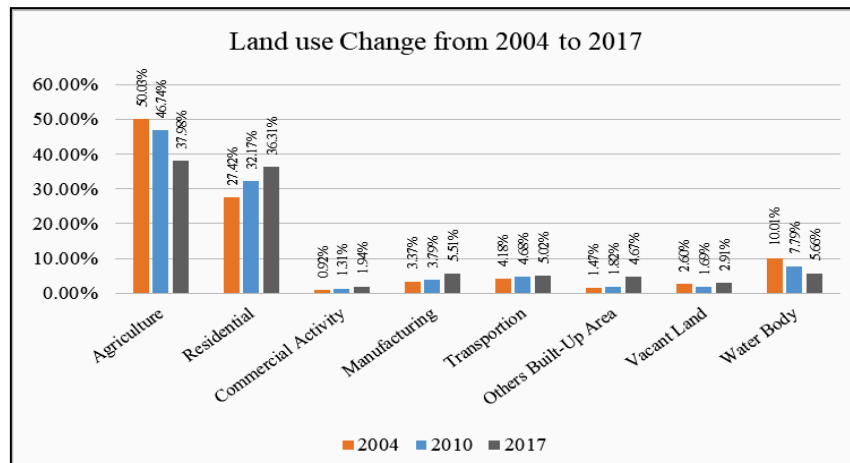
Table 4: Land Use Change during 2004-2017

Land use Type	2004	2010	2017	Changes in Area During 2004-2010 (Acres)	Changes in Area During 2004-2017 (Acres)	Changed area (%) in context of based year*
	Area (acres) & Percentage (%)	Area (acres) & Percentage (%)	Area (acres) & Percentage (%)			
Agriculture	869.75 50.03%	812.63 46.74%	660.31 37.98%	-57.12	-209.44	-24.08%
Residential	476.70 27.42%	559.41 32.17%	631.34 36.31%	+82.71	+154.64	+32.44%
Commercial Activity	16.04 0.92%	22.85 1.31%	33.66 1.94%	+ 06.81	+ 17.62	+109.85%
Manufacturing and Processing Activity	58.65 3.37%	65.86 3.79%	95.76 5.51%	+29.90	+ 37.11	+63.27%
Transport & Communication	72.73 4.18%	81.37 4.68%	87.30 5.02%	+5.93	+ 14.57	+20.03%
Others Built-up Area	25.48 1.47%	31.71 1.82%	81.28 4.67%	+49.58	+ 55.80	+219.00%
Vacant Land	45.13 2.60%	29.35 1.69%	50.68 2.91%	+21.33	+5.55	+12.29%
Water Body	174.04 10.01%	135.51 7.79%	98.35 5.66%	-37.16	-75.69	-43.49%
Total	1738.52 100.00%	1738.68 100.00%	1738.68 100.00%	-	-	-

Source: Google Earth Satellite Image, Prepared by authors, 2018;

\* Changed area (%) = (Changes in area during 2004-2017/ Area in 2004)\*100

From the computed land use data (Table 4), it is revealed that agriculture and water body are decreasing rapidly whereas residential, commercial, manufacturing, transport and communication and others built-up area are increasing gradually. The following figure 4 shows the land use changing pattern of the stud area during 2004-2017.



Source: Google Earth Satellite Image 2004, 2010 and 2017

Figure 4: Land use changing pattern of the stud area during 2004-2017.

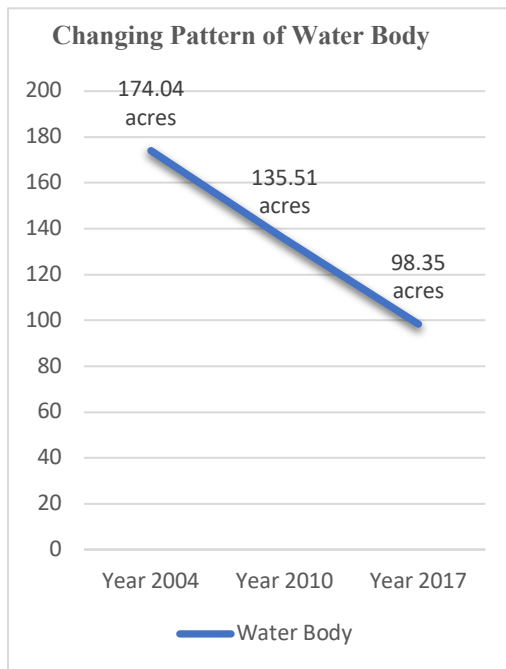
## Wetland Change in the Study Area

### Permanent Water Body Change

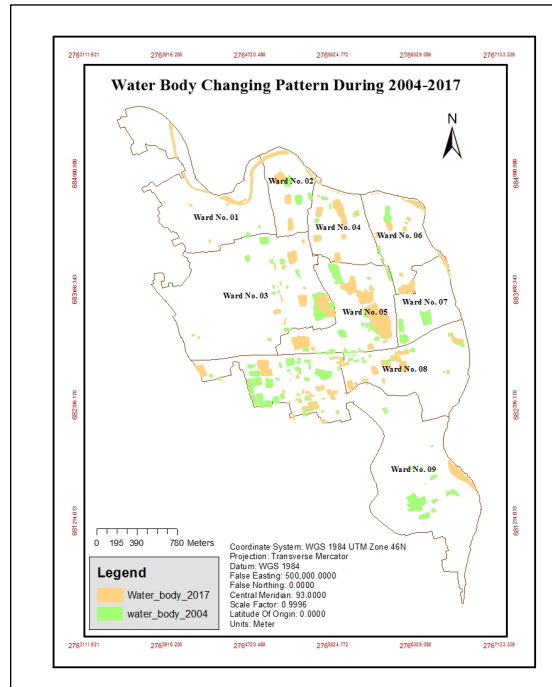
From the above computed land use data, it can be easily revealed that the water body of the study area are decreasing day by day. In 2004, total permanent Water Body was 174.04 acres which was 10.01 % of the study area. But in 2010 it was found 135.51 acres which was 7.79% of the study area. Comparing between 2004 and 2010, it is seen that the Water Body has been decreased 38.53 acres. This decreasing rate is 22.14% within only 7 years and it is 3.16% per annual.

Comparing the data, it is seen that the water body between 2010 and 2017 has been decreased 37.16 acres and this decreasing rate is 27.42% within 7 years and per annual 3.91%.

Finally, from 2004 to 2017 within 14 years on the study area the Water Body has been lost 75.69 acres which decreasing rate is 43.49% and annually 3.10%. Figure 5 and 6 showing the detail about changing pattern of permanent water body during 2004 to 2017.



Source: Google Earth Image 2004; 2010; 2017.  
Prepared by Authors, 2018  
Figure 5: Changed of Permanent Water Body.



Source: Google Earth Image 2004 and 2017, Prepared by Authors, 2018  
Figure 6: Changing Pattern of Permanent Water Body during 2004-2017

### Agricultural Land Change

Bangladesh is a signatory to the Ramsar Convention on Wetlands, which promotes the conservation and wise use of wetlands and their resources. The Ramsar Convention uses a broad definition of wetlands, which includes lakes, rivers, swamps, peatlands, estuaries, rice paddies, coral reefs, mudflats, water reservoirs and constructed wetlands. Wetlands do not need to be permanently inundated (DoE, Australia). In Bangladesh, many wetlands are ephemeral and remain dry for years at a time. The seasonal agricultural land is a rotating system, where lands were used for crop production and then left for the recovery for a certain period of time. During the recovery period, it remained as a bare soil and then passes to wetland or vegetation land as a natural succession (Islam et. al 2011). A major part of the study area land cover is agricultural land. Most of these Agricultural lands of the study area are used as a temporary wetland in the rainy season which are converting Residential, Commercial Activity, Manufacturing and Processing Activity, Vacant Land, Transport and Communication and Others Built-up Area. From the computed land use data, it is seen that in 2004 total agricultural land was 869.75 acres (50.03%), in 2010 it was counted 812.63 acres (46.74%) and in 2017 it was found 660.31 acres (37.98%). During these 14 years 209.44 acres (24.08%) agricultural land has decreased.

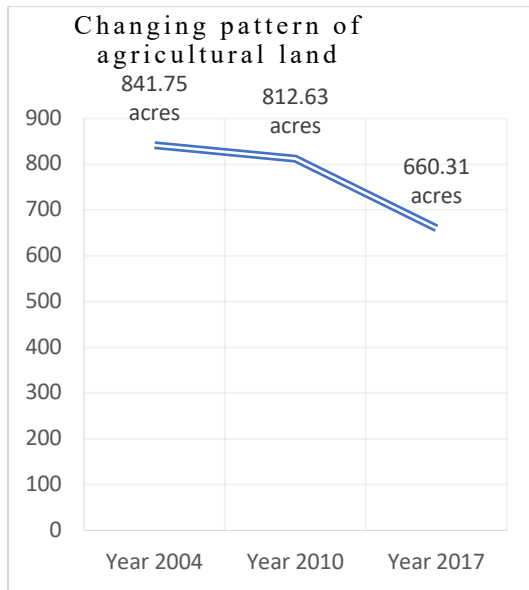


Figure 7: Agricultural Land Change during 2004-2017

Source: Google Earth Image 2004, 2017

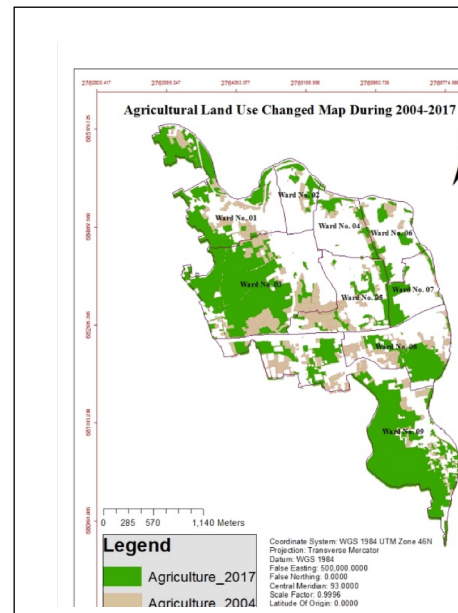


Figure 8: Changing Pattern of Agricultural Land during 2004-2017

Source: Google Earth Image 2004, 2017 and Prepared by Authors, 2018

### Causes behind the Water body Change

**Water body filling on The Study Area:** Low land filling is a common scenario in Bangladesh. In the study area wetlands are filling up gradually. Around 235 (95%) of respondents agreed that water body are filled up by various human activities. The following figure 9 shows the scenario of wetlands filling up



Source: Field Survey, 2018

Figure 9: Wetlands Filling up Scenario on The Study Area

**Constructions Activities on Wetlands:** A majority of respondent (about 217 respondent, 87%) agreed that indeed housing construction was taking place in wetland areas. The respondents who agreed that construction activities were being carried out on the wetlands also admitted that those activities benefited them as either as individuals or as a community, or both.

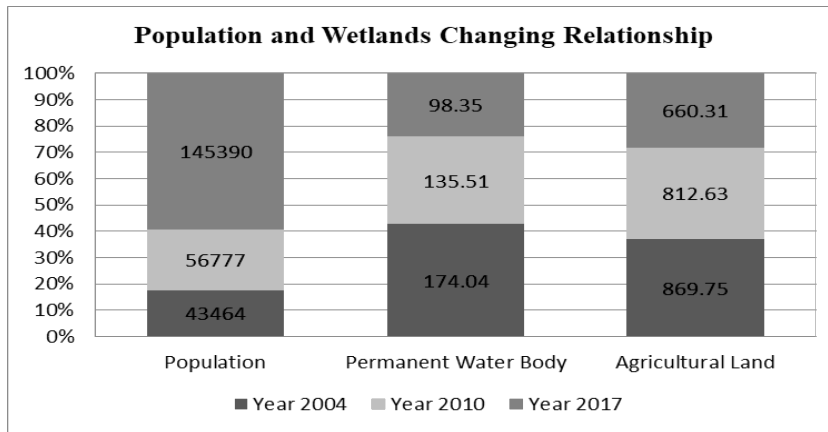


Source: Field Survey, 2018

Figure 10: Dominating Wetlands by Construction Activities

**Linkage between Population Changes and Wetlands Destruction:** A rapid population growth occurs in the recent past years in the study area. In the year 2001, 2011 and 2016 total population of the study area was respectively 43,464; 56,777 and 1,45,390 (BBS, 2001, 2011 and Eknajore Paurashava, 2016). During 2001-2016, total 1,01,926 populations

have increased in the study area. From the prepared land use map, it was found that in the year 2004, 2010 and 2017 total agricultural land was respectively 869.75 acres, 812.63 acres and 660.31 acres. During this time period 209.44 acres of agricultural land has decreased. At the same in the year 2004, 2010 and 2017 permanent water body was respectively 174.04 acres, 135.51 acres and 98.35 acres. During this time period 75.69 acres permanent water body has decreased. We can see a strong relationship that at the close time period where population has increased and water body and agricultural land has decreased. So, it can be saying that agricultural land and water body was converted to accommodate housing, commercial and other facilities to the growing population. The following figure 11 shows the details.

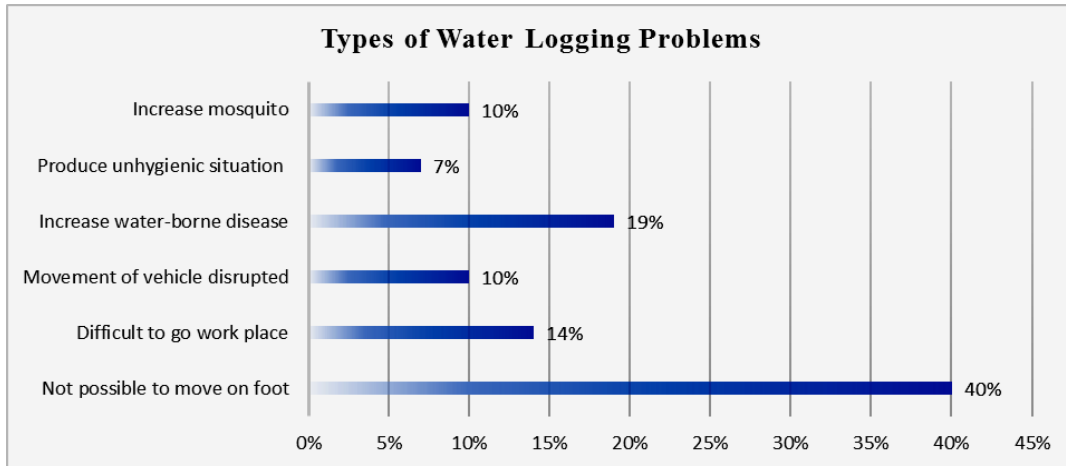


Source: BBS, 2001 and 2011, Dhamrai Paurashava, 2016 and Google Earth Image

Figure 11: Population and Wetlands Change Relationship

### Consequences of Wetland Change

**Water Logging and Drainage Problem:** From the satellite image analysis, it is observed that most of the low-lying parts of the study area have been filled up which were very important for the drainage system of the study area. According to the outcome of the questionnaire survey in the study area, it was found that 35% (88 respondents) of respondent agreed with the drainage and water logging problems. Again, highest number of respondents around 40% (100 respondents) answered that the situation become difficult to move on foot due to water logging in the rainy season. The following figure 12 shows the details.



Source: Prepared by Authors, 2018

Figure 12: Water logging problems on the study area

**Effects of Wetlands Change on Farming Sector**

In the study area, cropping patterns and amount of production has been changed due to wetland transformation. A large portion of the respondents 26% in the study area demanded that their crop land has been decreased due to wetland reduction. But most of the people around 33% claimed that impact of wetland loss on farming sector were reduction of crop land, crop production and fish production all of them.

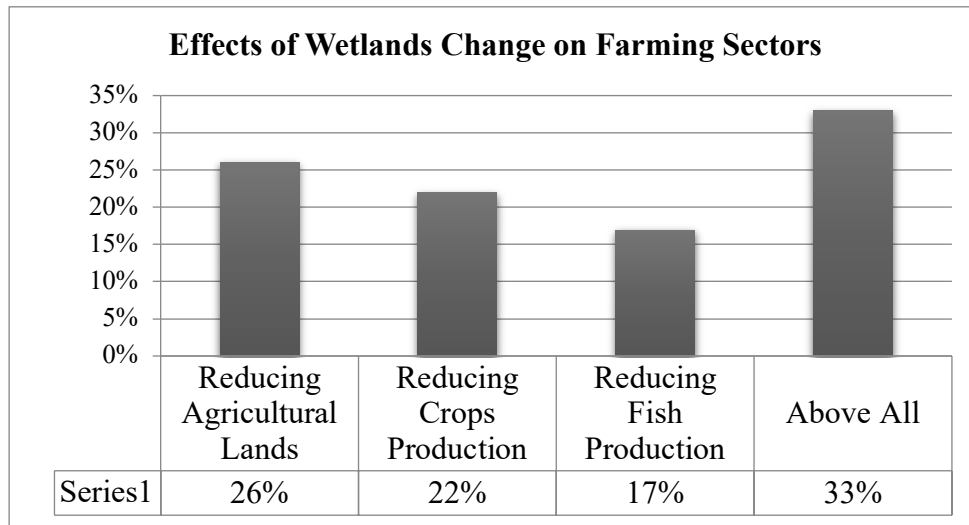


Figure 13: Effects of Wetlands Change on Farming Sector (Source: Field Survey, 2018)

## **Recommendations**

### **Existing Rules Regulations should be followed and implemented**

*Mega city, Divisional Town and District Town's municipal areas including country's all the municipal areas' playground, open space, park and natural water reservoir Conservation Act, 2000,*

Section 5 of this Act prohibited the changes of natural water bodies. Again, section 6 has said about the procedure to change natural tank. Punishment for such changes without approval from concerned authority is presented in the section 8. For preservation of natural water bodies in the Paurashava should follow this act strictly.

*Water act 2013*

The Water Act 2013 is based on the National Water Policy, and designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. As per this Act, all forms of water (e.g., surface water, ground water, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people. Paurashava government should follow this act.

*Private Residential land Development Rules, PRLD 2004*

As per subsection 3 of section 9 of chapter 3 of the PRLDR 2004, Water bodies and flows within the project area should not be hampered and its area cannot be reduced. Thus, the existing section is safeguarded for preserving the natural water body and does not hamper the flood flow zone. Private Residential Land Development Rule 2004 can be provided with an effective opportunity to regulate the unplanned development. With effective policies, regulations and the active participation of local people within Dhamrai Paurashava area, unplanned land development can be controlled. It is expected that the development rules and restriction should not only be in the written document but also come into enforcement and practice.

*Demarcation of Permanent Water body and Temporary Wetlands*

To protect the encroachment, it is necessary to demarcate all the permanent water body and temporary wetlands as soon as possible. This will ensure the conservation of wetland more appropriately and easily in the study area.

### **Implement the Paurashava Master Plan**

Dhamrai Paurashava has prepared a Master Plan for 2011-2031 which was approved by the government. Total 110.30 acres of land covering 7.85% of area is declared as water body up to year 2031. A total of 92 pond and ditches within the Dhamrai Paurashava are declared as retention area. But no action or effort was taken by the Paurashava to protect and conserve of these water bodies in the study area. So Dhamrai Paurashava should be careful about their master plan and should take attempts to conserve and protect declared water bodies stated in the Master Plan.



## Conclusion

Dhamrai Pourashava and its surrounding areas are growing in an unplanned and haphazard manner. Rapid population growth is extending towards the surrounding wetlands. It is revealed that in 2004, 10.01% land was permanent wetland but in 2010 and 2017 this became 7.79% and 5.66 % respectively in the study area. And finally, from 2004 to 2017 this percentage reduced to 43.49%. It is a dangerous warning for the study area. If the decreasing trend continuous then in the future remaining wetland of the study area will be totally lost. The remaining wetlands are crucial for the study area to keep the environmental balance. So, the Paurashava should careful to protect the existing wetlands and water body management should be first concern for any kind of development.

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## Spatial Analysis of Industrialization in Dhaka Metropolitan Planning Area

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Sabrina Sultana\*\*

**Abstract:** This paper focuses on spatial attributes and locational impact of industrialization within Dhaka Metropolitan Planning (DMP) area. Being in the heart of the country, Dhaka is facing tremendous industrial pressure. But the current process of industrial growth has been a threat to the environment and the lives of millions of people residing in and around Dhaka city. In this backdrop, this research attempts to analyze the present scenario of spatial distribution of industrialization in Dhaka Metropolitan Planning Area through industrial census data and Geographic Information System (GIS) data. For finding the impact of industrial development, this study assessed the impact of industrialization on adjacent residential areas and water bodies. This study finds that dispersedly developed industries in DMP areas, without following proper planning rules and regulations have negative consequences on water and environment. This research recommends that special industrial and economic zones should be established in DMP area to control haphazard growth of industries. Moreover, industries should be developed at locations designated at physical plans by following appropriate planning as well as environmental rules and regulations.

**Key words:** Industrialization, Dhaka Metropolitan Planning (DMP) area, Geographic Information System (GIS), Relocation, Detailed Area Plan (DAP), Red Industries.

### Introduction

Industrialization is an essential pre-requisite for rapid and sustained economic development and social progress. Industry is seen as the main “engine of growth” (Kaldor, 1967) and industrial development subject to cumulative causation to a larger degree than development of other sectors (Myrdal, 1957). Like other developing countries, Bangladesh is also experiencing industrialization and the trend of industrialization is increasing gradually. The case for development of manufacturing industries as a key feature of the development strategy of Bangladesh to accelerate growth and reduce poverty has got established immediately after country’s liberation in the very First Five-Year Plan by Government of Bangladesh (GOB, 1973 and Nath, 2012). In Bangladesh, the industrial growth took place at a slow pace. Between 1973-74 and 1999-2000, manufacturing GDP (Gross Domestic Products) increased at an annual compound rate of 3.8 %. The trend of growth for the same period was estimated to be 4% only (Bakshi, 2005). Most of the industries in Dhaka city are located on the bank of ‘Buriganga River’ that utilized the waterway to get supply of raw materials and to deliver the finished goods. Dhaka has become more and more attractive to the industrialist (Hossain, 1992). The Dhaka Metropolitan Development Plan (DMDP, 1995-2015)

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consultants have proposed four Special Incentive Zones for new industrial development. The Special Incentive Zones are Savar, Dhamsona, Kashimpur, Tongi and Gazipur.

Master Plans for Dhaka city have designated industrial zones for industrial development; however sporadic industrial growth has taken place over the years in various parts of Dhaka city violating planning and environmental rules and regulations. This paper focuses on the spatial distribution of industrialization in Dhaka Metropolitan Planning Area and analyzes the impact of industrialization on planned development of the city. This study also attempts to identify the residential zones that have been impacted by the undue and haphazard industrial development and also explores the impact of industrialization on physical and built environment.

### **Research Design & Methods:**

This study has adopted mixed approach method for the purpose of addressing the research objectives through purposeful sampling techniques. For the assessment of the concept of this study, Dhaka Metropolitan Planning (DMP) area has been chosen as study area. Rajdhani Unnayan Kartripakkha (RAJUK) and Department of Environment (DoE) officials have been interviewed for the information with KII (Key Informant Interview).

To fulfill the objective of the study, both primary and secondary data and information have been collected. Locational pattern and information of the industries in DMP area have been collected. For Key Informant Interview, Detailed Area Plan (DAP) expert and DoE official are interviewed. As secondary data collection, list of industries had been collected from different sources including DAP database.

By using the ArcGIS and SPSS software, data has been analyzed with several statistical techniques, maps etc. Density Analysis, Hotspot Analysis, Buffer Analysis etc. have been done in appropriate methods. Through proper assessment and analysis, locational distribution of industries and impacts of industrialization in planned development in Dhaka city have been examined for this study.

### **Theories of Industrial Locations**

Several economist and geographers made endeavor to determine the theory of industrial location. Alfred Weber (1929), a German economist took the first step. All theories those were discussed by spatial analysis by economist and geographers are of three: Classical or Economic base theory, Behavioral theory & Structural theory. Classical or Economic Base Theory is based on the natural and economic factors such as transportation cost, labor cost, raw materials etc. control the location of industry. The attention is drawn on the consumer's overall pleasure out of the products in Behavioral Theory (Carr, 1983). After 1970s, the Structural Theory worked on industrial location. Motivated by socialist idea low labor cost and managements are considered as main factor (Smith 1971). In the past there has been generally no public control exercised to determine in what part of a country a new industry should be established. "Spatial Analysis", a toolkit afforded to GIS software (ArcGIS and Quantum GIS), allows one to investigate geographic patterns in spatial data and the relationships between features (Mitchell, 2009).

Marshall (1961) have pointed out, industries may cluster together for reasons unrelated to internal cost considerations. Papola (1981) empirically examined the traditional theoretical propositions of industrial location and the impact of official and institutional efforts to bring-about regional balance in industrial development. Bakshi (2005) and Hasan (2014) attempted to study the problems and potentials of industrialization that faces a transition economy like Bangladesh.

### Scenario of Industries in DMP Area:

**Study Area Profile:** Dhaka Metropolitan Planning (DMP) area had been selected for this research. Dhaka is located in central Bangladesh at 23°42'N 90°22'E, on the eastern banks of the Buriganga River. DMP area covers a total area of 315.98 square kilometers. Dhaka is bounded by the districts of Gazipur, Tangail, Munshiganj, Rajbari, Narayanganj, Manikganj (BBS, 2011). The land use of DMP area indicates that only 3.14% of land currently belongs to industries (Draft DAP, 2015). According to the Far Eastern Economic Review, Dhaka will be home to 25 million people by the end of 2025 (Davis, 2006).

**Description of Industries:** There are 1857 industries in this DMP area as per DAP of RAJUK (Draft DAP, 2015). Most of them are rapidly developed in an unplanned way. Tejgaon, Hazaribagh, Mirpur, Demra, Kamrangirchar areas are mostly developed with industries.

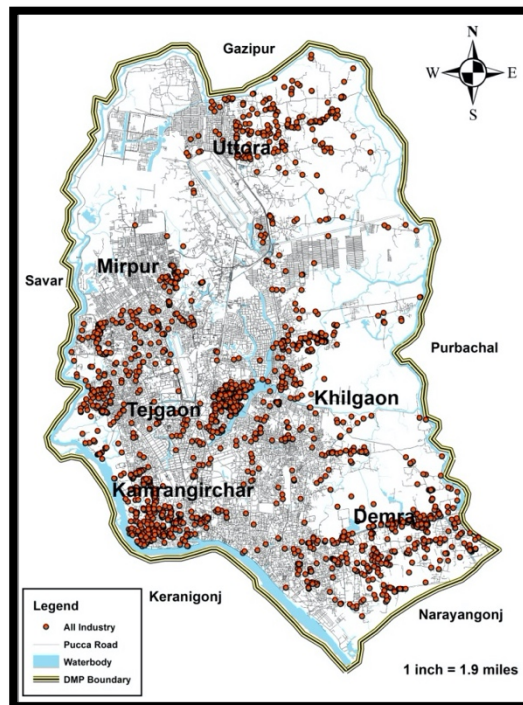


Figure 1: Industrial map of DMP area

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

### ***Spatial Distribution of Industrialization in DMP Area:***

**Categorical Analysis:** There are 1857 industries in Dhaka Metropolitan Planning Area. These industries have been into four categorizes according to their nature. These categorize are as follows.

**Category-1 (Use and Production type):** In this category, the total number of industries is divided into 19 types. As per the use and production type, these 19 types of industries have been found in DMP area. From the analysis it's found that maximum number of industries belongs to garment industries & those are 497 (26.76%) in number. There are 45 tannery industries. Beside this, there are 10.88% metal industries, 7.75% saw mill, 6.89% food industries, 6.25% plastic industries. There are 4.20% chemical & 2.42% Tannery industries.

**Category-2 (DoE Classifications):** According to DoE, there are 4 categories of industries (Environment Conservation Rules,1997). Most of the Red & Orange-B category industries are in Tejgaon, Kamrangirchar & Hazaribagh area. Green category industries are dispersedly distributed but most of them have been found in Demra area. There is Red category industries distributed in clustered manner in Tejgaon, Kamrangirchar and Demra area.

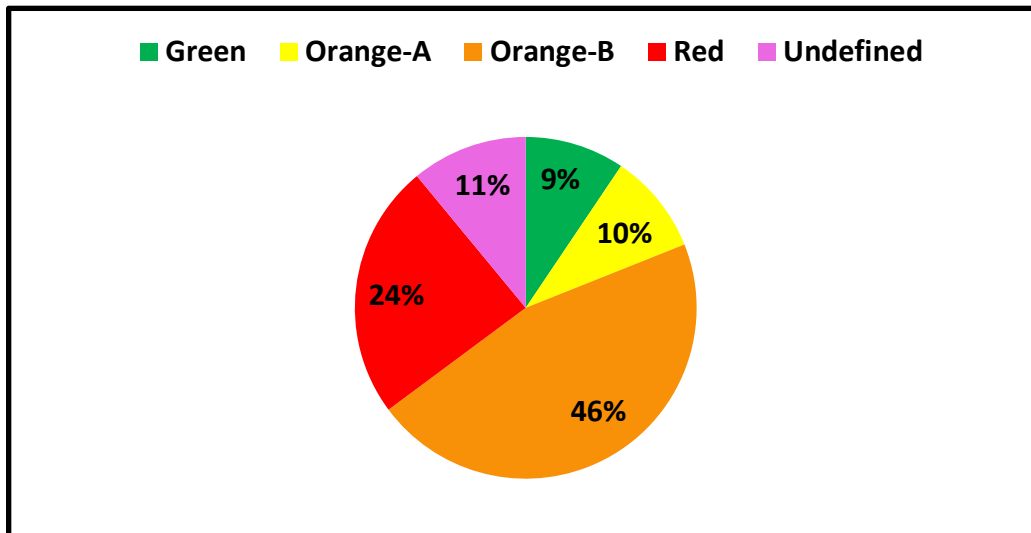


Figure 2: DoE categorical industries

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

**Category-3 (Structure Type) :** According to structure type, industries are divided into three categories, like Pucca, Semi-pucca & Katcha. There are 860 industries (46%) among 1857 that are semi-pucca and highest among all. 712 industries (39%) are pucca in DMP area. There are also 280 industries (15%) that are Kacha according to structure type.

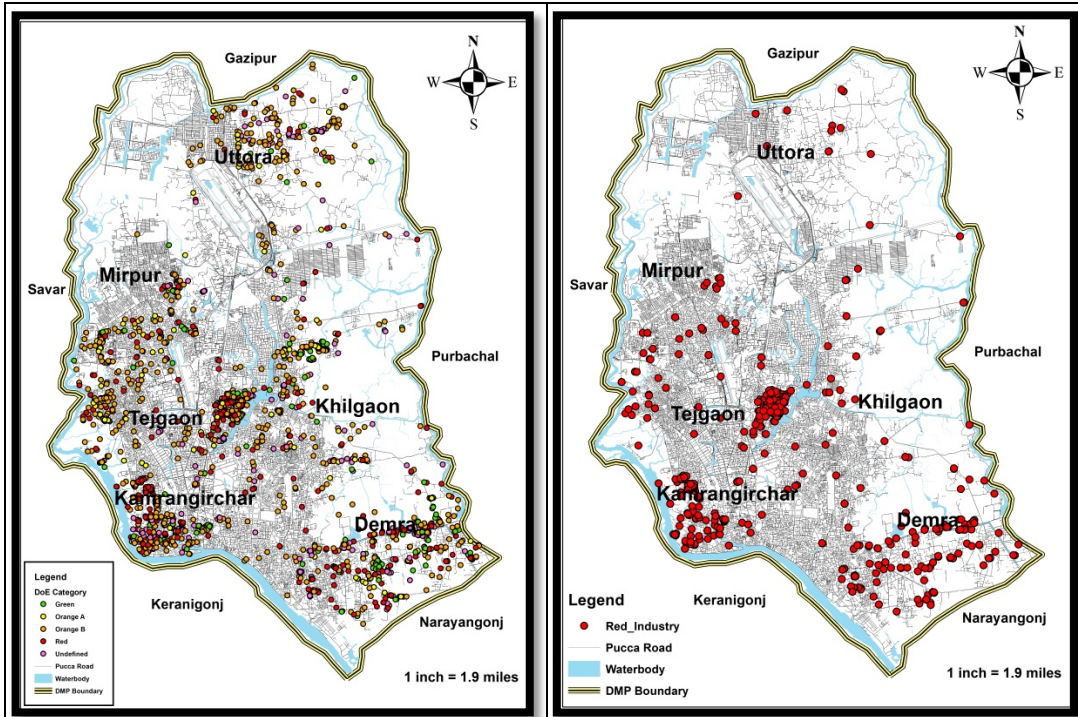


Figure 3: DoE categorical map of industries

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

Figure 4: Red category industries in DMP area

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

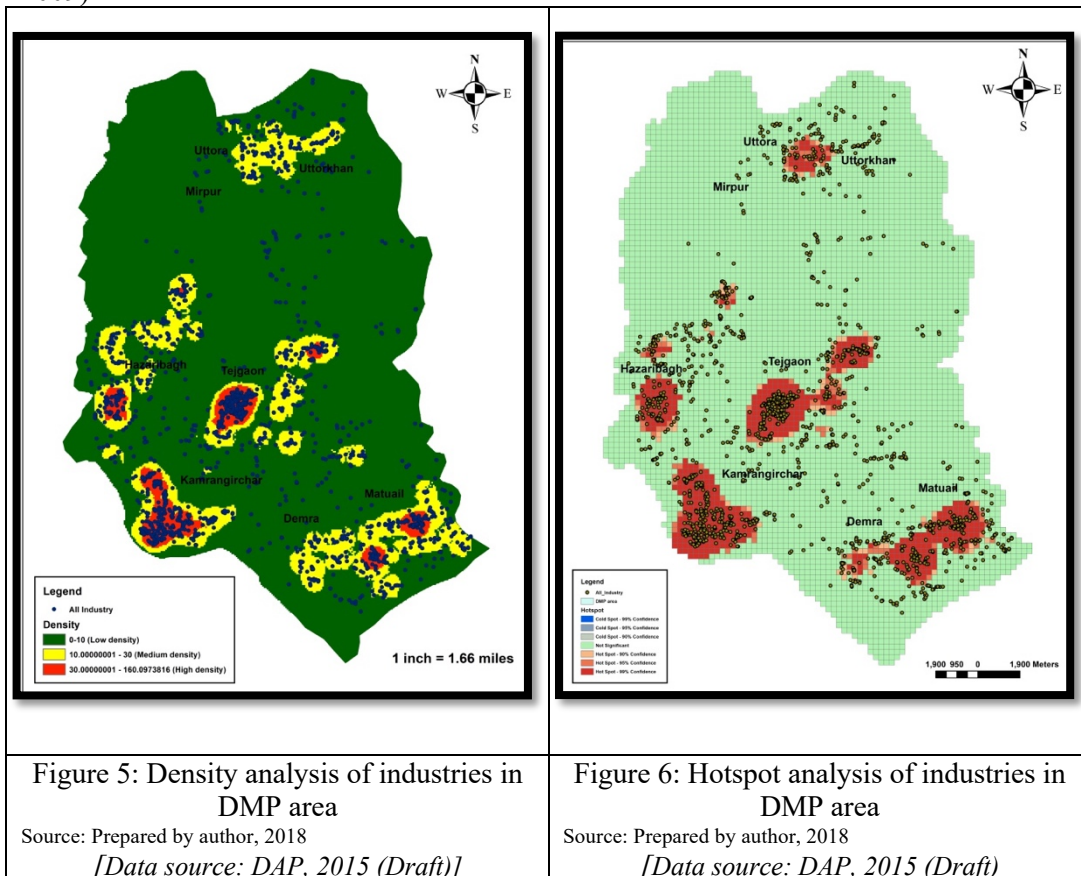
**Category-4 (Storey of Industry):** According to floor number of the industry, single storey industries are most in number & that was 1259 (67.80%). Second and third storied industries are respectively 198 and 119 in number which are relatively lesser in percentage in comparison to the single storey industries. All of those types of industries are distributed in a dispersed manner.

**Existing industries in proposed land use of DAP, 2010 (RAJUK) and different areas of DMP:** The existing 1857 industries of DMP area have been assessed with the proposed land use of DAP, 2010 by RAJUK and the areas where these industries have been located. There are 894 industries (48.14%) in urban residential zone and also 188 industries (10.12%) in mixed use area with residential and commercial characteristics. Though there are 193 (10.39%) industries in industrial area. But, there are 144 (7.75%) industries in proposed road network that means these industries ousted the public road space. There are many garments industries in urban residential zone of proposed DAP, 2010. There are 440 (23.69%) orange-B industries in urban residential zone. But, its alarming that there are 154 (8.29%) red industries in urban residential zone. From the analysis, it is found that there are 461 (24.82%) industries are located in Demra Thana.



There are also 305 industries in Gulshan, 271 industries in Tejgaon and 263 industries in Lalabagh Thana. Most of the garments industries are located in Mirpur, Mohammadpur and Gulshan Thanas. Most of the red industries are in Demra, Tejgaon and Lalbagh Thanas. There are 126 red industries in Demra Thana, 120 red industries in Tejgaon and 59 red industries in Lalbagh Thana.

**Quadrat analysis:** Quadrat analysis is another very well-known process for identifying patterns in points. For the purpose of superimposing grids on maps and then calculating the points within Polygons, ArcGIS Desktop 9.5 software has been used. “**Density Analysis**” helped to calculate the density of point features around each output raster cell. On the other hand, “**Hotspot Analysis**” have given incident points or weighted features (points or polygons), creating a map of statistically significant hot and cold spots using the Getis-Ord  $G_i^*$  statistic. Low value of cell size indicates ‘low density area’ in Density analysis and ‘Random pattern’ in Hotspot analysis. High value of cell size indicates ‘high density area’ in Density analysis and ‘Cluster pattern’ in Hotspot analysis (Mitchell, 2009).



In this analysis, 0-10 km radius parameter is low density area & industries are dispersedly distributed here. There is high density of industries in Tejgaon, Kamrangirchar, Hazaribagh, Demra & Matuail area. High density is setup as 30-160 km radius

parameters. Red spot in map indicates high value of hotspot. Map shows that Kamrangirchar, Demra, Matuail, Tejgaon, Hazaribagh, Uttorkhan area have high hotspot value area. That means these areas have clustered industrial pattern derived from the hotspot analysis.

## Impact of Unplanned Industrial Development

**5.1 Impact on Residential Area & Water Body:** Impacts on residential area & water body are analyzed with buffer analysis in GIS. Buffer zone of industries trends to calculate the area of industries. For this analysis, following analytical methods have been followed:

- 300-meter radius buffer of Red category industries,
- 200-meter radius buffer of Orange-B category industries,
- 150-meter radius buffer of Orange-A category industries,
- 100-meter radius buffer of Green category industries.

Impacts of industrial development on Residential area and Water body have been assessed with this analysis. Areas falling within each buffer zone has been analyzed using GIS map analysis.

Table 1: Impacts of industrial development on Residential area and Water body

No.	Categories	Radius of Buffer Zone	Affected Area (sq. km)		Percentages of Affected Area	
			Residential Area	Water Body	Residential Area	Water Body
1.	Red	300 meter	10571.95	2466.84	21%	11%
2.	Orange-B	200 meter	11886.72	1739.53	24%	8%
3.	Orange-A	150 meter	1536.92	182.48	3%	1%
4.	Green	100 meter	763.62	83.90	2%	0.4%

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

**Red Industries:** This study finds the residential area and water body within the 300-meter radius of Red category industries in DMP area. Most of the red industries have been developed in non-industrial zones, violating planning and environmental rules. Residential area of Mirpur, Hazaribagh, Demra, Uttorkhan, Mohammadpur have been found to be in the buffer zone of Red industries. Some part of Buriganga River besides Kamrangirchar, Hazaribagh area and some part of Hatirjhil are within this buffer zone.

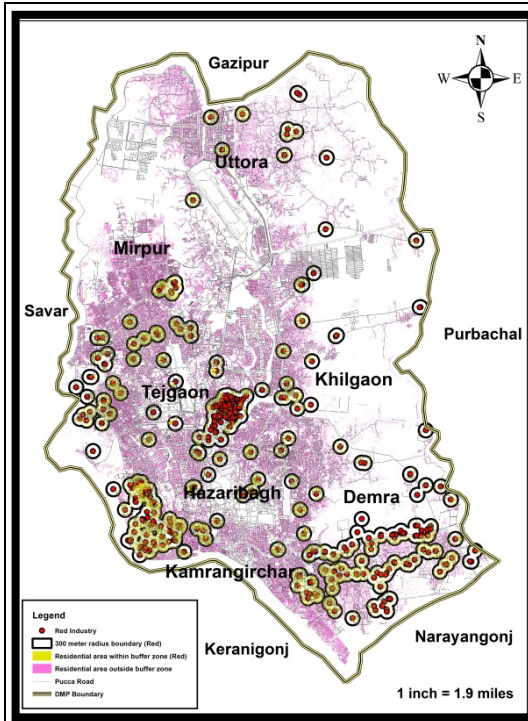


Figure 7: Residential area within 300-meter radius of Red industries  
 Source: Prepared by author, 2018  
 [Data source: DAP, 2015 (Draft)]

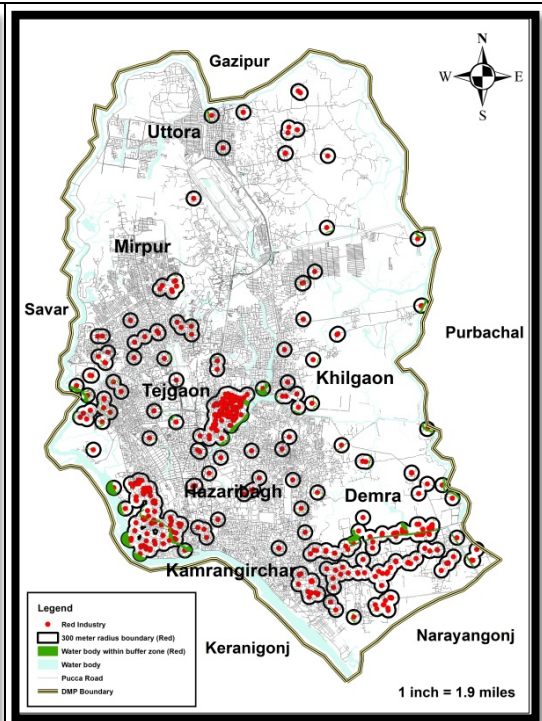


Figure 8: Water body within 300-meter radius of Red industries  
 Source: Prepared by author, 2018  
 [Data source: DAP, 2015 (Draft)]

**Orange-B Industries:** The residential area and water body within the buffer area that is calculated from 200-meter radius of Orange-B industries have analyzed. Most of the residential area of Mirpur, Mohammadpur, Khilgaon, Hazaribagh, Demra, Uttorkhan etc. have been found in this buffer zone. Some part of Buriganga River beside Hazaribagh & Kamrangirchar, some part of Shitolokkha River besides Matuail, some part of Turag River besides Uttorkhan & some part of Hatirjhil besides Tejgaon area are within the buffer zone of Orange-B industries.

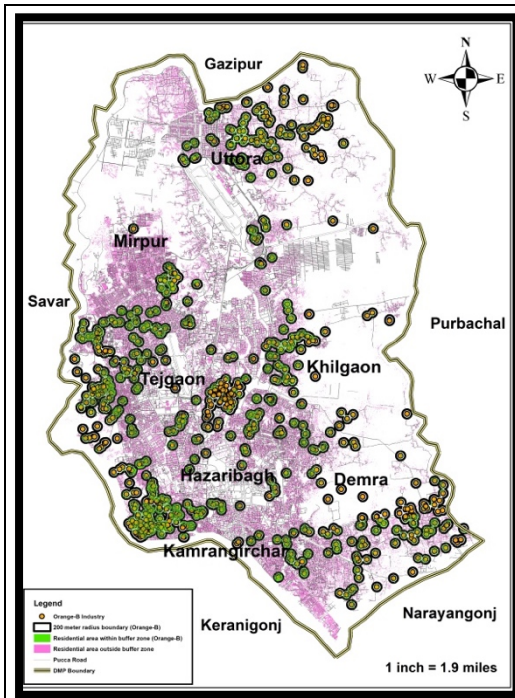


Figure 9: Residential area within 200-meter radius of Orange-B industries

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

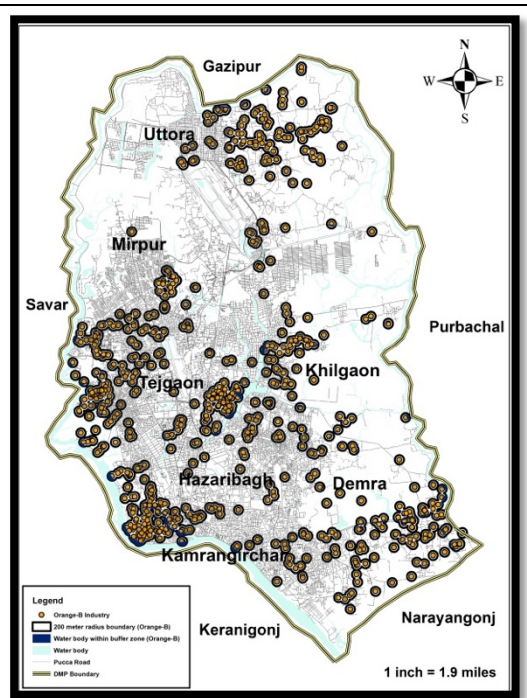


Figure 10: Water body within 200-meter radius of Orange-B industries

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

**Orange-A Industries:** This study reveals the residential area and water body within the buffer area of 150-meter radius of Orange-A industries. There are some portions of Mirpur, Hazaribagh, Demra, Khilgaon area that are situated in this buffer area. Some part of Buriganga River besides Kamrangirchar area are within this buffer zone as well.

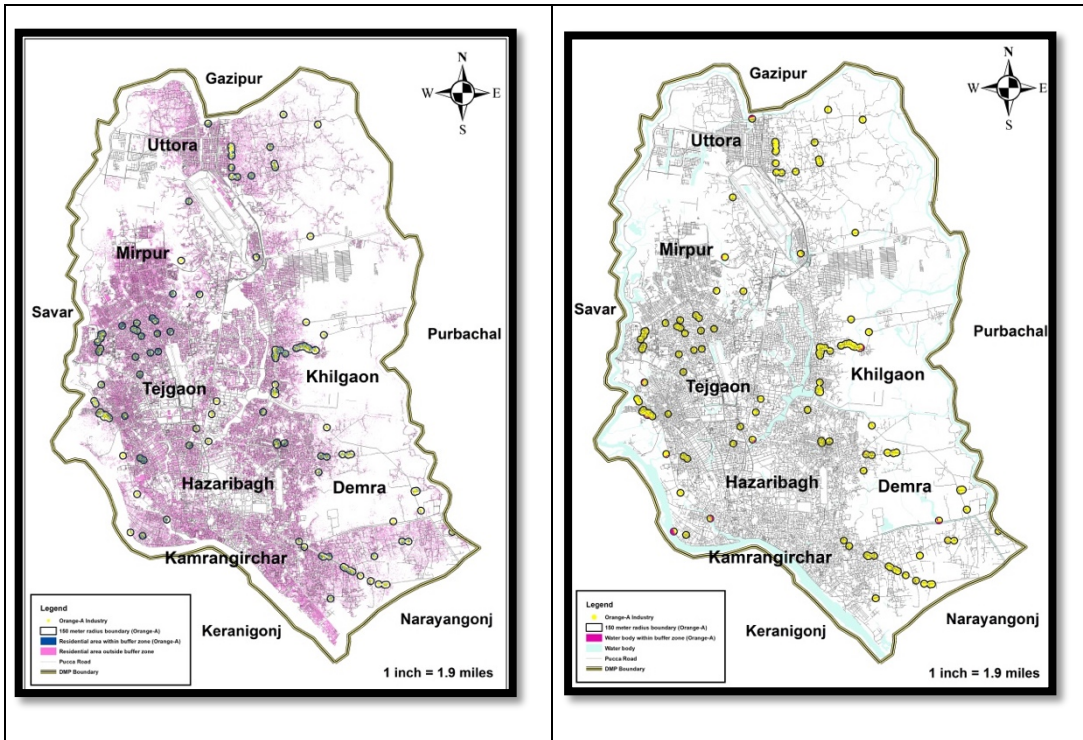


Figure 11: Residential area within 150-meter radius of Orange-A industries

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

Figure 12: Water Body within 150-meter radius of Orange-A industries

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

**Green Industries:** The residential area and water body within the buffer area of 100-meter radius of Green industries have been assessed. Some parts of residential areas in Matuail, Mirpur, Hazaribagh area are within the buffer zone of Green industries.

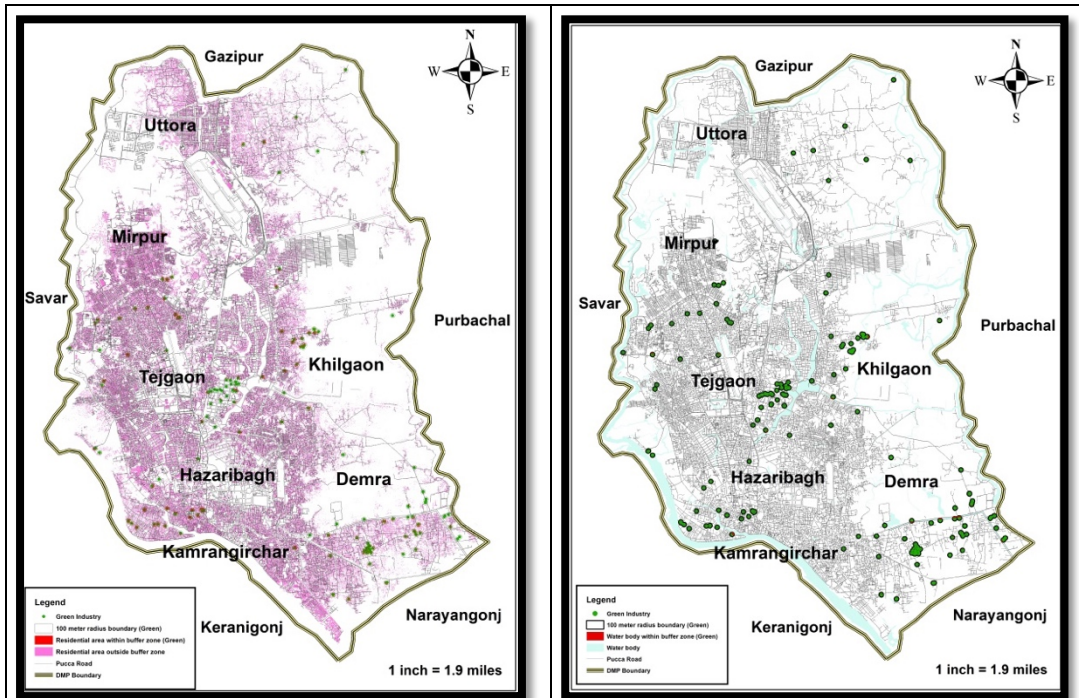


Figure 13: Residential area within 100-meter radius of Green industries

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

Figure 14: Water Body within 100-meter radius of Green industries

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

**Location of Industries along Riverbank:** Industries along the bank of river or waterbodies have profound impact on water and environment. Numbers of industries that are situated within 500-meter radius of the river in DMP area have been analyzed using GIS. This analysis finds that 296 industries are situated within 500-meter radius of the river in Dhaka Metropolitan Planning Area. 167 of those industries (56.42%) are Orange-B industries. There are 67 Red industries (22.64%) as well falls under this zone. There is high number of garments industries in the River bank area with 500-meter buffer zone. There are 61 garments industries, 49 plastic industries, 25 leather industries and 4 tanneries have been found in this buffer zone. Maximum industries of this type have been situated along the bank of Buriganga River and remaining has been found along the riverbank of Turag River & Shitolokkha River.

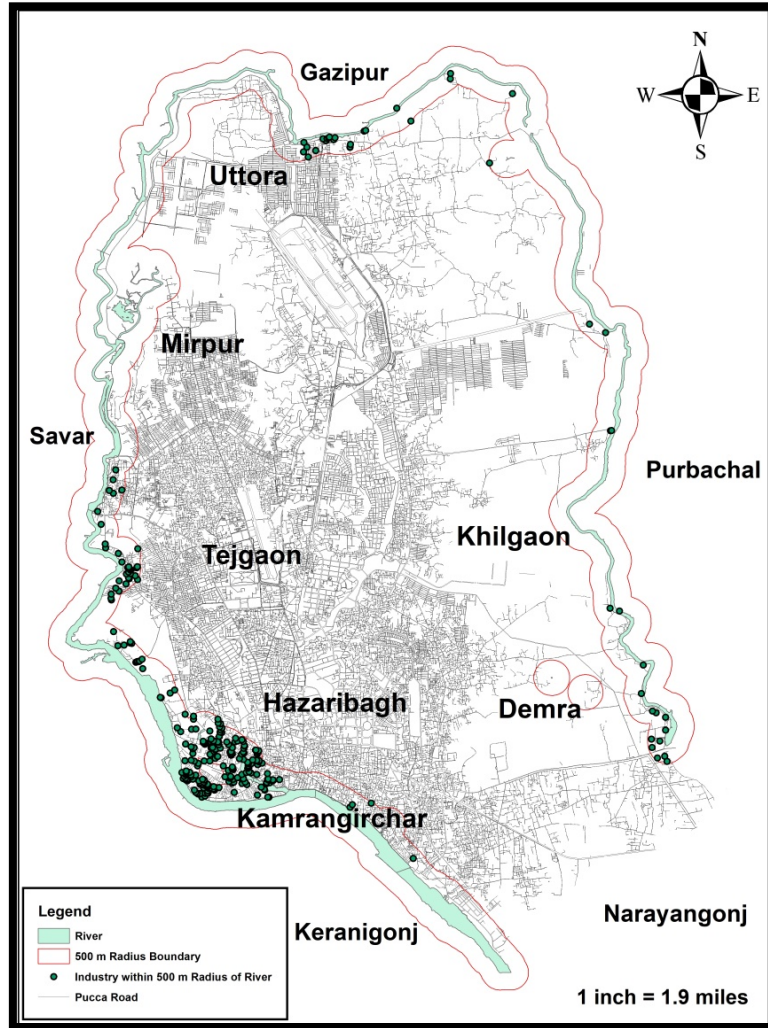


Figure 15: Industries within 500-meter buffer of river

Source: Prepared by author, 2018

[Data source: DAP, 2015 (Draft)]

**Results and Discussions:** This study has focused on physical attribute analysis and corresponding spatial distribution of industries. The Dhaka Metropolitan Development Plan (DMDP, 1995-2015) indicated some locations for industrial development and it restricts haphazard development of polluting industries within these areas. But the spatial distribution pattern and trend analysis of industrialization in DMP area illustrates that that there had been no control over the development of industrial establishments in DMP area. Major findings regarding industrial development in DMP area are as follows:

- i. Garments industries are highest in number in this area among all industries. Metal, saw mill, food, plastic industries are also large in number. There is large amount of industries belonging to Orange-B category. Large portion of industries are single storeyed and semi-pucca industries are large in number.
- ii. There is high density of industries in Tejgaon, Kamrangirchar, Hazaribagh, Demra & Matuail area. Kamrangirchar, Demra, Matuail, Tejgaon, Hazaribagh, Uttorkhan area have high hotspot value area that means these areas have clustered industrial pattern.
- iii. Most of the industries are in 'urban residential zone' and also in 'mixed use area' of proposed land use of DAP, 2010. Basically, most of them are garments industries. 8.29% Red industries are found in 'urban residential zone'.
- iv. 24% of gross residential area falls within the buffer area that is calculated from 300-meter radius of Red industries. 21% of gross residential area is situated within the buffer area that is calculated from 200-meter radius of Orange-B industries. 11% & 8% of total area of water body is within the buffer area of Red and Orange-B industries respectively.

### Major Findings from Key Informant Interview

Urban Planners from Planning Cell of RAJUK engaged in DAP preparations and Assistant Director of DoE had been interviewed for expert opinions regarding the spatial pattern of industrialization and its impact on built and natural environment. Major issues explored from KII have been summarized here:

- Due to the random development of industries and lack of monitoring ability of development authorities and relevant organization, this type of development violating planning and environmental laws could not be controlled.
- Most of the area of Tejgaon designated as Industrial Zone is yet unutilized or underutilized.
- Relocation of Tannery industries were not developed in planned way.
- Red category industries can't be located in DMP area unless it is on designated industrial area.
- Red category industries are being bound to relocate their industries from their prevailing non-industrial zones.

### Recommendations

Industrial locations are key determinants in shaping the physical and built environment of cities and settlements. Hence appropriate distributions of industrial locations are immensely required for maintaining the good quality of built environment. Therefore planning policies and regulations should be formulated in a prudent way for guiding the industrial locations in a planned and sustainable way based on the prevailing socio-economic context of the Dhaka city.

- i. **Development Control:** Development Control Authority of Dhaka city had their plans to control and guide the development of the area. But this study reveals that



lack of monitoring and inefficiency in development control has allowed the industries to grow in an unplanned and unregulated manner. In addition, there are some conflicts between the policy laid down by the authority and their development control mechanisms as well. These conflicts need to be resolved very soon for guiding planned industrial development in DMP area. The Development Control Authority must coordinate with DoE regarding the approval of industries in order to ensure sustained growth and development of the city.

- ii. **Economic Zone:** Cluster development as well as industrial zoning and at the same time initiatives for geographical diversification of manufacturing can be effective. Special economic zones should be established in DMP area to control haphazard growth of industries. Industries located around residential areas should be relocated in EPZ or other industrial area
- iii. **Planned Distribution of Industries:** Dispersedly distributed industries should be developed or relocated in cluster zone. Existing industries should be relocated in cluster industrial area.
- iv. **Maximum Utilization of Existing Industrial Zones:** Maximum utilization of existing industrial zones, as designated in prevailing plans for Dhaka city should be done which can prevent the unscrupulous industrial development in and around the Dhaka city.

## Conclusion

This paper explores the pattern of industrial development in Dhaka city and reveals that most of the industries have been developed in an unplanned way violating planning and environmental rules and regulations. Therefore these industries of different categories have profound impact on air, water, built and biological environment. In addition, residential living environment of Dhaka city is severely affected by sporadic industrial growth in DMP area. In this backdrop, proper planning and industrial zoning is highly required to guide planned industrial development in Dhaka city. Moreover relocation of appropriate industrial that are detrimental for residential environment should be done on an immediate basis. Planning authorities should be highly stringent on its role of development management and exercise its due power for the sake of ensuring public health and environment to attain sustainable development goals.

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## Determinants of Profitability of Handloom Units Operating in Tangail District of Bangladesh

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**Abstract:** Handloom industry is a traditional cottage industry in Bangladesh which has a glorious past and rich history. Due to numerous reasons handloom industry has lost its glory in the recent decades. Available studies observe that handloom industry in Bangladesh is marginally profitable. The present study is an effort to estimate the contribution of various key factors affecting profitability of handloom units operating in Tangail district of Bangladesh. To this end, the study analyzes primary data collected from 90 households involved in handloom weaving activity from two upazilas of Tangail district. The multiple regression analysis in the study found that firm specific factors- labor cost and yarn costs have significant influence on profitability the handloom units. Estimated regression coefficients indicate that increase in labor and capital costs reduces profitability of the units. Age, acting as proxy for experience of the owners, is also a significant determinant and has positive influence on profitability of handloom units. By performing a disaggregated analysis, comparison is made among single-loom units, small units and large units and the results show almost similar findings except for some minor variations. Interestingly, capital cost has not turned out significant in the main regression as well as in the regression for single-loom units although it became significant in the case of small and large scale units. Similarly, price of product is found to have mixed influence on profitability of the handloom units. It is found significant in case of single-loom and large units while insignificant in case of all and small units. Other variables viz. education, family size, unit size and considering handloom as main occupation do not pose any significant effect on profitability of the handloom units.

**Keywords:** Determinants, profitability, handloom units, Bangladesh.

### Introduction

Profitability or profit earning capacity plays a crucial role in the structure and development of any business firm. Profitability measures the efficiency of using various inputs in the production of a firm. The perpetual existence of a firm depends on its profit earning capacity. For any production unit, maximizing profitability is the main objective. Profitability of a firm is thus a key concern for its ability to better withstand negative shocks and contribute to stability of the production system. If profitability decreases and the situation continue for long time, it becomes impossible for the firms to continue their business.

Handloom, the largest cottage industry, plays a crucial role in economic development of Bangladesh especially in the rural areas. In Bangladesh, about 0.556 million handlooms

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in 0.183 million production units employed around 1 million people directly, and an additional 0.5 million people in related works like marketing, transporting, etc. in the rural areas (BBS, 2005). In this way the sector became an important supplementary source of employment and income for rural people of Bangladesh (Islam and Elahi, 1991). By enhancing income through handloom weaving activity, rural people can alleviate their poverty to a significant extent (Raihan 2010). It is observed that handloom weaving activity has flourished in Tangail district of Bangladesh during the last quarter of nineteenth century. Currently more than 95 thousand people in Tangail directly engaged in handloom industry which constitutes around 10% of the total employment in the district. In addition, another 50 thousand people in the district are engaged related works (BHB, 2005). Handloom weavers of Tangail district mainly produce *Tangail Sharee*, a renowned female wear. Due to numerous reasons, in many cases, handloom weaving activity has turned out less profitable in the recent years compared to other rural economic activities. Many of the respondents under this study have reported that profitability of the industry is very low and if it continues for years, they will have to close down their business. Therefore, the present study tries to identify the determinants of profitability of the handloom weaving units in the study area.

The present study is organized as follows: after introducing the issue in Section 1, Section 2 discusses the previous literature on the issue. Section 3 presents the scenario of handloom industry in Bangladesh while Section 4 discusses the methodology followed in the study, and results are discussed in Section 5. Finally, Section 6 summarizes the whole study.

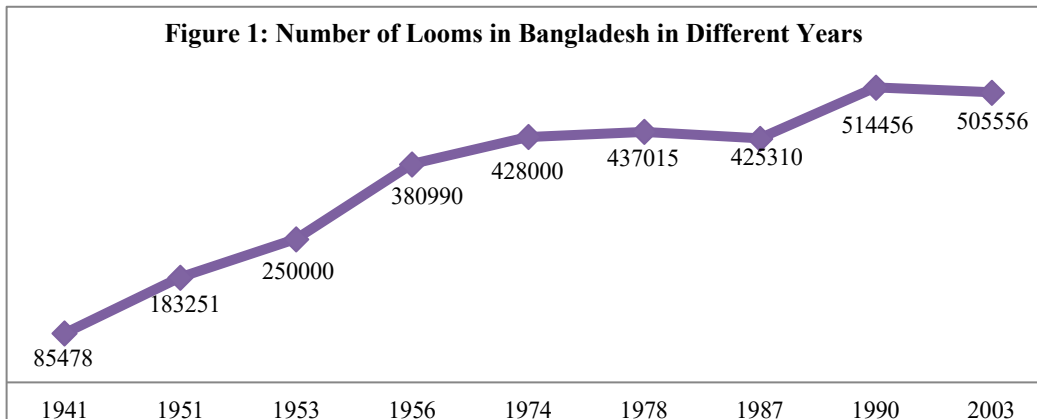
### **Literature review**

Several studies have devoted to analyze handloom industry in different contexts albeit their number is not large. Islam and Elahi (1991) found handloom industry as a supplementary source of employment for small farmers in Tangail district that enhance income for those marginal people. In addition, it creates an opportunity for employing female and child members of the family throughout the year (Sobhan, 1989). Handloom industry, therefore, significantly contribute to alleviating poverty in the rural area (Raihan, 2010). Due to numerous reasons, handloom becomes less competitive compared to other weaving forms. Chowdhury (1990) found that handloom weaving units in Bangladesh are economically more efficient compare to the powerloom units and mills. However, studies conducted in the recent years revealed that in most of the cases handloom weaving is marginally profitable and in some cases less than other occupations (Islam et al. 2013, Liton et al. 2016, Jahan and Kumkum 2016). Islam et al. (2013) found handloom industry in Kumarkhali Upazila of Kustia district is marginally profitable. Jahan and Kumkum(2016) and Rahman (2013) also found handloom industry profitable although marginally. In international arena, Patra and Dey (2015) and Mathew (1987) also found almost same results while looking into the profitability aspects of handloom industry in Kerala and Odisha states of India, respectively. Islam and Hossain (2015) and Jaforullah (1999) found a significant inefficiency in handloom weaving activities that may be one of the reasons for lower profit. In addition, lack of capital, lack of yarn, lower demand, high competition from powerloom, high price of raw materials, etc. are also

responsible for lower profit in the handloom industry (Liton et al. 2016). Due to lower profitability, many of traditional weavers left their parental occupation. Islam and Hossain (2018), while emphasized on investigating the determinants of profitability for reviving handloom industry, found a significant influence of sales revenue, labor cost, yarn cost, capital cost and other cost associated with the industry on profitability of handloom weaving activities in Kumarkhali Upazila of Kustia district.

### Handloom industry in Bangladesh

Handloom weaving industry of Bangladesh has a glorious past and a rich history. It was started during the reign of Sultan Qutbuddin Aibak (1206-1210 AD). In that time it was mostly visible in Dhaka district and its surrounding areas. During the Mughal era handloom received patronage from the emperors and nobilities and as a result expanded to all over the region.



Source: Bangladesh Bureau of Statistics (2005).

It is observed from Figure 1 that number of loom increased up to 1990, though due to high competition from powerloom and mill sector during following years, the number decreased. Currently, the handloom industry of Bangladesh has more than 0.18 million handloom units having 0.51 million handlooms.

Handloom industry is considered as family based rural industry. More than 92% handlooms in Bangladesh are located in rural areas under 90% handloom units. In contrast, 10% handloom units having only 8% handlooms are located in urban areas. In addition, 95.3% handlooms are being operated as family based private units and only 4.7% are being operated as non-family based units. Another characteristic of handloom industry is it is a cottage industry and the size of handloom units is generally small. According to handloom census 2003, around 93% of the handloom units are premise based that operates around 77% of total looms in Bangladesh and rest 7% factory based units operates 23% looms. More than 57% handlooms are being operated in small units having maximum 5 looms. While 28.92% looms are being operated in medium size units having 6-19 looms and 14.05% in large units having more than 20 looms.

A large number of rural labor forces are engaged in handloom industry in Bangladesh. Next to agriculture, it is the second largest source of rural employment.

Table 1: Size of Employment by Sex

Items	Years and percentage							
	1986	%	1987	%	1990	%	2003	%
Male	648865	73	443135	55	571765	56	472367	53
Female	244160	27	362565	45	455642	44	415748	47
Total	893034	100	805700	100	1027407	100	888115	100

Source: Ministry of Textile (MOT) and Bangladesh Bureau of Statistics and cited in BBS (2005).

It is observed from Table 1 that in the year 2003, a total of 0.89 million weavers were directly employed in handloom industry. Among them 53.19% were male and 46.79% were female. These figures were 72.66% and 27.34%, respectively, in 1986, and 55.65% and 44.35%, respectively, in 1990. In addition to this, there are two types of weavers in handloom industry in Bangladesh namely- family worker and hired worker. Although handloom industry in Bangladesh is traditionally a family based rural industry, it employs a large number of hired workers. Among 0.88 million weavers engaged in handloom industry, 53.41% come from family source and 46.59% come from non-family source. Therefore, handloom is an important source of rural employment.

Although handloom industry is very crucial for rural economy of Bangladesh in terms of employment and income, it faces numerous problems. Therefore, the number of handloom units as well as looms has been decreasing in the recent decades. In addition, operational rate also decreases after 1987. According to BBS (2005) among 0.51 million handlooms, 61.7% are operational while the rate was 73% in 1978 and 68.5% in 1990. A number of reasons are responsible for existing huge number of non-operational looms in Bangladesh. According to BBS (2005), lack of capital is the main reason for existing a large number of non-operational handlooms in Bangladesh, and many of the non-operational looms are being shutting down due to this problem. In addition, lack of yarn, marketing problem and labor shortage, etc., also turned out to be serious problems for this sector.

Though the handloom weaving activity spreads out all over the country, it is mainly concentrated in some selected areas and Tangail district is one of them. Handloom contributes rural economy of the district significantly from the early nineteenth century. Presently, more than 37,000 handlooms are in operation in Tangail district under 6,500 handloom units and they are contributing to enhance income of 0.15 million people directly or indirectly.

## Methodology

### Selection of study area and data collection

The present study is mainly based on primary data. This study selects Tangail district purposively, a traditional handloom concentrated area in Bangladesh, as the sample area for identifying the determinants of profitability of handloom industry. Then following random sampling method two upazila viz. Tangail Sadar and Delduar are selected for data collection. A total of 90 respondents were selected randomly and interviewed with a

questionnaire that encompassed all required information. Secondary data, whatever used in this study, are collected from reports of Bangladesh Handloom Board (BHB), various reports of Bangladesh Bureau of Statistics (BBS), published journal articles and magazines.

### Empirical model

The empirical model for this study is designed to assess the contribution of various factors determining profitability of handloom units operating in the study area. It is found from previous studies (Islam et al. 2013, Islam and Hossain, 2018) and survey reports that profitability of handloom weaving activity mainly depends on the following key factors- sales volume and price, labor cost, yarn cost, capital cost, along with some other demographic, social and economic factors e.g. age, education, occupation, family size, firm size, etc. (Akter et al. 2019). Therefore, considering these variables the study constructs the profit function of the weaving handloom units written as follows:

$$\Pi_i = f(AGE_i, EDU_i, FS_i, US_i, LC_i, YC_i, CC_i, AR_i, D_i) \dots (1)$$

$$[i = 1, 2, \dots, 90]$$

Where,  $\Pi_i$  stands for profitability of the  $i^{\text{th}}$  handloom unit, and  $AGE_i$  and  $EDU_i$  for age and educational qualification, respectively, of the handloom owners.  $FS_i$  and  $US_i$  stand for family size and unit size in terms of looms, respectively.  $LC_i$ ,  $YC_i$ ,  $CC_i$  and  $AR_i$  refer to per unit labor cost, yarn cost and capital cost and average price of product of the  $i^{\text{th}}$  firm. Finally, the variable  $D_i$ , is used as a dummy variable in the model for capturing whether handloom is main or supplementary occupation (1= if weaving is the main occupation and 0 otherwise) of the household.

To estimate the contribution of the key factors, Ordinary Least Squares (OLS) method is employed in the following form:

$$\Pi_i = \beta_0 + \beta_1 AGE_i + \beta_2 EDU_i + \beta_3 FS_i + \beta_4 US_i + \beta_5 LC_i + \beta_6 YC_i + \beta_7 CC_i + \beta_8 AR_i + \beta_9 D_i + u_i \dots (2)$$

Where  $\Pi_i$  is profitability of the  $i^{\text{th}}$  firm, and  $AGE_i$ ,  $EDU_i$ ,  $FS_i$ ,  $US_i$ ,  $LC_i$ ,  $YC_i$ ,  $CC_i$ ,  $AR_i$ , and  $D_i$  are explanatory variables explained earlier;  $u_i$  is the stochastic error term and  $\beta_i$ 's are coefficients to be estimated.

### Descriptive Statistics

The descriptive statistics of the variables affecting profitability of the handloom units are shown in Table 2. The standard deviations of the observed values of the variables and the differences between maximum and minimum values apparently show that the sample handloom units are not homogeneous in terms of firm specific as well as social and demographic characteristics. It is observed from Table 2 that average age of the handloom owners is 49.28 years with maximum 72 years and minimum 30 years. The average education of the unit owners is 4.49 years with maximum 12 years. The unit operating households have an average family size of 5.7 members. The average size of the handloom units is 7.01 indicating that a large share of them is small units. The units constitute both single loom units as well as large units having 38 looms at the highest. A



varying scenario is also seen in case of various types of costs, average price of output per unit and sales volumes.

Table 2: Result of Descriptive Analysis of Collected Data from Handloom Units

Items	Age	Education	Family size	Unit size (looms)	Labor cost (Tk.'000)	Yarn cost (Tk.'000)	Capital cost (Tk.'000)	Per product Price (Tk.)	Sales volume (Tk.'000)
Mean	49.28	4.49	5.38	7.01	461.42	648.40	12.67	1464.72	1390.21
Std. Deviation	11.18	3.93	2.21	8.16	614.49	1011.09	12.19	724.41	1976.20
Minimum	30.00	0.00	2.00	1.00	32.40	33.60	0.98	450.00	76.80
Maximum	72.00	12.00	13.00	38.00	2970.00	5550.00	52.40	3200.00	9000.00

Source: Authors own calculation.

Labor cost varied from Tk.32 thousand to Tk.2970 thousand per unit while yarn cost varied from Tk.33.6 thousand to Tk.5550 thousand per unit depending on production volume and productive efficiency. As quality of product varies from firm to firm, price of the products also varied significantly. It is found that price of product (*sharee*) varied from Tk. 450 (minimum price) to Tk. 3200 (maximum price) with an average price of Tk. 1464.72. Yearly sales volume of the handloom units also varied among handloom units. It varied from Tk.76 thousand to Tk.9000 thousand with a mean of Tk.1390 thousand. Among the weaver households, 62 have taken handloom as their main occupation while the rest 28 operate handloom as their secondary occupation.

### Regression Results

In this section, a discussion of the estimated results based on equation (2) is provided. The discussion has progressed in three phases. In the first phase all handloom units are taken together for the discussion and subsequently in the second phase, disaggregated discussions are performed taking the single loom units, small-size units (having maximum 5 looms in the unit) and large-size units (having more than 5 looms in the unit). In the third phase, comparison of results across unit categories is made. Validity of results is tested by R-square and VIF values.

### Regression Results for All Handloom Units

Primary data collected from all the sample handloom units are fitted into the regression model specified in Equation (2) and estimated using Ordinary Least Squares (OLS) method. The results are presented in Table 3 below.

Table 3: Regression Results for All Handloom Units

Exp. variables	Coefficient	Standard error	t-value	p-value
AGE	0.009**	0.004	2.21	0.035
EDU	-0.074	0.060	-1.23	0.223
FS	0.008	0.115	0.07	0.944
US	-0.010	0.029	-0.34	0.732
LC	-0.019***	0.002	-8.87	0.000
YC	-0.003*	0.001	-1.79	0.077
CC	-0.001	0.021	-0.02	0.983
AR	-0.002	0.001	-1.37	0.173
D	-0.225	0.468	-0.48	0.632
Constant	-1.984	1.414	-1.40	0.164

N: 90; R-squared: 0.733; Adj. R-squared: 0.614; VIF: 4.13

Source: Authors own calculation. *N.B:* \*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively

It is observed from Table 3 that profitability of handloom industry is mainly determined by labor cost and yarn cost incurred by the handloom units when firm specific factors are concerned. All the sample handloom units were found to produce *sharee* and the results explain that keeping other factors unchanged, a one thousand Taka increase in labor cost results in a decrease of profitability by 0.019 percent. Yarn is the most important raw material in handloom industry and it determines the profitability significantly. The result shows that if yarn cost increases by one thousand taka in an average handloom unit, it cause to reduce the unit's profitability by 0.003 percent. Contrast to labor and yarn costs, age of the unit owners shows positive effect on profitability of the units. The finding is expected as age of the handloom owners reflects their experiences of involvement in handloom activity. Other variables do not impose any significant influence on profitability of the firms in the study area.

### Regression Results of Single Handloom Units

Handloom weavers in the study area are basically poor and in maximum cases due to lack of capital they operate handloom in small scales. Around 20 percent respondents operate single loom units. Therefore, a separate regression is run for this category of handloom units and the results are presented in Table 4 below. It is observed from Table 4 that in addition to labor and yarn costs, price of output per unit is a significant determinant of profitability of the single loom firms. However, unlike the earlier regression, age or experience has no impact on profitability of this category of handloom units. It is evident from the table that while labor and yarn costs have negative affect, price of output has positive affect on the profitability of single loom unit.

Table 4: Regression Results of Single Handloom Units

Determinants	Coefficient	Standard error	t-value	p-value
AGE	0.047	0.049	0.97	0.359
EDU	-0.021	0.098	-0.21	0.835
FS	-0.119	0.192	-0.62	0.550
US	-	-	-	-
LC	-0.008***	0.002	-3.88	0.004
YC	-0.001*	0.0005	-1.91	0.089
CC	0.005	0.033	0.16	0.873
AR	0.002*	0.001	1.88	0.093
D	0.455	0.585	0.78	0.457
Constant	-2.470	1.681	-1.47	0.176
N: 18, R-squared: 0.684, Adj. R-squared: 0.571, VIF: 8.21				

Source: Authors own calculation. *N.B:* \*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively

It explains that if price of output per *sharee* increases by one Taka, profitability of the unit increases by 0.002 percent. Labor cost and yarn cost have negative impact on profitability of the single loom units as expected earlier.

### Regression Results of Small Handloom Units

Handloom is basically a small business activity in the study area and besides single loom units more than 50 percent respondents in the study area operate small units consisting of 2-5 looms. Regression results for this category of handloom units are provided in Table 5.

Table 5: Regression Results for Small Handloom Units

Determinants	Coefficient	Standard error	t-value	p-value
AGE	0.012**	0.006	2.02	0.042
EDU	-0.075	0.095	-0.79	0.435
FS	-0.159	0.228	-0.70	0.490
US	0.252	0.369	0.68	0.501
LC	-0.019***	0.004	-5.08	0.000
YC	-0.003*	0.002	-1.97	0.082
CC	-0.006*	0.003	-2.25	0.023
AR	0.001	0.002	0.27	0.792
D	-0.259	0.832	-0.31	0.757
Constant	-3.082	3.318	-0.93	0.359
N: 46, R-squared: 0.643 Adj. R-squared: 0.604, VIF: 6.35				

Source: Authors own calculation. *N.B:* \*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively

Table 5 showed that in the case of small handloom units with 2-5 looms labor, yarn and capital costs play significant role in determining profitability of the owners. Age of the

owners again played significant positive role and other factors did not turn out significant.

### Regression Results for Large Handloom Units

Large scale handloom establishments require higher investment in capital which is generally financed by bank loans. Therefore small number of households is found to operate large scale units (number of looms more than five) in the study area. The current expenditure for operating these units is also high as they need higher number of hired labors, yarns and other variable inputs. The volume of production and sales revenue are also high for these handloom units. Large scale handloom units also enjoy the benefit of economy of scale which may reduce per unit production cost and thereby increase profitability of the units. Regression results for the large scale handloom units are presented in Table 6 below.

Table 6: Regression Results for Large Handloom Units

Determinants	Coefficient	Standard error	t-value	p-value
AGE	0.005	0.036	0.14	0.887
EDU	-0.115	0.109	-1.05	0.309
FS	0.163	0.158	1.04	0.316
US	-0.041	0.037	-1.11	0.283
LC	-0.022***	0.005	4.68	0.000
YC	-0.009***	0.002	4.61	0.000
CC	-0.079*	0.041	1.92	0.072
AR	0.005***	0.002	3.12	0.007
D	-0.226	0.746	-0.30	0.766
Constant	-2.819	3.316	-0.85	0.408

N: 26, R-squared: 0.711, Adj. R-squared: 0.661, VIF: 3.98

Source: Authors own calculation. *N.B: \*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively*

It is observed from Table 6 that like other category of handloom units average labor cost and average yarn cost are important determinants of profitability in the large scale units. Capital cost is also a significant determinate that affects profitability negatively while price of output per unit affects profitability positively in the case of large scale handloom units. Other factors do not affect profitability significantly.

### Comparison of Regression Results

It is observed that handloom activity is generally operated in family environment. In the case of single-loom units family members work as labor while in the small units a few number labors are hired in addition to the family labors. However, in the large scale handloom units all labors are hired labors and the factories are mostly located outside the family premises. Considering these features of the handloom units separate regressions are run and the results are compared in Table 7.

Table 7: Comparison of Regression Results Various Category of Handloom Units

Determinants	All	Single	Small	Large
AGE	0.009**	0.047	0.012**	0.005
EDU	-0.074	-0.021	-0.075	-0.115
FS	0.008	-0.119	-0.159	0.163
US	-0.010	-	0.252	-0.041
LC	-0.019***	-0.008***	-0.019***	-0.022***
YC	-0.003*	-0.001*	-0.003*	-0.009***
CC	-0.001	0.005	-0.006*	-0.079*
AR	-0.002	0.002*	0.001	0.005***
D	-0.225	0.455	-0.259	-0.226
Constant	-1.984	-2.470	-3.082	-2.819

Source: Authors own calculation. *N.B:* \*\*\*, \*\* and \* indicate significance at 1%, 5% and 10%, respectively

The regression results for all the four regressions, presented in Table 7, have revealed almost similar findings regarding the determinants of profitability of the handloom weaving units operating in Tangail district. It is found that two most important determinants of profitability of the handloom units are labor cost and capital cost and they turned out negatively significant in all the four regressions. Age, which acts as proxy for experience of the owners is significant determinant of profitability for the small size handloom units but not significant for the other two categories. Similarly, capital cost has not turned out significant in the main regression as well as in the regression for single-loom units although it became significant in the case of small and large units. This indicates that there is variation of capital use in these two types of handloom units that, has significant bearing on production and profitability. Price of product is found to have mixed influence on profitability of the handloom units. It is found significant in case of single-loom and large units while insignificant in case of all and small units. Other variables do not pose any significant effect on profitability of the handloom units.

## Conclusion

Handloom weaving is an important occupation of the households in the rural areas of Tangail district. Although the activity is still profitable, it suffers from many problems and its profitability depends on socio-economic, demographic and firm specific factors. The findings of the study indicate that conventional input factors- labor, yarn, etc. are the main determinants of profitability of the handloom units operating in the study area. Experience of the weavers also provides significant dividend as far as profitability is concerned. It is found that handloom products differ in quality from firm to firm and, therefore, their price also differ in a competitive market setting. As a result, mix results are found about the influence of price on profitability of the handloom units. Since conventional inputs determine the profitability of the firms, institutional support through providing credit to the handloom owners would benefit the sector significantly.

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## **Rethinking the International Labor Migration-Development Nexus: A Brief Survey of the Literature**

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**Abstract:** International labor migration has been a livelihood strategy for long. There is a direct positive impact of such migration on the sending country's economy and also on the households of the migrants in the form of remittances. Hence, migration has both macro and micro implications. Particularly for lower-income or lower-middle income countries with abundant working-age labor force, international labor migration is considered as a possible solution to intense unemployment problem and poverty. But in the present world, migration is no longer an unmixed blessing. Human-trafficking, brain-drain, inequalities, indebtedness, etc. all are endogenous to international migration. Hence, equally important as remittance, is the due consideration of economic, social, cultural, and psychological costs of migration as these are adding up all the times in the dynamic paradigm of globalization. But seldom these get commensurate attention like remittance in the contemporary development theories and policy circles due to lack of literature survey in this field. Shining light on this side of the coin may unfold the true cost-effectiveness of international migration nowadays. This paper is a conscious effort in this regard to survey some contemporary literatures on migration and development, migration and its costs, migration and brain drain, migration and human trafficking, migration and inequality, and migration and migrants' indebtedness.

**Key Words:** labor migration, remittance, costs of migration, development.

### **Introduction**

Labor migration from one country to another has long been a popular trend. And it still is. On the other hand, the direct impact of migration on the development of the sending country is underscored by remittance. Related literatures define labor migration as – the movement of person or a group of persons from one geographical unit to another across an administrative or political border cherishing to settle temporarily or permanently in a place other than their places of origin. Cummins (2008) mentioned that once a person crosses the borders of his/her native country and stays in a different country for a period of time, it is called international migration. Usually people migrate for better jobs, better earning, and better standard of living. The portion of migrants' earnings abroad that they send to home-countries are termed as remittances. Remittance is popularly defined as the amount or money, goods, or both sent home by the migrants. The United Nations (2009) revealed that some 215 million people or 3 percent of the world's population are believed to live outside their countries of birth. Ratha, Mohapatra, and Scheja (2011) said that according to the official estimates, migrants from developing countries sent over \$315

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billion to their origin countries in 2009, three times the size of official development assistance. Cummins (2008) reported that there are several forms of international migrants such as, temporary migrants; undocumented migrants; highly skilled and business migrants; forced migration; irregular migrants; asylum seekers; family members; refugees; return migrants; and long-term, low-skilled migrants.

But in the back-drop of recent surge of human trafficking, it has come under critical scrutiny. Is labor migration an unmixed blessing for the sending country? What are the consequences of migration on the migrant labor, and also for their families back home? These questions remain to be answered. Faist (2008) found that the relationship between international migration and economic development in the origin country has been traditionally explained from two contrasting theoretical approaches: the “Convergence” point of view and the “Divergence” point of view.

**Definition: Convergence:** It is a neo-liberal economic theory that states that the sending regions obtain major benefits from out-migration for their development process (Hermele, 1997).

**Definition: Divergence:** Divergence school argues that out-migration hinders development of the sending regions as it escalates the state of dependency and undermines the prospects for development. (Hermele, 1997).

## Literature Survey

### Migration and Development

Migration has been considered as a livelihood strategy for long. Whenever people could no longer secure a livelihood in their own country, many opted for migration elsewhere. Iredale, Hawksley, and Castles (2003) mentioned that individuals’ migration is part and parcel of family strategies for survival or mobility in the developing world. According to Schiantarelli (2005), there has been the argument that by sending workers abroad, low income countries can derive a net positive development impact and reduction in poverty. As pointed by Vertovec (2007), temporary labor migration programs may be better able to deliver development and poverty reduction dividends more effectively than permanent or semi-permanent migration.

Alam et al. (2015) argued that international human capital migration is one of the key components of microeconomic development in a labor supplying country. The returns of migration play a significant role in the economic development and growth of the source country. Mamun and Nath (2010) found that remittance is the second largest financial inflow, exceeding global aid in various developing countries. Ratha and Mohapatra (2007) mentioned that remittances tend to be strongly countercyclical in Bangladesh and India. It implies that remittances have a tendency to rise during recessions in recipient country’s economy. Migrants try to send more during economic hardships of their families back home. Woodruff and Zenteno (2001) said that remittances can encourage entrepreneurship, generate significant employment and income and influence economic development and poverty mitigation by encouraging microenterprise development. Yang and Martinez (2006) revealed that migrant households have a higher tendency to invest in

comparison to the non-migrant households. Alam et al. (2015) found that international Human Capital migration significantly improves the local and household economy of Bangladesh such as house ownership, improvement of economic conditions, donation towards local institutes and infrastructure, new work experience, new skills, and poverty reduction. Hossain (2012) argues that overall migration rate do not convey the full picture of the impacts of migration. The structure of migration (i.e., skilled or unskilled migration) is also significant. M. Rahman (2009) argued that types of migration have different impacts on the process of development in sending countries. Mendola (2012) found that the extent of the impacts of migration on local economy is influenced by the number and distribution of migrants in the population or the amount and dispersion of remittances. The impacts of migration and remittance on source countries can be apprehended directly through changes in expenditure and investment pattern of host-households (having migrant member), and indirectly through multiplier effects at meso and macro-level in the labor-market composition. G. J. Hugo (2016) mentioned that both internal and international migrations have increased exponentially in scale, and both are causes as well as consequences of rapid economic and social change. He concluded that mobility of internal and international migrants is now part of the calculus of choice of most Asians. It can and does provide opportunities for them to improve their lives. It can have outcomes in terms of economic development and poverty reduction for families, communities, regions and nations. Whether those outcomes are positive or not can be influenced by policy. Lucas (2005a) says that migration may influence rural production and expenditures, and migrants may be motivated to invest in their area of origin by others through demand-side spillovers. Ghosh (2006) found in China and South Africa that remittance-receiving households increased crop production by investing the extra capital available from remittances. Rapoport and Docquier (2005) mentioned that remittances have been shown to promote self-employment by providing much needed financing for small businesses. Taylor (2006) found that in Mexico, one-fifth of the capital invested in small enterprises comes from remittances. Glytsos (2002) has found evidences that remittances may indeed have served to accelerate investment and economic growth in local economies for some regions as Pakistan, India, Mediterranean countries and Eastern Europe. Dustmann and Kirchkamp (2002) found that the migrants from Turkey to Germany seem to become active entrepreneurs after their return to home by investing their savings from Germany to finance their businesses at home. Hasan (2006) cited remittances as making up around 60% to 70% of the recipient household's total income. Taylor and Martin (2001) concluded that migration will have the largest positive effect on rural economies when the losses of human and other capital are small from out-migration; when the benefits of migration accrue disproportionately to households that face the greatest initial constraints to local production; and when households that receive remittances have expenditure patterns that produce the largest rural income multipliers. In 2001, M. Rahman (2009) surveyed that migrants tend to be comparatively better-educated. 94% of them were literate compared to 59% adult literacy rate in Bangladesh in 2001. He also found that 72% of the migrant families were headed by wives left-behind, 78% of the wives of migrants were the main recipients of the remittances, and 72% of the wives left behind enjoyed the sole right of using the remittances. He identified that international migration perhaps promotes nucleation of

families (i.e., where only the husband, wife and their children reside) in rural Bangladesh as remittances allow migrant's wives and children to be more autonomous lifestyle. Wives of migrants enjoy considerable leverage in division of labor and decision-making in their own families compared to their non-migrant counterparts. All these are suggestive that international migration may increase women empowerment at the local level.

Asis (1995) found in recent literatures that migration can induce upward social mobility for migrant families in the origin countries. M. Rahman (2009) described that temporary migration of many Bangladeshi migrants has contributed to social change in their own families and communities over time, and this process will most likely stimulate macro-changes in Bangladeshi society in the near future. Goldin, Cameron, and Balarajan (2011) have shown that remittances stimulate local development. Hemmi (2005) argued that in developing countries, the existence of migration opportunities might cause conflicting effects on long run growth rate and transitional growth rate.

However, many researchers and scholars disagree with such high positive returns of migration all the times with all the countries. Ellerman (2003) expressed that much of the literatures is excessively optimistic about the impact of North-South migration on the South. Patzwaldt (2004) found evidences about the difficult positions of illegal labor migrants in Russia and commented that informal migration is widespread and safety norms in the workplace are frequently violated, hygienic living conditions and norms of fair treatment and remuneration are disregarded. Okólski (2006) stated that the impact of migration for work on the economic development of micro-regions of migrants' origin is (with rare exceptions) very limited. The basic reason for that is a very low propensity on the part of migrant households to save or invest. Migrants tend to transfer back home a substantial part of their earnings in kind (e.g. second-hand cars) and their households tend to spend most of the remitted money on current consumption and purchase of a car or an apartment which all are very much non-productive investments in nature contributing hardly anything to the local economic and social development. Tanner (2005) pointed out that particularly for a vulnerable sending country, the benefits of such migration have their limitations, some of which are already visible and have been analyzed, some of which are still unknown, and finally some of which have not yet been sufficiently or objectively examined.

### **Migration and its Costs**

M. M. Rahman and Lian (2005) mentioned that migration costs comprise a wide range: economic costs, social costs, and psychological costs. Economic costs are of two categories: direct (visible expenses in the migration process e.g., airfare, visas, medical checkup costs, etc.), and indirect or hidden (decline in family incomes due to loss of income-generating assets or due to repaying debts). Ahsan Ullah (2013) uncovered that some degree of psychological stress is always involved whether migration is voluntary or forced, planned or unplanned. It emerges from the cultural shock and adaptation difficulties in the destination countries. Acculturative stress may foster poor adaptation, identity crisis and problems in daily life abroad. But unfortunately such psychological health issues are seldom considered and poorly addressed. Every migrant had to pay a

psychological price during their stay abroad. G. J. Hugo (2016) mentioned that international migrants often move into contexts where they not only have a difficult legal status abroad, but they speak a different language and have different cultural attributes which restricts their ability to adjust. Ahsan Ullah (2013) also highlighted that migration abroad inevitably associates opportunity costs as it is a choice between “to stay” and “not to stay”. Apart from these two costs of migration, Berry (1992) found that there is a social cost involved as children grow up without their parents in case of migration. Lucas (2006) found that in Africa, where the chunk of skilled population is smaller, the skilled-labor migration can be a great obstacle for the development of the same. Agesa and Kim (2001) conclude that in Kenya, migration is likely to split the family geographically thereby emerging psychological costs of separation. Yeoh, Graham, and Boyle (2002) examined that in case of temporary migration, the migrant family members have to live under transnationally split conditions where the non-migrating families are “left behind”. Germenji and Swinnen (2004) argued that if migrant work is lucrative enough, left-behind households may entirely forgo productive activities and live primarily on remittances. Mendola (2012) highlighted a macro-level danger that remittance may compete with rural production and slow economic expansion. Remittance inflows may hamper the export performance and, hence, output growth and employment. In Morocco, it has been seen that because some farmers are able to live from remittances, they abandon cultivation (Glytsos, 2002). Hence, Taylor and Martin (2001) rightly pointed out that the full opportunity cost of rural out-migration includes not only the lost agricultural product of the migrant but also the loss of agricultural production of others.

G. Hugo (2009) identified that highly skilled migrants often remit less to origin country. One reason is that they come from well-off families with lesser family needs. Another reason is that they often manage to bring their immediate family with them, and hence their commitment back home may not be as great as that of low-skilled migrants. Carling (2005) said that due to lack of capital to finance migration and lack of required skills, the opportunity to migrate is limited for the poorest section of the community. G. Hugo (2003); and Iredale et al. (2003) explained that any assessment of the impact of out-migration on sending communities cannot be understood outside of the context of the family in the non-western context. M. Rahman (2009) also found negative implications like misuse of remittances, broken families, and lack of parenting for children apart from the positives of migration.

Many migrant workers in Saudi Arabia have been abused and exploited. Some of them live like slaves. Some female migrants become victims of sexual abuse and forced confinement. Khan and Ghazanfar (2003) mentioned that annual death of Bangladeshi workers in Saudi Arabia reportedly is between 200 and 300, due mainly of industrial accidents, murder, suicide, drowning, execution and stampede. As per the ILO Research Department based on (IOM) (2004), migrants face abuse in home countries by overpaying for recruitment and logistical help. Recruitment fees in Bangladesh and Vietnam are around 3.5 times the per capita income. Workers from Nepal do not need to pay any placement fee, while Bangladesh has comparatively high fixed fees for migration. Such high recruitment fees introduce significant debt burden on the migrants. Estimates indicate that more than 10 per cent of migrant income goes to debt servicing at

home (Khatiwada & Samaniego, 2014). Cellini (2007) found that when labor productivity and wages depend on the average level of human capital, voluntary skilled migration lowers the average level of human capital and productivity performance in the source countries.

McKenzie and Rapoport (2010) discovered that migration depresses attendance in schools and achievement of children between the ages of 12 to 18 years. Ngoma and Ismail (2013) also found that public expenditure in education is negatively related to human capital formation in the migrants' source countries implying that subsidizing education without appropriate measures for retaining skilled labor in the source countries is inefficient when a country is faced with persistent skilled labor migration. Groizard and Llull (2007) disclosed similar picture that skilled migration rate has a negative impact on human capital investment in source countries as their findings showed that the effect of skilled migration rate on human capital investment is insignificant. Ngoma and Ismail (2013) recommended that in the source countries, skilled labor migration related policies should be considered cautiously as Dustmann and Mestres (2010) highlighted that skilled labor migration has become more unidirectional and relatively permanent leading to potential human capital loss in source developing countries. Ngoma and Ismail (2013) finally showed their concerns that globalization might exhaust skills from developing countries and eventually slow down their growth potentials and convergence.

Hence it seems safe to comment that for human capital development of the sending developing country, mere mobility of anybody and everybody as migrant without sending country's need-based selection policy may backfire both in the short-run and long-run.

### **Migration and Brain Drain**

Lucas (2005b) unfolded evidences of severe brain drain in low-income countries which is another major concern of migration at community level in the form of loss of human capital. Riccardo Faini (2003) concludes that brain drain is associated with a smaller flow of remittances as there are considerable evidences that skilled migrants have lower propensity to remit. So, brain drain can have double blow to the economy of the low-income sending countries in the form of loss of human capital and that of remittance as well. Koettl, Holzmann, and Scarpetta (2006) thinks that brain drain is a major concern to source countries. Source countries lose a significant amount of human capital through highly skilled migration. Ngoma and Ismail (2013) find that, in the short run, the probability of skilled migration impact adversely on human capital investment both at secondary and tertiary educational levels. They also mentioned that brain drain raised the education and income level of the destination countries at the cost of the source countries. Apart from that, skilled migration will hurt mostly the other skilled workers in the home country more than it affects the remaining unskilled workers. CHEN (2009) argued that when destination country is biased towards skills of the migrants, they relax restrictions on migration of highly-skilled workers which will become damaging to the economic growth of the source countries in the long run. Furthermore, it is argued that when asymmetry of information about the skills of immigrants exists, brain-waste might occur if the expertise of the highly-skilled migrants is not utilized adequately in destination

countries. Katz and Stark (1984) claimed that only the people with below-average skills have incentives to migrate.

On the other hand, a considerable amount of literature recently argued that brain drain might lead to “Brain Gain” in the source developing countries of the migrants (Ngoma & Ismail, 2013). It was also argued that a surge in skilled migration rates can lead a source country out of underdevelopment trap through “brain gain” and inter-generational transfer of human capital (Fan & Stark, 2007). Beine, Docquier, and Rapoport (2001) differentiated two growth effects related with skilled migration: the “Brain Effect” and the “Drain Effect”. The former is assumed to be beneficial, resulting from investments in education induced by migration opportunities due to higher expected return abroad. And the later is potentially detrimental to the source country’s economy due to the departure of valuable skilled workers. The net impacts of these two effects will depend on which effect is dominant. From cross-sectional data of 127 developing countries, Beine, Docquier, and Rapoport (2008) showed that brain drain migration contributes to an increase in the number of skilled workers left behind in developing countries. They further concluded that countries with comparatively low level of skilled migration and low level of human capital are likely to experience net gain. Ngoma and Ismail (2013) found in theoretical literature that highly skilled migration might have both positive and negative effects in the source country. Kugler (2006) found positive effect between human capital and remittance. The findings of Grieco (2004) indicate that most migrants’ source developing countries lose their most talented individuals before they are adequately trained. Ngoma and Ismail (2013) found that although brain drain impedes human capital investments in developing countries by draining skilled workers, remittances received by migrants’ dependent back home are partly spent on education. But the extent of such positive impact depends on whether remittances tend to rise with the increase in skilled migration rates as R. Faini (2006), and Dustmann and Mestres (2010) argue that skilled migrants tend to remit less due to the permanent nature of their migration.

### **Migration and Human Trafficking**

While the demand for foreign labor continues to expand, migration flows have become increasingly diverse and complex (IOM) (2004). This has been instrumental in causing a proliferation in fraudulent brokers and agency syndicates. They often determine the networks to use for migrants. Apart from that, loose governmental concern, widespread corruption, etc. also instigate potential migrants to opt for illegal and costly routes of migration. The motive of such brokers is to make quick money from the transportation process (IOM) (2004). Wickramasekara (2003) said that irregular migrants account for 30-40 per cent of the total migrants in Asia. Siddiqui, Sikder, Haque, and Hossainul (2004) found that, in many cases, they fall themselves in abusive and exploitative situations when they move with little or no information. In this process, a large number of semi-skilled and unskilled migrants fall into the agents’ traps by spending their last resources, and emptying all their savings, to finance their migration. Kassim (2001) mentioned that major source countries of illegal or semi-skilled workers in Malaysia are: Indonesia (85.5%); Myanmar (4.7%); Thailand (3.2%); India (2.3%); Bangladesh (1.6%);

and Pakistan (1.2%). As Chan (1999) mentioned, due to its booming economy and severe labor-shortage, Malaysia made an agreement with Bangladesh to import skilled, semi-skilled, and unskilled labor from the later. However, within four years, it terminated the contract. But the flow did not stop. Many still trespass using illegal routes offered by traffickers and brokers. Chantavanich, Germershausen, and Beesey (2000) found that Thailand is one of the major regional hubs for irregular migration and trafficking. It is simultaneously an origin, destination, transit and facilitation center for the illegal migrants. As Ahsan Ullah (2013) pointed out, though Thailand is not a labor-importing country, the number of illegal workers arrested in the year 2000 was 4,44,636. Easy to get tourist visa, cheaper hotels and food cost all act as catalysts in choosing Thailand as a transit country than neighboring Singapore. However, Singapore is a transit country between Bangladesh and Malaysia. Ahsan Ullah (2013) was also surprised to identify that while the final destination of the migrants was Malaysia, many did not even know that they were going to Thailand first, and they were also unaware that they not given Malaysian visas. The brokers withheld the workers' passports until they were on board the aircraft so that they became unable to verify the type of visa actually endorsed in the passport. Finally they discover Thai tourist visa in their passports. The routes chosen by the traffickers depend on the extent of risks involved and the convenience in transferring the victims to other points. The total journey of migrants is strictly guided by the traffickers.

### **Migration and Inequality**

Many works point to an increase of inequalities between migrant and non-migrant households back home (Mendola, 2012). Haan et al. (2000) identifies that migration improves the economic position of those who migrate and consequently increases inequality. M. M. Rahman (2004) found that international migration is considered as a status symbol, and migrant families use migration as a strategy to reposition themselves in the rural social class. Üçok (2006) identified that migration not only relates to the movement from one society another, but can also entail a change in social class and status.

### **Migration and Migrants' Indebtedness**

M. M. Rahman (2015) said that with rising cost of migration, most migrants' fate has been sealed into taking debt. Families of the migrants usually borrow from relatives, money-lenders, and they also sell or mortgage their farmland to finance the costs. This in turn, reinforces the dependences of family economics upon remittances. In case of debt migration, the recovery of the economic health of the family is contingent on the availability of external resources in the form of remittances. Afsar (2009) said that in debt migration, not all migrants are able to be out of debt during the first contract period in the Gulf (within two to three years). It necessitates renewal of contracts or re-migration.

## Conclusion

Mendola (2012) identified that costs and returns of migration flow are still unclear which is especially true with respect to migration of rural people of developing countries. The financial and opportunity costs of migration can be substantial. M. M. Rahman (2015) stated that both the economic cost of migration and migrant remittances are equally important. But often the latter draws the most attention in academic and policy circles today. The government often overlooks the implications of chains of debt and the distortion of family economics in the migration process. The economic cost of migration is a key component for Asian labor migration, but unfortunately, is not duly recognized in contemporary literature. Hence, to be successful migrant, and to have a cost-effective migration, the migrant himself/herself should have conscious effort in identifying who should migrate, and who should not, where to migrate and where not to. The government of the sending countries should put in place prudently devised migration policies to help succeed the migrants. Finally, both the migrants and the governments of the sending countries should realize that migration should not be a matter of whim but a matter of economic feasibility instead.

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## **The practice of childhood in both rural and urban settings in Bangladesh: An Ethnographic Exploration**

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**Abstract:** This paper offers some preliminary observations concerning the nature of childhood construction in the context of Bangladesh. In general this paper examines the relationship between childhood, place and socio-economic condition. This understanding is based on a growing body of work on 'anthropology of childhood'. By reviewing existing literature, we show that children are not seen as social actors in their own right. We argue that we need to document children's perspectives on, and participation in, the social world. By providing ethnographic evidence from a transnational social setting in Biswanath, Sylhet, we have presented children's experience, which lays out different kinds of childhood. Alongside this, empirical data has also been provided from Dhaka city. This leads to ask whether childhood should be seen as a cultural universal. We argue that children negotiate with adults in subtle ways. Childhood is thus a matter of 'doing' rather than 'being'. We conclude that childhood is contextual and negotiated, and is highly shaped by children's embodied practices.

### **Introduction**

In this paper we attempt to examine the practice of childhood in slums (locally called 'colonies') in Biswanath in Sylhet. We investigate specific contexts where most of the children are internal migrants enabling them to share power with adults in the household, making biological factors (e.g. age) irrelevant for children's identity. This challenges the existing conceptualisation of childhood, which presents children as 'cultural dopes' who are forced to do things according to the will of parents (Ahmed, 2005).

Apart from the Introduction and Conclusion, this article is divided into three main sections. In the second section we discuss the existing literatures, which are devoted to the conceptualization of children. This section will pay special attention to the ways in which children are conceptualized in both governments of Bangladesh and academic discourses. A critical outlook will be provided as to whether these literatures, one way or another, conceptualise childhood in terms of age e.g. biological factors. Against this conceptualisation, a critique will be made to show whether childhood is a socio-political concept. To do so, the contexts from which ethnographic data have been drawn are introduced in the third section. The fourth section deals with the practices of childhood. In this section, we discuss some theoretical relevance of Bourdieu (1977) and Giddens (1984) in the context of childhood. Taking examples from our ethnographic data, we argue that poverty forces many children to take part in income generating activities which enables them to 'bargain' and 'share' power with their parents. Children negotiate this changing situation with adults in subtle ways. Childhood thus is a matter of 'doing' rather

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than 'being'. We conclude that childhood is contextual and negotiated, and is highly shaped by children's embodied practices (Ahmed, forthcoming); Ahmed, 2019a).

### **The anthropology of childhood**

The anthropology of childhood has flourished as a distinctive field which emerged in Britain during the 1970s. It differs from classical anthropological culture and personality studies conducted by American anthropologists such as Margaret Mead during the 1940s and 50s. These studies explored the processes in which socialisation and cultural transmission take place during childhood. One of the major limitations of these accounts was to ignore children's own active role (Montgomery, 2009). The focus was instead on the mechanisms through which culture passed between the generations.

In recent years, by contrast, children are seen as social actors in their own right. This understanding enables us to document children's perspectives on, and participation in, the social world. According to this approach, children experience different kinds of childhood in different cultural milieux and thus questions are raised about whether childhood should be seen as a cultural universal. Recent scholarship argues that while 'children may not occupy central social, political and economic roles in society, it is important to see that they can and do make an active contribution' (Lancy, F. D, 2012). In this paper, based on empirical observation, we seek to outline anthropology of childhood which emphasizes the different social worlds of children and how children can take household economic responsibility in absence of their adult guardians.

Contemporary literature argues that childhood and the experiences of children are shaped through particular histories, cultures and political economies (Levine, 2008). This understanding is a crucial point in understanding changing nature of childhood which we shall be discussing in the paper. Anthropologists remind us to beware of creating the impression that particular constructions of childhood have a fixed relationship to particular places (c.f. Gardner and Mand, 2012; Fog-Olwig, 2003: 4). Taking a cue from Gardner and Mand (2012), we will argue that culture is neither fixed nor bounded by place and space (Gupta and Ferguson, 1994) but also note that the children involved in our research were 'matured' in a particular way in order to act as 'adult-like' in order to run their family. Our work is also situated in anthropology of active children rather than being passive 'adults in the making' children are active cultural agents, with their own agendas and perspectives (Benjamin, 2012; Hirschfeld, 2002; Montgomery, 2009).

### **The conceptualization of Childhood in Bangladesh literature**

The (Convention on the Rights of the Child) CRC comprises 54 articles. The first defines a child as every human being below the age of 18, unless majority is attained earlier according to the law of the country (Ivans- Smith, 1998). In this act, age 18 is the general benchmark definition. Following CRC in 1990, the Bangladesh government has accepted the global categorization of childhood as vulnerable persons who needed protection and the right to education, health and nutrition (Government of Bangladesh, 2002). Children's roles and rights are determined by age. This has been reflected in CRC. All laws, policies and practices relating to children must therefore apply to persons of this age (CRC,

undated: 3). Following CRC the government differentiates children into different age groups: under 7 no criminal responsibility, 6 to 10 must attend school, under 12 cannot work in shops, offices, hotels or certain workshops (except as apprentices), under 14 cannot work in factories, child vagrants must be held separately from adults, under 15 cannot work in certain parts of transport sector, under 16 may not be held in ordinary prisons or receive capital punishment, girls cannot consent to sexual intercourse, under 18 girls cannot marry, under 21 boys cannot marry (UNICEF, 1997, 9-10).

There are a number of problems in the CRC definition: firstly; the government has adopted an unproblematic Western model of ideal childhood. Secondly; childhood is defined from an isolationist view, which assumes it to be a special category. Thirdly; it is also assumed that childhood has no linkages with socio-economic classes, gender, age groups and generations<sup>1</sup>. Interestingly, the CRC definition followed by government is being reproduced in most of the literatures in Bangladesh. Let us have a brief look at the ways in which childhood is being conceptualized in Bangladesh literature.

Blanchet (1996) describes different types of childhood, which are highly variable cut across class, gender, age and regions. She tries to define childhood in relation to human rights entitlements of children set out by the convention of Rights for Children. Blanchet's study successfully shows the existence of different types of childhood in urban society in Bangladesh. According to her, *bustee* children are a degraded social category. What are missing from her analysis is the question of how *bustee* children themselves feel and experience and how they interact with wider society where hierarchy is predominant. Our findings show that the *bustee* in Jalalgaon represents a dynamic life where people struggle to win against the odds. In Blanchet's study middle class children are considered as a special category. Another weakness of her study is that, though she is very much interested in taking into consideration the cultural dimension of childhood, she unconsciously conceptualizes childhood in terms of biological factors. Blanchet falls into the same trap of western discourse on childhood conceptualization of which she is critical. It is explicit in Blanchet's conceptualization that childhood is not homogeneous and varies in different context (ibid.37-69). Our findings suggest that *bustee* children in Jalalgaon have different narratives and testimonies, which imply changing and negotiating boundaries between children and adult. Blanchet mentions the hierarchical structure of childhood within the family. But one may argue that the way this hierarchical structure is constantly changing is determined by children's bargaining power.

In *Belonging to Others: Cultural Constructions of Womanhood Among Muslims in a Village in Bangladesh* Jitka Kotalova (1993) explores human maturation and childhood. She places an emphasis on personhood which shows the dynamic aspect of childhood. Though Kotalova draws our attention to the 'child' as an individual being of intrinsic worth, autonomous and self-fulfilling, she does not consider the 'child' as an agent (1993: 69). In what follows, we shall explore issues attached to transnational place and children's role in more detail, suggesting that these lie at the heart of an understanding of

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<sup>1</sup> Age limit for defining child varies in different organizations. For example, Women repression Law defines childin age 16 years, ILO defines in 14 and UN convention defines 18 years.

dynamic nature of childhoods. We shall also provide ethnographic evidence how a focus on economic role might inform wider understandings of 'adult-like child activity'.

The conceptualization of children is highly problematic in the pioneer work of Aziz and Maloney (1985). This study uses the cultural categories of childhood such as *sisukal* (infancy), *balaykal* (childhood), *kaisor* (adolescent), *madhaykal* (middle age), *bridhokal* (old age) and so on. We argue in this paper that childhood is not static, rather it is highly dependent on socio-political factors beyond biological determinism. 'Unda bacha' 'chotoboro' are not categories related to physical attributes as Aziz and Maloney tend to assume, rather bodily growth is determined by their role, responsibility and duty. A *bacha* can take the leadership of his or her family as breadwinner. This sort of complexity has not been given significant treatment in Aziz and Maloney's study.

Tanvir Mokammel's report on 'Conceptualisation of Children in the Bangladesh Media' (1994) explores how childhood is being represented in media, especially on Bangladesh Television (BTV). Mokammel argues that western nuclear family-centred values are reproduced and recycled through different programmes. In these programmes a middle-class value oriented child ideology is assumed to be followed irrespective of class, gender and regions. According to Mokammel the social milieu and the characters are very middle class. He also argues that 'even when the plays is set in rural surroundings, the characters are imbued with urban middle class values.....' (quoted from Blanchet, 1996:171). In these plays we find obedience to parents and to elders, loyalty to religious precepts, hard work to achieve good academic results, self-sacrifice and modesty are presented as general characteristics. As Mukammel strongly argues, "The hard reality of the teeming millions of working and unprivileged children are never depicted on Bangladesh's television screens, as if they did not exist" (ibid:171).

A number of points can be made from the above literatures on the conceptualization of childhood in Bangladesh. First; children are often conceptualized in a highly homogenized way. Second: portrayals of children centre on 'innocence' ('obujh'), *komolmoti* (politeness), *bacha manush*, *kichubujena*, and so on. Without looking more closely at what children do and the relationships between adult and wider society, the literatures define children as a biological category where age is a determinant factor. Against this assumption, an alternative explanation of childhood is necessary to understand how childhood is constructed. Our empirical data shows that children's identity is largely shaped by various factors such as, the precarious social position of adults, children's conformity and obedience, children's participation in domestic and income activities, and negotiation of power within the household. All these factors enable migrant children to gradually embrace the changes in their new roles and responsibilities in a new place. These findings come from our ethnographic fieldwork in Sylhet. Let us have a look at the context from which we have drawn our data.

### **The contexts of the paper**

Our arguments are based on some ethnographic observations concerning the nature of childhood in different locations in Bangladesh. Whilst these observations are based on a number of research projects we were involved amongst Londoni migrant village in

Biswanath, Bibiana, Sylhet, we intend that what follows will contribute to the wider project of conceptualising the relationship between childhood, place and poverty (cf. Gardner and Mand, 2008; Fog-Olwig, 2003; Young and Ansell, 2003; 2004). In addition, the research on Child rights in Dhaka city, as part of Save the Children-Sweden-Denmark partner organisations review, and in its situation of child participation had a simple empirical aim: to provide qualitative data on childhoods<sup>2</sup>. Our experience in these research works go with a growing body of work on childhoods. Within discussions of these works, however, children are largely presented within dominant discourses as 'in need of help of the adults.

This village Jalalgaonis located in the heart of Biswanath, a booming Londoni area only twenty minutes by bus from Sylhet Town<sup>3</sup>. Our main objective in undertaking the research was to understand the intersecting dynamics of internal and overseas migration in the village. With its resplendent shopping malls, fast food outlets and multi-storied community centres, Jalalgaon is a 'Londoni' village *par excellence*. In contrast, a number of people live in the various colonies (slums) in Jalalgaon. By 'colony' (a local term) we are referring to low brick and tin houses, reminiscent of urban *bustees* found over South Asia, which are rented to in-coming individuals and families on a sliding scale of cost according to the facilities on offer. Viewed as outsiders, their inhabitants are generally viewed in negative terms by villagers, who argue that they are 'dirty' and bring 'crime' and 'deviance' to the village. Over our year's fieldwork, colony households were in constant flux.

In addition to our Biswanath research, many of the insights on which this paper is based draw on our research experience on issues of child rights and situation analysis in both rural and urban settings in Bangladesh. We have been researching the child right issue with international organisations. Perspectives from these experiences will be referred to this paper. Let us discuss a few words about the context of this work.

The study was devoted to build up a Baseline and Situation Analysis of three organisations namely Child Brigade (CB), Icheey Media (IM) and VorerAlo (VA) (Ahmed *et al.* 2006). Save the Children Sweden Denmark (SCSD) facilitated these three child-led organizations through providing trainings as well as logistics. The main aim of this study was to look at the ways in which Save the Children Sweden Denmark SCSD addresses the child rights-based monitoring and evaluation system based on a framework for bringing positive changes in the lives of girls and boys.

Based on this, the study suggested specific strategic directions for future programming in light of baseline survey and situation analysis, with the purpose to represent children's' voice as they were the key actor. We also suggested that without an understanding of specific situation- in which child-adult and socio-cultural factors are intertwined.

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<sup>2</sup> Later in the paper we shall question this term; for now let us use it as shorthand for families and communities who are spread over different locations within the diaspora

<sup>3</sup> The research was funded by the Sussex University's DRC in Migration, Poverty and Globalisation. The project involved a year long study of a *Londoni* village (which for reasons of confidentiality we shall call Jalalgaon) in Biswanath Thana, Greater Sylhet in 2004-6.



### Practice of childhood

It is evident that a number of studies and literature on childhood are highly dominated by the sociological and psychological approaches which define children as 'cultural dopes' whose lives are determined by the wider social organization (Elkin and Hendel, 1972; Danzier, 1971; White, 1977; Akhter,). Against these theoretical dimensions, anthropologists are concerned with the study on childhood long before (1998). The pioneering study illustrates children as a muted group and they need to be given voice. Along with this path James and Prout (1990) has echoed the earlier tradition in giving emphasis on participating and engaging children. In their everyday practices, how childhood is practiced within a social context is the main interest of the anthropologists (James, 1993). James argues that early years of human life is not biological, rather than it is social.

But these studies do not consider children as agents located in the acceptable boundary of adult-child relationships in different societies<sup>4</sup>. It is necessary to understand the process of negotiation between adults and children that stresses the individuality of the child. Anthony Giddens enables us to combine both individualistic approach and structural approach, which is highly relevant to an understanding of children's individuality. Our data shows that it is not structural rules created by adults, nor the social and cultural ideology that set up the structural boundaries to be followed strictly. Against the existing social science literature on individuality, Giddens argues that social practices are ordered across space and time (1984:2). In a similar vein, adult in colony dwellers in Jalalgaon do not discourage their children from taking on a new role of working, because it helps to improve their lifestyle. Though children learn to exercise more freedom they maintain their conformity to status at the society as well as within the family as 'good' and '*lokhi*' boys.

Like Giddens, Bourdieu argues that many aspects of individual behaviours are governed by community codes of conduct, but will vary according an individual's experience and position. We would add that place and location have also an important role in shaping children's behaviours and roles. The habitus concept of Bourdieu's is useful here. According to Bourdieu, 'habitus' captures the socially structured aspect of subjectivity in social practice, meaning a system of durable, transposable dispositions (1979). Bourdieu uses the term strategy to describe the diverse ways in which interests are addressed and meanings negotiated by social actors.

Thus individual actors may use strategies within the framework of the community's code of conduct, but their interpretation of these codes might show diverse outcomes, which are found in the formal cultural rules. In colonies in Biswnath, the slum dwellers' experience of migration, which is constantly in flux, contributes to their vulnerability and forces them to get involve in income generation opportunities. These opportunities allow both adults and children to re-interpret hierarchical relationships to a level which enable

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<sup>4</sup> With exception (White, 2004) Who argues that 'Child-centred' development practice must not be 'child-only': social and economic justice for poor children must be tackled in the context of their families and communities.

them to share status and power. To explain this, let us take two examples, namely changing child-adult relationships, and children's work in daily lives from Jalalgaon.

### **Children's personhood: Changing child-adult Relationship**

It is almost common in Bangladesh that children aged 5-9 are supposed to do some household activities. These sorts of jobs have no recognition, especially from an economic point of view. Changing locations has given children and adults in Jalalgaon a chance to enter a new role adjustment. The migrants find this place as good chance for survival. The children's involvement in different income generating activities enable the adult to participate in survival strategies. With new role of children in income, the adult leaves the space for children. The following case illustrates this.

Shah Alam, aged 10, narrates his experience. According to him,

My family consists of five members. My father is a van driver and my mother sells bread in the bazaar. I was born here. My parents came in Biswanath from Mymensingh about sixteen years ago. My father used to drive a van from the very beginning. But now he had to abandon it due to his sickness. My mother had a dream to educate me. That's why, she never ever asked me to get involved in income generating activities. About five years ago, she sent me to school. I finished primary level. Then I had to quit the school. Actually I did not get any interest in this type of study. That time, my parents scolded me very much and requested me to go to school. But I just ignored them, because I was keen to play. After passing some time, I realized that I just simply spoiled my life in my own hand. After leaving school, first one year, I did not do anything, just spent time idly. At that time, my father got sick and he lost his energy to drive the van. My mother tried to run the family. But I realized that it is very tough for her to run this family alone. Then I took the decision to do something. I asked my parents to lend me one thousand taka for opening a small business. I started selling pickle. I earn 50-100 taka a day. Of this money I spend 25-30 taka per day as my pocket money and the rest goes to my mother. With this pocket money I go to restaurant with my friends and buy something for my sisters. I do not enjoy this business. I will shift to another business soon. I want to do something better for earning more.

The case has a number of elaborations. The precarious economic condition forces a child to get involved in income generating activities. This is not an unusual case for a child in Bangladesh. The conformity arises when he was about to leave the school. He was obedient to his parents. But he was brave enough to take the initiative to run a business himself. And it was highly negotiated with the parental authority. The case also shows that once he has started a business to contribute financially, it was highly regarded by the parents. In addition, a child can take decisions without consulting with his parents. The case also shows that children embrace the changes around them about their new role. Within and between the households, children's activities allow them to share and bargain power. It is interesting to observe whether children's role is violating or conforming the patriarchal/ hierarchical orders? The case illustrates that children's outward conformity allows them to make a space for their position but without changing junior-senior hierarchy.

Bourdieu's work also encourages us to take similar enquiry to explain bargaining processes, which initiate change in the intergenerational relationship through re-interpretation of boundaries and rules. In fact, children's access to income is not seen as threat to patriarchal hierarchy rather it is interpreted as a symbolic capital introducing change and *habitus*. Both adults and children adopt strategies that interpret their actions in a new way linking many of these practices as survival strategy. This is the context where we shall follow Bourdieu to examine the changing nature of adult-child relationships through analyzing their day-to-day interactions and negotiations.

### **Children's Roles in different contexts**

In this section we will discuss the changing nature of roles and responsibilities borne by children in different contexts and show what activities receive approval from adults as appropriate for their children (Khan, 2019). There are different levels of acceptance for different activities, depending on age and gender among the migrants in Biswnath. According to cultural ideology, there is a division of labour for boys and girls in a household. A girl is supposed to help her mother in cooking, washing and so on. On the other hand, a boy is not supposed to do any household work.

The colony (literal meaning is slum) children do not do work regularly. In other words, the children's work is not conventionally treated as 'job' or 'work'. The parents have categorized their children's work in five ways:

Firstly, some children are involved in income-generating activities. They are actively engaged in work such as hotel boys, sales boys in furniture house, assisting the builders, peddlers, van drivers and disposal collectors. These tasks are done regularly. And the parents believe that these tasks or work are 'productive'. These children's income is considered as breadwinner for those households who are abandoned, widowed, disabled. Their family sometimes depends on them. Because, they want to try to help their family in the time of crisis.

Secondly, some get involved in irregular earnings. These tasks are not salaried and not on contract basis. At times of adult earners' absence or at times of crisis these children do contribute by engaging in income. The nature of these tasks include: selling tea on the street, collecting disposal items from *Londoni* houses, selling ice cream, rickshaw pooling and the like.

Thirdly, some children spend their time by playing, chatting and gossiping.

Fourthly, some are school going children. These children are obedient or *badho* kids. Most of them are not involved in income generating activities. Because, their parents do not let them involve in income generating work.

Finally, those who go to school regularly, at the same time help the parents by getting involved in income earning activities. For example, children may go to school in the morning and come back home at noon. In the afternoon, they may go with their fathers to help them out by selling tea or giving hands to grocery businesses. They want to involve income-generating work to give financial help to the family. Some '*beyadop*' (impudent) or *obadhochelemeye* do not want to listen to their parents' orders. This is the common

testimony most of the parents in Jalalgaon provided us. Their purposes are not to help their parents financially rather than self-empowerment. If they have money, they can do anything without their parent's permission.

Our work on children's organisations in Dhaka city told the similar story (Ahmed et al. 2006). Children in three different organisations define childhoods and child rights differently. They refer it to relationships between material benefits and their fulfillment. It can only be meaningfully understood in terms of relationships between adult and child and situations on which this relationship is based. For the same reasons, role and responsibility only make sense within relational explanations. For example, as we have pointed out that current uses of 'child rights' as in an abstract and absolute sense. In some cases, parents and children do use the word 'child rights' according to their own perceptions, which are the reflection of their contextual situation. They use it for multiple aspects that are often related to material conditions e.g. livelihood.

Our findings also suggested that attitudes and practices of adult individuals and organizations are a major obstacle to ensure child development. The major characteristics of child rights across the three organizations are: (1) Rights is neither given nor delivered but emanates from specific social and economic conditions. (2) Childhood does not follow stereotype image. and (3) Interactions with adult and their organisations only one (albeit important) practice to promote child rights. Children's efforts and their capacity to run an organisation is sustainable only when a much wider set of attitudes and practices comes together to create a *culture of organisation*, including a wide appreciation of the importance of children's organisation.

Ahmed's ongoing (2019) research in New York unveils the nature of diasporic childhood. Carrying out amongst the Bangladeshi first and second generation, Ahmed's ethnographic research is framed by three interrelated conceptual questions. The first of these concerns how childhood is experienced in diasporic spaces (Gardner and Mand, 2012), whilst the second question focuses on how, through focusing on children's perspectives we might widen conventional understandings of the nature of transnational connectedness and / or diaspora. A third question concerns the formation of contested and debated of 'Americanized' cultural identities within the diaspora, an issue that to date has tended to be viewed solely in terms of the perspectives and practices of the first generation adults/parents. This contemporary research asks how this domain of family violence is reproduced in and through representations of culture, age and difference. It investigates how Bangladeshi children understand, subvert and imagine alternatives to the adult's authoritarian cultural values and engaged in various forms of violence in which they are enmeshed.

## **Conclusion**

We have argued that childhood is contextual and negotiated going well-beyond biological factors. Drawing on secondary materials and our own ethnographic fieldwork, we have examined how childhood can be understood as socio-political construction, which cannot be simply be understood as biological differences between adults and children. Children's experiences are not necessarily visceral as their role and responsibilities enable them to

act adult-like behaviors, making their personalities more culturally constructed than Natural/universal.

We suggest that age-based categorization for defining childhood is problematic, largely because it portrays children as innocent, naïve, powerless, vulnerable and ‘in need of help and protection’. This representation of children does not capture the power and authority in adult-child relationships. We have also argued that children should be considered as individuals or persons shaped by socio-political contexts. Children’s individuality in different sites we studied can be understood through the process of negotiations. Adults are assumed to enjoy authority according to cultural ideology of Bangladesh but their superiority is threatened by their positionality in a new location. The Biswnath data shows that children can take over the sole responsibility of the household which provides them power. Both the colony dwellers’ children in Biswnath and child led organisations in Dhaka city prove that age is not a determinant factor for their child identity; rather it is contextual, based on a specific time and space.

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## **Between Universalism and Cultural Relativism: Understanding UNCRC as a middle ground approach**

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**Abstract:** United Nations Convention on the Right of the Child (UNCRC) is the most widely ratified human rights treaty of the United Nations that comprise 195 countries. Despite this promising number, it has often been criticised for its universal nature and western biasness. However, if we give closer look to the process of this document to become a treaty, the participatory party and the content then we will find it very difficult to call this document as western bias. It gives plenty of space to incorporate local culture. Hence, cultural sensitiveness is also part of UNCRC. For this reason, this paper tries to examine the cultural sensitiveness of UNCRC with by bringing the context of Bangladesh and argue that it could be understood as a middle ground document between universalism and cultural relativism. In Bangladesh, guardianship thought to be the most important part to understand child rights. Anthropologists, especially Sarah White (2007) defended guardianship norms and argued that UNCRC stands against it. This paper tries to challenge the above statement and argues that it is possible to understand guardianship norms in Bangladesh within the UNCRC framework.

### **Introduction**

United Nations Convention on the Right of the Child (UNCRC) is often criticised, especially from anthropology corner, as a western bias universal document. This paper tries to challenge that by bringing the context of Bangladesh and argue that it could be understood as a middle ground document between universalism and cultural relativism<sup>1</sup>. In the case of Bangladesh, As Sarah White (2007) shows, children rights and entitlement thought to be rest under the normative framework of guardianship, which differ from the universalistic understanding of child rights. In her views, the guardian plays a prime role to give basic necessities and security to children and they also mediate between children and the community. Understanding children's rights outside from community and guardian in western individualistic style, in her point of view, will be no use in the context of Bangladesh and there is a great danger, this attempt might be identified as an outside imposition. Her way of understanding clearly focus on cultural relativist approach. However, defender of universalism argues that culture is unimportant, there are some common problems in child rights around the world which need to be protected

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under the umbrella of universal child rights. Savitri Goonesekere (1998) for example stated- “Asian children today are struggling as a result of a common legacy of authoritarianism and exploitation ... The international norms on child rights are thus as relevant for children in developing countries as they are for children in the Western world ...” (As cited Arts 2010: 12). According to this thought, it gives us an opportunity to fight against harmful cultural practices like using child as a soldier, discrimination of a child on the basis of gender, class, caste, ethnicity etc. White (2007) herself discuss some problems of guardianship norms like, discrimination of female child, the problem for the child who lacks guardian etc. Therefore, both universalism and cultural relativism have some opportunities and shortcomings. Hence, it is very important to find the middle ground between universalism and cultural relativism debate. The middle ground approach can help us to take positive aspect of both approaches and stand away from their limitations. For that purpose, we need to find how UNCRC on the one hand, help us to ensure children’s basic necessity and security by guardianship norms and on the other hand, create a space to stand against the discrimination and limitations of guardianship norms.

Beside the introduction and conclusion, I will discuss this topic in three more sections. Next section, I will briefly introduce the debate between universalism and cultural relativism both in terms of a broader discussion of human rights and in relation with child rights. Then in the subsequent section, I will discuss about guardianship norms and its importance to understanding child rights in Bangladesh. In the penultimate section, I will explain, how UNCRC can be explained as a middle ground on the debate between universalism and cultural relativism and a useful instrument to translate universal understanding of child rights to the local context of guardianship in Bangladesh.

### **Cultural relativism Vs Universalism: A Necessary Debate**

Since the 1990s, the debate between universalism and cultural relativism divide the academic sector as well as practical field on the discussion of human rights. Although it is now relatively settled in the middle ground with the understanding of ‘plural universalism’ (Arts 2010: 10). Universalism emphasizes, as Parekh (2005: 284) explains, on the ground of ‘common humanity’. The human being as a species have some common interests and problems which lead them to form a morality in order to uphold those common interests and fight against common problems (ibid). In the case of children, they all have the common interest of getting basic needs, secure environment to grow up, education etc. which give the morality that all the children of the world required those needs. Those are their rights as a child, which they entitled. Cultural relativism, on the contrary, claims that human nature and rights bounded upon the society they live. In this view, culture is seen as a moral category, which determines a person’s dignity, responsibility, and rights (Parekh 2005:284). We may bear as the same species but our understanding of morality differ base on the society we live. Therefore, according to this approach, what can be called as problem or as interest for children depend upon the culture, which gave normative meaning in a certain context.

Both of these approaches, however, have some shortcoming. Universalism seems to undermine the value of diversity and plurality of human being. Human understanding of

social reality is different; therefore, their interpretation of rights will be different from place to place. The universalistic idea is also problematic in the sense that it creates biasness where some norms and values globalized and use as a political tool to marginalize other norms. Mutua (2001) for example, discusses about this issue where he shows how western norms become the benchmark to marginalize non-western norms, which are often treated as savage practices not because they are harmful, rather because they are different from western norms. Cultural relativism, on the other hand, devalues the person's role and rights as a cosmopolitan citizen. The fact that - culture is not static, it is changing all the time. It changes by incorporating transnational or other cultural norms and rejecting its own. For example, the character of *Zwarte pet* (Black pete) in St. Nicolas ceremony was thought non-problematic in the Netherlands just a decade ago, but now many people perceived it as a symbol of racism (Noel, 2015). The cultural relativistic approach is also problematic to understand inequality and tension within a culture. Cultural value can be used to maintain existing inequality in terms of caste, class and gender. Donnelly (1984:412) for example, shows that All African Council Churches condemn politician for picking some parts of their traditional values and use them for their own political interest.

Universalism and cultural relativism both have some problems and possibilities. However, if we take the middle position, then, both of these approaches become useful. Parekh (2005:285) called this middle ground position as 'plural universalism' whereas Donnelly (1984:412) explain it as 'weak relativism'. Both concepts actually try to combine positive characteristic of universalism and cultural relativism. Plural universalism understands universality in diverse ways and weak relativism give space for the universal idea to come in. In terms of child rights, there are some differences and some commonalities among children's interests and problems in the world. These differences give us the opportunity to understand children's rights in the local context, while universality gives us the opportunity to fight collectively against harmful cultural practices.

### **Guardianship Norms as a Distinctive Nature to Understand Child Rights in Bangladesh**

In Bangladesh, children's right and entitlement thought to be rest under the guardianship of an adult, most often father (white, 2007: 512). Children are often called son or daughter of someone. If a child misbehaves, it is thought to be his or her guardian's fault, which gives the guardian an authority to correct them by moral teaching or by punishing. Sarah White (2007) discussed explicitly about the nature of guardianship in Bangladesh. According to her, it has some negative characteristics as well as some positive outlooks. Negative, in the sense that it is patriarchal in nature. Most of the time, a male member of the family who thought to be a guardian. If a father died or absent in a family, then the elder son or son in law become a guardian (ibid: 513). It also gives authority to a person to beat a child, which is thought to be right to correct a child's behaviour. Guardianship norms also create a problem when a child work outside and employer become a guardian. There are regular news coming up in the newspaper in Bangladesh that a child was beaten by his/her employer which create question whether an employer has the moral

right to become the guardian of a child or not. On the other hand, as white (2007:513) discuss, guardian, give protection to a child from the outside community. It is thought to be a guardian's responsibility to give food, shelter, education and other facilities to the children. Guardian act as a mediator to a child and *somaj* (community). Hence, if a guardian failed to deliver basic needs to the child, it makes that adult minor on the eye of *somaj*. Guardian is also having the responsibility to socialize child fully to make him/her capable to understand social reality when he became mature. Maturity, here, is not only dependent on age. As white argue, it depends more on how much a child understand social reality. In her words,

This is generally assessed in terms of how far a child, woman, or sometimes even a man can 'understand' (*bujhe*). Training is given both informally, through teasing, chiding, example and guiding, and formally, through tuition at home, school or madrassa (Muslim religious school). Small children have excused responsibility because they 'don't understand anything' (*kichu bujhe na*) (ibid: 514).

Marriage is thought to a transition to step in to the adult world. Therefore, the guardian is also responsible for marriage. This process of guardianship, however, reverses when parents get older. Then, it is the children's responsibility to take care of his/her parents. For white (ibid: 516), these ideas of guardianship are so powerful in Bangladesh that creates a problem for those children who lack guardian. These children are the most vulnerable and often the victim of physical and verbal abuse. For these children, employer or sometime child rights NGOs, become a guardian that give protection from those injustices. For white, this is the process that a child is understood in Bangladesh. Therefore, when we talk about child rights we should take this local context into account, otherwise, it will become an alien concept, which eventually will be failed. In her words,

In order to address effectively the specific situations in which children find themselves, these situations need to be analysed in their own terms. This means seeking local understandings of what is taking place, from the children themselves and from others involved, such as parents, teachers or employers. (ibid: 517)

Although White did not mention about a specific article or paragraph of UNCRC which create problem to understand child rights within the framework of guardianship in Bangladesh, her article stands negatively on the universal rights of the child. Throughout her paper, she argues that UNCRC gives a lot of opportunities to fight against discrimination of children but it also creates an opportunity for some development agencies to make children as an 'object of development gaze'. In her words,

The problem – here, the lack of child rights – is defined externally by representatives of the 'global community'. It is then projected internally, in theory onto all countries, but in practice rather discriminately, according to which are the subjects and which the objects of development intervention. In this case, 'child rights' as defined first by the CRC and then by the agencies' elaboration of the Convention becomes what Bangladesh lacks. (ibid: 509)

However, if we analyse her argument we can see that her criticism is more on the implementation of child rights rather than on the UNCRC as a document. The problem White discussed is more related to the translation problem. When the child rights problem

in Bangladesh understood under the framework of a global idea through the translation of local NGOs, it then failed to incorporate local context. Translating global concept into a local context, as Merry (2006:40) explain, never an easy process. It may create confusion among local people or may become something very different and ‘out of reach’ from the ‘global legal system’. Merry (2006:44-48) discuss about two types of translation. One is ‘Replication’, which mostly done by replicating global idea into local context by giving the local meaning of that global concepts. From the discussion of White (2007), we can say that replication may not helpful to translate child rights idea into the Bangladesh context. However, Merry (2006: 47) mention another type of translation, ‘Hybridity’, which give the opportunity to understand the global idea in the culturally prescribed way. I believe this approach is more suitable to understand child rights in a culturally sensitive way. For that reason, first, we need to ask- if whether guardianship is an important aspect for implementing child rights in Bangladesh then the next question will come whether UNCRC creates a problem for that. If not, then we can use UNCRC to hybrid global child rights idea and local guardianship norms to implement better child right policy for the child.

### **UNCRC as a Cultural Sensitive Universal Document:**

United Nations Convention on the Rights of the child is the most widely ratified human rights treaty that comprises 195 countries including Somalia as the latest party. Bangladesh is one of the first group of countries who ratified UNCRC. The process of ratification come to a long process of discussion in both international and national level and it by no means force imposition. A country can sign a treaty, which does not mean they should ratify it. The United States, for example, sign the UNCRC treaty 1995 and do not ratify it yet; Somalia, on the other hand, ratified it recently after it had signed at 2002<sup>2</sup>. It is very difficult to accuse UNCRC, at least the process it becomes a treaty, as western bias document. Within the process, it tries to incorporate many diverse viewpoints and opinions. In its drafting and finalizing the process, 19 western, 6 eastern European and 32 Asian, African and Latin American country representatives took part (Johnson, as cited Arts 2010). Beside the process, UNCRC also gives an opportunity for countries to put reservation to escape from certain responsibility on the time of their ratification (Arts 2010:12). This, however, as mention in Article 51, applicable only if it is not ‘incompatible with the object and purpose’ of the Convention. Nonetheless, this gives the opportunity to a country to express their differences. Bangladesh, in this case, also put a reservation. Bangladesh put the reservation on article 14 paragraph 1 and Article 21 about adoption clause, which they cite that it ‘would apply subject to the existing laws and practices in Bangladesh’<sup>3</sup>.

Now, if we look at the content of the UNCRC, then we will find that it is a lot more open ended than its critics suggested. It gives the opportunity to take local context in to the

<sup>2</sup> Information about UNCRC treaty signatories and ratification taken from chapter IV, section 11 of United Nations treaty collections site. [https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg\\_no=IV-](https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-)

<sup>3</sup> *ibid*

account and applied it in a culturally sensitive way. We will now examine Bangladesh context and discuss how UNCRC can be applicable in the discussion of its cultural reality. Sarah White and others discuss how the understanding of the child in Bangladesh is different from western perception. One of the important aspects is that Bangladeshi culture does not have an appropriate word for a child. They use different category of words, which in fact not always related to age. The word *shishu* mean toddler that refer to children who do not understand anything. *Balok/ Balika* refer to the children who understand a little bit and *Kishor/Kishori* refer to the teenage people who understand social reality but not fully. UNCRC, although criticize for age centred child categorization, it gives the opportunity to incorporate various cultural norms to understand child rights. Article 1 of UNCRC states, ‘a child means every human being below the age of eighteen years *unless under the law applicable to the child, the majority is attained earlier*’ (emphasis added) (Save the Children, 2006: 59). Therefore, UNCRC does not a bound child under 18 years category, rather gives the nation state to follow their own law and categorize children. Bangladesh, in fact, practicing this option. In the National Children policy, they identify the different category, namely adolescent, who are categorize between 14 to 18 years age group<sup>4</sup>. For marriage, male at the age of 21 and female age 18 are allowed according to the law. Consequently, these different understandings are already practiced. Understanding children outside from age category may be helpful for perceive social reality but it is very difficult to formulate law and implement those policies. The reality of children may even different from local place to place. Therefore, for legal purpose, understanding children outside age category is still a big challenge.

UNCRC, however, give us an opportunity to find the solution to those problems within the age category framework. For instance, the idea of guardianship that Sarah White discussed explicitly. Her discussion showed us how children are understood under the realm of guardianship in Bangladesh. UNCRC in fact, do not contradict of that aspect. For example, article 5 which state-

States Parties shall respect the responsibilities, rights and duties of parents or, *where applicable, the members of the extended family or community as provided for by local custom, legal guardians or other persons legally responsible for the child*, to provide, in a manner consistent with the evolving capacities of the child, *appropriate direction and guidance* in the exercise by the child of the rights recognized in the present Convention (emphasis added). (ibid)

If we focus on the emphasis text on that article, we can clearly see that UNCRC gave ample opportunity to incorporate local context. It includes a wide range of family, a community in terms of local custom and legal framework of a country. It, in fact, use the word guardian and refer that they can give appropriate direction and guidance. The word appropriate also give the opportunity to incorporate local context (Arts 2010:15), which can be applicable to understood guardianship norms of Bangladesh that white (2007) discussed. In terms of guardian’s role as a provider of food, shelter, protection and

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<sup>4</sup> Ministry of Women and Children Affairs, Government of Bangladesh 2011

humanizing child to understand social reality, UNCRC also focuses on those topics and accept the importance of guardian's role as a duty bearer. Furthermore, it also emphasized state role to respect the responsibility of such guardian. Therefore, there are lots of prospects to take guardianship norms to count and implement. Additionally, UNCRC can also be useful to fight against the negative aspect of guardianship norms in Bangladesh, like patriarchal norms that put girl children in a disadvantage situation. At article 20 of UNCRC, it speaks about to take the necessary step and provide special provision to the children who "temporarily or permanently deprived of his or her family environment" (Save the Children, 2006: 63). In paragraph 3 of the same article, it details about to provide appropriate assistance for these children in consideration of their "ethnic, religious, cultural and linguistic background" (ibid). Hence, UNCRC not only speaks about the protection of children who discriminate in guardianship norms but it also asks states to take appropriate measure in consideration of cultural context.

Now, about the discussion of those children who lack guardian or fell outside of guardianship norm, UNCRC, in this case, ask the state to give special protection and provision of such kind of children. In article 10, it speaks about the children whose parents reside different states, article 21 speak about adoption rule and emphasize given on the best interest of the child. Article 22 speaks about the refugee children and article 22 discusses about the mentally and physically challenged children – all these cases UNCRC ask the state to take special measures.

On top of all, one of the main pillars of UNCRC is the 'best interest of the child', which give signatory countries to incorporate their local context. In article 3 of UNCRC 'best interest of the child' intentionally left undefined which offer ample opportunities to understand children in a locally defined way (Arts 2010:14). Consequently, if children wellbeing relies on the guardian in Bangladesh then we can take guardianship as an important aspect for child rights. Conversely, where guardianship creates a problem for children best interest, the state can implement necessary step both in terms of correcting guardian attitude and provide legal support for those children. UNCRC put state as prime duty bearer to protect child rights. Its duty is not to take out responsibility from the guardian, rather helping guardian, family, and community for the best of their children. In many sections, UNCRC discusses about the responsibility of the state to help parents who cannot provide necessity to their children. In paragraph 3 of article 24, for example, ask the state to help parents and other responsible bodies with the aim of enabling them to uphold the children rights. In article 30, it discusses about the minority children and explains how those minority identities important for children's wellbeing. Therefore, it tries to incorporate state, community, family, and guardian –all for the best interest of child.

Even though UNCRC have all the instruments to understand child rights both in universalistic as well as cultural sensitive way, there is still a chance that it can be identified as an outside imposition. This may happen if the translator misrepresents or partially represent UNCRC. In a developing country like Bangladesh, Child rights NGOs play the most important role to translate a global idea into the local context. As Marry (2006: 48) discuss, this translator has to make a fine balance between global value and local context. Too much local incorporation may weak their link with global value,

whereas too much global may disintegrate them from the local context. In developing countries, this process of translation however influenced by donor agencies (often western) who give financial support to the local NGO to fight against some specific issues related to human rights or child rights. This dependent relationship sometime leads translator to understand UNCRC in a very narrow manner. Openness and cultural sensitivity become marginalize on that process. My own experience while I was discussing with a worker from an NGO called VERC about their child sanitation rights program, may clear this discussion furthermore. He told me-

It was difficult for us to explain to people that children have the rights to get proper sanitation facility. They ask us – why you talk about children only? Don't we look after our children? These questions also create confusion among us. When we ask our senior officer, they replied that our focus on this project is child, so we have no other option. However, after a month, a person from saving the children helped us. He told us that child is a part of the community, so, if you do not take care of them in their early age - may create problem for the whole community. Children in that area cannot use the toilet which adult use, for that reason they need the proper toilet. This process also keeps a child away from unhygienic diseases. After that, we could explain this to the community<sup>5</sup>.

From the above quotation, we can understand why translation and the role of the translator is so important. My discussant ensures me that they were following UNCRC from the beginning. However, from the above discussion, we can see that they interpret differently. This may happen because of their inability to fully understand UNCRC or may be for too much dependence on donor prescriptions. Nevertheless, a translator of translators teaches them how to translate on that context. His interpretation, if we give a closer look, actually hybrid local norms with global child rights idea. He is also describing child rights under the framework of UNCRC, though differently from my discussant's earlier understanding. However, it should be mention here that the process of translation is complex and there is no guarantee that this same idea can be successful in other places. Yet, this process shows us how UNCRC can become a mediator tool to translate global universal child rights idea into the local context.

## **Conclusion**

Translating global idea into local context always a big challenge. However, this process is very important to implement the human rights idea in a meaningful way. This paper explained that UNCRC can be a useful document for translators to mediate between universal child rights idea and local cultural norms. In Bangladesh, guardianship norms are the most important aspect of understanding child rights. UNCRC as a cultural sensitive document left lots of space to incorporate these guardianship norms. On the other hand, UNCRC as a universal document, create the opportunity to fight against the negative aspect of guardianship norms. This dual character of the document actually

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<sup>5</sup> This conversation took place when I was working as an assistant consultant of that project at 2010. The aim of that project was to evaluate the health and sanitation programme of VERC that implemented in three districts in Bangladesh.

helps us to find a middle ground between universalism and cultural relativism debate. Challenge, however, is on the implementation of that middle ground approach.

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## “Coming Out from Pan and Jumping Into Oven”: Divorce and Societal Ideology about Divorced Women

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Abstract: Muslim Marriages and Divorces Registration Act 1974 is the reflection of our patriarchal society and according to this act husband has exclusive right to divorce his wife at any time and showing any reason, but wife will be able to divorce when she gets that right to divorce her husband from her husband, and she should have to face and also prove few reasons. Divorce is not the end but all the trauma starts from here for a woman. One of my female respondents have said, “Leaving a marriage is possible but does marriage leave someone in her entire life?” When a woman is getting divorce she is being denoted as ‘divorced’ by everyone, whenever she is going out or a ceremony everyone is busy to get her a groom or to listen to her story of getting divorce or blaming her for getting divorce. This scenario is very rare for a divorced man in our society, which is the reflection of patriarchy.

### Introduction

According to the Muslim Family Law of Bangladesh, marriage is a contract and when a marriage contract is broken legally, that has called divorce (Abasar, n.d). When husband and wife think it is impossible to carry on their marital relation anymore for different reasons only then they decide to divorce. Reasons and the ratio of divorce are different in different classes. Generally, divorce rate is very high among upper and lower class but this ratio is comparatively low among middle class (Monitorbd. news, 2017). Nowadays divorce rate has increased a lot rather than previous time (Stevenson and Wolfers, 2007). Still now divorced women have to face different kinds of societal pressure and trauma rather than divorced men in different time and context. “*You don’t need to show that you are divorced, just put on the nose pin all time*”-it will be very tough to find a woman who has not faced this type of experience after her divorce.

Our society tries to search the ‘actual’ reason for divorce and in that case ‘woman character’ is the first thing to dissect. Her total life is the object of question now, like her family history, parent’s ‘character’, job, education, male friends, extra marital relationship etc. People get an interesting topic to create some spicy stories. People do not gossip about these stories at her back only but sometimes they also attack her in person also. “*Oh! You are that lady who couldn’t manage to stay in in law’s house?*” Not only women but also divorced men are being faced different kinds of questions regarding their broken relationship, but in case of women, this happens much more and continues during her lifetime. The patriarchal society represents these kinds of harassment as unproblematic and thus validates these (Martin, 2000). Patriarchal societies are same in all over the world that is why the reasons for violence against women are also same everywhere (Rosaldo, 1974). As a result, not only the women of Bangladesh but also women among all the patriarchal societies go through same situations after getting divorce.

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Established laws are reflection of society, Muslim Marriages and Divorces (Registration) Act, 1974 is reflection of society and culture of Bangladesh as well. According to this act, an adult and healthy minded husband can divorce his wife at any time and without any reason, husband has exclusive right to divorce. On the other hand a wife will get right to divorce only after her husband provide that right to her through marriage registration paper (Section 18) and if she fulfills those conditions of divorce and can prove those, which are impossible to prove sometime (Advocateregan, 2015).

Recently most talked-about divorce is Tahsan-Mithila divorce. People from all level are criticizing about their divorce everywhere on Facebook, media, newspaper etc. They are trying to explore the 'exact' reason for their divorce. Some critiques are writing that the reason is they both had extra-marital relationships (The Life Guide, n.d). Many people in Facebook are writing that, "*Even girls like Mithila are also unable to be wife?*" Here Mithila is a star but people are questioning her as a divorced woman, which is surely the reflection of our patriarchal society.

Here in this article, I have tried to represent and analysis social ideology regarding divorced women of our society and reasons behind these. Divorced women experience different social pressure and psychological trauma through society and state law which dominate, control and deprive them in different way. I have conducted this research funded by the University Grants Commission Bangladesh in 2017-18 fiscal year. My research field was a village of Savar Upazila named Jaleshwar, situated near Savar bus stand, Dhaka. My respondents were both man and women. I have chosen this field for my research because the population of this area is so diverse; they have diverse occupation, class, also diverse social and economic status. Therefore, it was easy to get diversified experience regarding my research questions. I have used different qualitative research methods to collect information, such as structured interview, case study, FGD, observation etc. Beside primary source, I also have used secondary sources for my research.

### **Divorce as a concept**

Divorce is known as 'talaq' in our society. 'Talaq' is an Arabic word; it means breaking or separating something. When a marriage contract is broken through a legal procedure that is divorce. According to the Muslim family law divorce is a valid right of both husband and wife. In a stage of marital relationship when husband and wife think that this is not possible to continue this relationship anymore only then they decide to divorce and can get divorce by maintaining few procedures. There was a time when husbands were uttering 'talaq' three times and divorce was done in our country. It was not an established law but most of the member of our society was not against that custom so it was very common. Even now, India is going through this procedure and facing many problems so they are trying to abolish this custom legally. Nevertheless, this is not legal in our country anymore. Even if someone divorce through registration paper it will not be done instantly. According to the Muslim Marriages and Divorces Registration Act 1974, divorces should be made only through an authorized kazi and divorce notice should have to send to wife and also local chairman of Union Parishad/Pourashova chairman/city corporation chairman (Bdnews24.com, 2015).

To control uncontrolled power of husband in case of divorce, providing the power of divorce to women, and to solve many other problems in Muslim community law amendment has taken place in different times, like The Dissolution of Muslim Marriages Act 1939 and Muslim Family Law Ordinance 1961. Law amendment has taken place also in different times after that to ensure proper right and dignity to husband and wife both, like Muslim Marriages and Divorces Registration Act 1974, The Muslim Marriages and Divorces (Registration) Rules 1975. Family Courts Ordinance 1985 has also been established to dissolve different familial issues quickly such as divorce, mohrana (dower), alimony, custody etc.

Marriage is not a contract rather it is an impassable religious institution according to Hindu religion. The main responsibility of a Hindu father is to arrange his daughters' marriage. Bridegroom's consent is unnecessary, marriage is not dissolvable and polygamy is allowed for men only. Hindu women of Bangladesh get few privileges of staying separate or getting alimony from her husband according to the Hindu Married Women Right to Separate Residence and Maintenance Act 1946. But they have to prove some reasons among these- if husband has a serious infectious disease, husband's behavior is life threatening for her, married to another women, abandoned her, or changed his religion (Daily Prothom Alo, 2018)

The scenario of both Hindu and Muslim family law are clear here where none of these laws has treated men and women, husband or wife equally that's why they are not getting equal right. Equal right could not be ensured through a discriminative law and also justice could not be provided as well because patriarchal laws always ensure privilege to men only. That is why Wollstonecraft (1975) and Mill (1970) have mainly blamed to traditional laws for subordination of women.

### **Perception of divorce**

The divorce rate has been increased drastically in our society for some years and the main reason is our patriarchal society, which subordinates and controls women always. Now a days women are being engaged to public place more than previous time like education, job, business and much more, but as patriarchal ideologies always control women but educated and working women tries to come out from this domination so the ultimate result is divorce. Mills (1956) says, loyalty is the main motto of civilization where two types of tendencies belong at the same time, (a) everybody wants to dominate, (b) nobody wants to be dominated. Arendt (1986) says same thing, according to her exertion of power is connected to domination and domination is connected to the desire of not being dominated. So everybody wants power, wants to exercise power, to control other through this power but at the same time nobody wants to be controlled or dominated by other. In our patriarchal society, most of the time husbands are exploitative, wives are being exploited, and patriarchy validates this exploitation, subordination. As no one wants to be dominated so women raise their voice against these exploitations and subordinations sometimes by divorcing her husband. Divorce ratio is higher now a days and most divorce notices are being sent from women, educated and working women. One of my respondents Rahela (35), her experience matches this situation, she says, *“I will earn by myself, I will bear my*

*own costs and I have to be accountable for my own expenditure to my husband, this is not possible for me that's why I have divorced my husband".*

Patriarchy is inextricably related to marriage and divorce so we need a clear explanation of it. Patriarchy means father's rule or man's rule (Barnard and Spencer, 1996). Patriarchy means the authority of father or someone equivalent to father, father's power or control, so here the meaning of father is not parent but it has, of course, an elaborate meaning (Rahman, 1998). Cairns (1997) has said something different like patriarchy is such power relation which goes back to a stable situation, insults and demoralize women, creates hesitation and complexities within this system. Somebody says the ultimate meaning of patriarchy is man will be only powerful (Ahmed and Chowdhury, 2003). Rowbotam (1979) has said that patriarchy is a complex and stable system where women are trapped day by day rather than becoming free. Women spend all their live through this structure where patriarchy always fixes a guardian for her whether she is child or old, educated or self-dependent. Father is the guardian of a girl before marriage, after marriage husband, and after husband's death son is the guardian for his mother. Our patriarchal society thinks that women could not stay alone no matter she is adult or not she has to be controlled by another man always. Now a days few women are coming out of this patriarchal structure, and also coming out from the unlimited control of a guardian named husband.

Feminists have also different definitions regarding patriarchy. Mitchell (1971) says, patriarchy is such a system of structure where women are only an exchangeable product of man. According to her man holds a symbolic power in this system that is liable for women's inferiority. Brownmiller (1975) has said patriarchy is an ideology that controls women by threatening about rape and harassment. Women are being locked up into private places through these fear and ideologies. Rahman (1998) have said that patriarchy is that ideology which represents man as absolute and stronger than women and that's how it validates male subordinations over women. Kandiyoti (1988) have said something different about this, she said that patriarchy always subordinates, dominates and controls women but at the same time women continues their bargaining within patriarchy for their rights, negligence etc. One of my respondents Noor (29) said something not only about her divorce but overall scenario of divorce among our society, she said *"My husband used to torture me physically, mentally and economically in every way without any reason, many other women have shared same experiences with me and then they have divorced their husbands, if this continues women will not be interested in marriage someday"*. According to her divorce is not only resistance to patriarchy but also the way of bargaining with patriarchy and this is true for many other divorce she thinks.

Schuler (1991) on the other hand has said that violence against women is very common among all the cultures, all the classes, all the religions and all the countries but the difference is sometimes these are happening in front of everyone, sometimes behind everyone. Wrong (1993) said that power and violence also exist among different relation in the name of love, and attraction that is why we cannot define power so easily. Our society validates all kinds of violence to women occurring in marriages and sustains these in the name of traditions, customs, rules and regulations. That is why we got to see different kinds of change in culture, society and laws but those social norms related to women, subordinates women remain unchangeable and unending. The ultimate reason is to protect

patriarchy through this. Millet (1970) has said similar thing, she said, patriarchy has created different kinds of ways to control women, economic dependency is one of them and this is the main reason of women’s subordination. Patriarchal society restrains women from being engaged to productive work so that man could be the only breadwinner for the family. Even though women are also earning men remain the only owner of that income. If women are not agreed to handover that money to her husband then she gets threat of divorce or gets divorce. One of my respondents Tapsee (40) said, *“My husband used to take all my salary, didn’t allow me to spend even single penny, still I was silent just for family but I couldn’t tolerate physical torture anymore, so I have divorced him”*. Women go through different kinds of torture through marriage but do not take any legal action against their husband, Cairns (1997) have discussed the reason behind this. Cairns (1997) said, most of the women could not distinguish from their experience which is violent and which is not, because our society and culture does not explain those as violence. Some wives think that it is her husband’s religious and social responsibility to correct her by scolding, beating, or slapping. That is how violence becomes normalize within marital relation. However, some women who think these as violence, as abnormal, as control, as domination and it is not possible to tolerate for her, they resist through divorce.

Thomas (1997) has asked a question, *“Why man harasses women?”* Social and psychological both perspectives are related to this but psychological perspectives are more relevant he thinks. He said that men construct violent behavior by themselves and most of the men think that their behavior and mentality create their masculinity, which controls women at the same time. Many women claim that their husband used to torture them physically and mentally which are related to social masculine behavior.

Our patriarchal society defines husband as a guardian of his wife, as a result, power exertion is very normal among this relation where wives are being controlled and exploited thorough different ways. If any dispute occurs in marriage husband says, *“I will kill you”*, *“today is your last day”*, and which are obviously life threatening. There are many wives afraid of their husband, says, *“I am afraid of my husband like death”*. Our society and culture represent husband as her guardian so he has every right to control her, dominate her. Husbands are using their ‘valid’ power that has given by our religion, culture, society and of course law. However, behind this guardianship, everything is ‘valid’, that’s why we don’t get scared hearing domestic violence, marital rape. We evaluate these as normal as other violence happening in our society. Not only man but also most of the woman carry out same mentality that is why patriarchy is sustaining age after age, generation after generation.

### **Divorced women among society**

*“Our country is developing day by day, women don’t tolerate domestic violence rather they decide to divorce. Women do not remain silent about mismatch or husband’s extra marital affair. Women are coming out from broken relationship. Or is it like coming out from pan and jumping into oven? In case of divorce first barrier comes from family. And then who will take the responsibility of these women after divorce? When divorce procedure is done then most important question is-Who will marry this divorced women? Nobody is worried about*

*divorced man's marriage. Parents, sister, brother, neighbors, relatives couldn't even sleep worrying about her. Even office colleagues, shopkeepers in front of her house, uncle from roads, friends from Facebook all are worried about a divorced woman's marriage. Who will marry this divorced woman? Why will marry?"*

(Rumana, 2018)

Wollstonecraft (175) has represented the actual portrait of 18<sup>th</sup> century women, "*Married women are just like bird in a cage, they have nothing but false dignity*". She said that middle class women give up everything, such as their freedom, ethics only for their family. Women who do not give up these and decide to divorce are called selfish, nobody treats them as a 'decent' woman. One of my respondents Banu (50) shared similar experience about one of her divorced relatives, "*Slut women decide to divorce, women who are courteous and decent will die in husband's hand rather divorcing him*". She is also a wife and staying with her husband tolerating everything because she is a 'decent' woman, she thinks. Bourdieu (1972) clarifies about symbolic violence, according to him, violence is not physical all time, evident, concrete or physical wound rather different types of ideologies, language, and symbolic system could be violent. In case of divorced women, they are facing different types of symbolic violence everyday by society. My respondent Fiba (32) has said about this, "*I don't like to go out without very emergency because people pass provoking comments like failure, omened, unties come to show fake love and tear, total drama*". This symbolic violence are another way of patriarchy to control divorced women.

Educated and working women are facing much more violence then other. Inferiority complex is very common among the husbands whose wives are empowered because they are not dependent to their husband anymore, so they will not be able to control their wives, and the ultimate result is domestic violence (Daily Prothom Alo, 2017.) Through my research, I come to know that, many educated divorced women are being asked this question, "*Why did your husband beat you?*" Her answer was, "*Without any reason*". This is the main reason why educated working women were being tortured. When they were inside house, with no job, everything was 'normal', no violence occurred like this, but just after getting the job husbands start to feel inferior, as a result start to control, subordinate and torture their wives. Only then, educated and working women decide to divorce sometimes. Akanda and Shamim (1984) have compared among violence against women in rural and urban where there are a lot differences about perception of violence, its definition and also meaning.

Society has specific and accepted criteria of violence regarding divorced women, like one of the respondents Shanta (30) said, "*After my divorce everybody was asking the reason, I was explaining that he used to beat me and then they wanted to see wound, blood, and sore. I replied that I haven't saved those blood and then they poked- my mother's character is better but where did I get this?*" Our society is much more happy if a woman continues her marriage with a broken leg or hand because her husband, her guardian did this. Our society is happy if a woman stays in their marriage until they die by their husband but society does not like women with broken hands or legs but leaving or divorcing their husband and starts to question their 'character', her mother or sister's 'character'. Martin

(2000) has differentiated types of violence in the context of Colombia. He said that not all violence are normal or non-problematic but which one is non-problematic or problematic that depends on time and context. So he says to explain any violence according to culture, society and its history also. He has differentiated violence into two types, one is normal violence and another is extreme violence. Normal violence are those, which are socially acceptable and extreme violence, are connected to barbarous, torture, cruelty. Whenever husband beats his wife in a closed door then there will be no proof, so there are possibilities to trust or mistrust her. Again, she has no proof. Another thing is society validates domestic violence and these are ‘normal’ violence. One of my respondents Jannat (41) said about this socially accepted violence, *“It’s very normal and obvious for women to tolerate this”*. Thurston (1996) have explained these violence on the context of man, he said that man describes these violence in a gendered way, which is related to their masculine identity. One of my male respondents Ramzan (42) said, *“I have never beaten my wife nor used a slang but again she divorced me, now I feel it was better to beat her”*. Most of the man from our society could not remember the reason why their wives divorced them when they have done ‘nothing’, they have beaten one or two times but that could not be the reason of divorce. Where they are torturing their wives mentally, sexually but they do not find any reason for divorce. Kelly (2000) is very relevant here; she said that there are a lot of violence against woman, which do not have any name that’s why she used a concept, “a continuum of sexual violence”. Violence against women that do not have name will be included among this concept. She said that sometimes women say “nothing really happened,” means it could be much worse, but she is saying this because it is not defined as violence among law or police or society. What is the feeling of the victim is not countable here. When husband beats her and she has wound in her body but she is saying, “nothing happened” because society does not think that something has happened said Kelly (2000). Similarly among our society if a married woman got raped by her husband and blame, nobody will listen, nor law neither society. Because according to our society and law married woman cannot be raped by her husband. One of my respondents Jamila (47) has filed a case against her husband that he raped her. Her husband’s lawyer was asking her in the court, *“Do you even know the difference between marriage and sex? And everybody was clapping”*. That clarifies the perception of rape between society and law. Kelly and Redford (1996) have explored those social systems, which invalidates the experiences of women related to sexual violence. They said that men that’s why woman’s experiences are not included here make laws and policies. Shuvra (2009) said that in our society man are controlled by punishment but women are controlled by sexual harassment, rape, rumor, eve teasing. A most effective way to control a divorced woman is to spread a rumor about affair or extra marital relation with anybody. “She was a slut”, “Slept with ten men” are very common well-known rumor about divorced women. *“Does it matter she is divorced? There are lot of men around her and she still has desire.”* One of my male respondents was saying about divorced women.

Our society is very worried about the ‘character’ of a divorced woman and also their marriage as well. Everybody thinks that divorced woman should marry a divorced man, one of my respondents Hasnat (42) was saying, *“Divorced man can marry anybody he wants but divorced woman should marry a divorced man, or a man lost his wife.”* Society has no such headache about divorced man, whether he was married or not, what happened,



why he got divorced, nothing. Our legal system is also same where women have to go through different discriminations and face different negative comments. The patriarchal society represents these violence as non-problematic and that's how these sustain in our society age after age.

## Conclusion

Marriage is a normal procedure among our society but divorce is not like that, especially for the woman. Women should have to think about herself, her family, and relatives while divorcing. Most of the families of women are not agreed with her decision of divorce, or against her decision. The family wants the name of her husband at least because of the psychology regarding divorced women, social representation of masculinity and femininity. After everything if the woman gets a divorce at last again society does not take it normally and she has to go through bitter experiences, which are very rare for a divorced man. Our law is the actual reflection of our culture and society where gender discrimination is crystal clear. Divorce laws are very much discriminative and unequal for women. Women have to face discrimination in every step of divorce, like getting a divorce, mohrana, guardianship, alimony etc. That is how patriarchal societies create and sustain discriminations through masculine and feminine ideologies and women are controlled by these also.

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## **Water Conflict Management in Dhaka City Slums: An Empirical Study**

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**Abstract:** Access to adequate fresh water coupled with the persistent scarcity of water supply triggers conflicts amongst different actors in the slum's areas of Bangladesh. Migration of the rural people to the urban areas has aggravated the conflict of interest in water supply in Dhaka, the capital city of Bangladesh. Therefore, the research aiming to explore to what extent, conflict triggers in the slum areas centring water supply and how water-related conflicts are solved? Who are the main actors and why they are playing such a role in indulging or mitigating conflict for water management? From the empirical evidence commissioned in two slums of Dhaka city, it is perceived that corruption and mismanagement relating to water supply resulted in divergence among the relevant actors. Besides, a strong presence of middle-man in water business causes mismanagement of water supply as well as creates discrepancy among slum dwellers for access to fresh water. The paper aims to explain the pattern of conflict about water supply management at the slums in Dhaka City. It also directs efforts towards exploring causes behind conflicts encompassed by water issue and nature of conflict among three parties, i.e. slum dwellers, the government, and non-government and conflict management process among the relevant stakeholders.

**Keywords:** Water Supply, Corruption, Conflict Management, Slum Dwellers, Urban Local Governance

### **Introduction**

Water governance enables to improve the sustainable development of water resources and services. How societies choose to govern their water resources and services has profound impacts on people's livelihood, and the sustainability of water resources is the central point of this discourse. Urban slums are becoming all-inclusive with a stamped variation between developing and developed countries. In data, it shows that the slum population of the world consistently grew from 715 million in 1990 to nearly one billion in 2005(Hossain & Ahmed, 2014). The rate for Bangladesh is also increasing day by day. However, one of the biggest challenges for those areas is access to adequate fresh water. Access to adequate freshwater and scarcity of water supply in Dhaka city have become critical issues for the past few years. Conflicts among various stakeholders have made this issue crucial for the investigation. Wide variations in the seasonal availability of fresh water, climate change and unpredictable primary production in field crops, have resulted in large-scale migration from rural areas to urban centres in the country, particularly in the Dhaka city.

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Consequently, it has created massive pressure on clean and safe drinking and household use water in Dhaka city. The total number of slums in Dhaka City Corporation area is approximately 4,966 (Islam, Angeles, Mahbub, Lance & Nazem, 2006). Expansion of urbanisation is aggravating the poor living standard of the poorest segments in the slums, where access to the drinking water of them remains a key challenge. Slums in Dhaka city are densely populated with substandard housing facility, which results in the scarcity of basic needs (Un-Habitat, 2007).

The major problem is created by large scale co-modification of this natural resource and excessive profit motive at the cost of sufferings of the poor people. Dhaka is one of the world's largest mega-cities accommodates more than 13.1 million people within its 1,353-square kilometre area. According to the most recent UN estimate, its population will reach 16.8 million by 2015 (Alam & Rabbani, 2007). The population density has exceeded 40,000 per km<sup>2</sup>. Most disturbing information is that roughly 3.4 million people of the city (37.4%) live in the slums. Reportedly, slum dwellers increased from 25% in 1996 to current 37.4%, living in an area of only 4% of the total DMA area (Angeles et al., 2009). According to CUS majority of these poor communities are located on land owned by private individuals or under multiple private ownership. Only 21.4% are located in government and semi-government, and while only 1.2% are found on land belonging to non-government organisations (Hossain, 2008).

In Dhaka groundwater remains the primary source (Ahmed, Nishigaki, & Dewan, 2005) and 53% of the family have admittance to pipeline water while 43.1% depend on tube wells for their consumable water sources. The rest of the family units rely on upon lakes, and different sources (Dewan, 2013). Dhaka Water Supply & Sewerage Authority (DWASA) which is responsible for water supply in Dhaka City, presently confronting a water shortage of around 500 million litres for every day, and the sum is prone to increment by 2015 (Islam, Chou & Kabir, 2011). Already acute shortage of safe drinking water exists, and indications are there that it will become scarcer in future. The situations of slum dwellers are worse than the other inhabitants of the city (Akbar, Minnery, Horen & Smith, 2007). Over the years, a few NGO's in Dhaka City have been working to provide safe water to the slum dwellers, but there are not sufficient to cope with the increased demand. On the other hand, public initiatives are also insufficient.

Given the context clearly explained about, several questions remained unexplored how water is distributed among the slum dwellers in Dhaka city? To what extent, conflict triggers in the slum areas centring water supply and how water-related conflicts are solved? Who are the main actors and why they are playing such a role in indulging or mitigating conflict for water management? This paper intends to clarify the reason why conflict is pertinent for water supply issue among the slum dwellers.

### **Conflict Management: Conceptual Clarity**

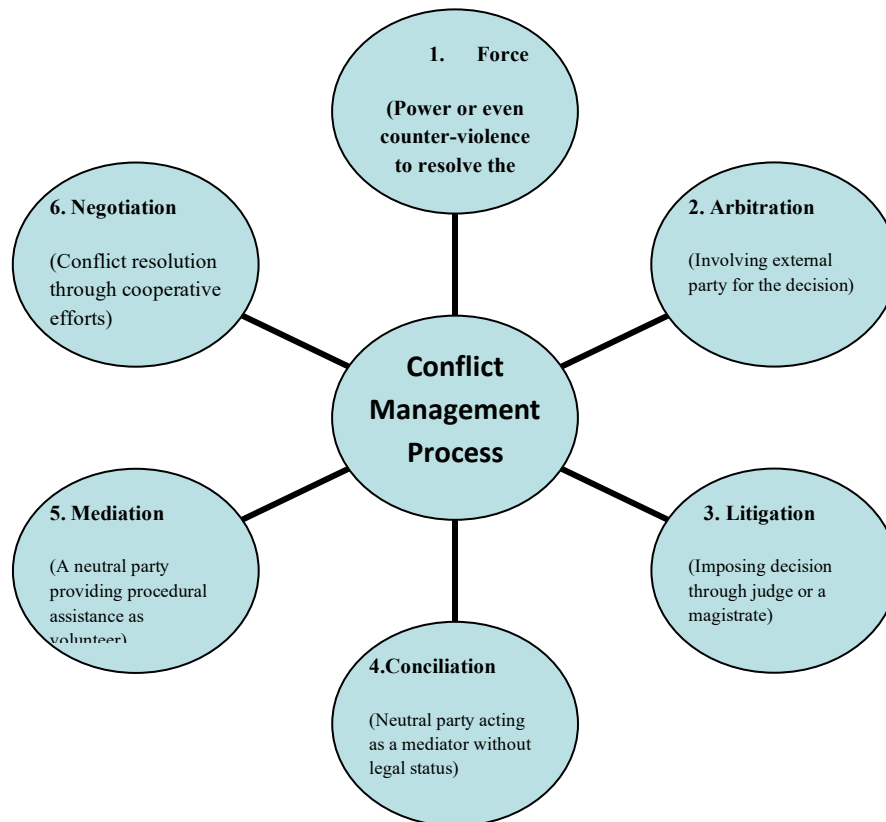
A conflict resolved when a mutually compatible set of actions is worked out. Some contend this does not have any significant bearing to profound established conflicts. Lazarte (2006), for instance, recognises 'irreconcilable circumstances that can be determined through the transaction, and 'basic clashes' that are exceptionally hard to

arrange as they identified with the association of social and regularly depend on the unequal conveyance of assets. He likewise demonstrates that numerous conflicts are a blend of distinctive sorts of disputes including social and also political viewpoints and that the "rationale" of the activity of the performers included contrasts from the rationale of the conflict (Visscher, Warner, & Bustamante, 2008). Actors act by their perceptions that may be founded on a personal aggregate memory and not on objective facts. Such deep-rooted problems may require a change in society. In this type of conflict, an analysis of the problem is needed in much greater depth to explore what course of action may be possible.

This study focuses on an urban resource sharing conflict that also has different dimensions. This conflict, unlike natural resource sharing, has a reasonable chance of being solved by better management by involving the actors. It embraces the definition proposed by Wallensteen (2011, p. 15) that conflict is a social circumstance in which at least two performing artists (parties) strive to acquire at the same moment in time an available set of scarce resources. This definition covers many aspects of the conflicts of interests that may arise in connection to water supply and sanitation, especially if a 'clean environment' is taken as a scarce resource. However, scarcity is not the only cause of water conflicts in Dhaka city, because system loss, wastage by powerful and abusive uses is also blamed. It is better to say that the conflict is partially human-made and partially by the lack of adequate supply situations. This conflict is a social situation where one party tries to profit from a given situation or attempts to tackle its water supply and sanitation issues in such a way that it negatively affects other parties. From this point of view, conflicts may stay covered up until other gatherings don't understand that they are adversely influenced or can be open when they know it and don't acknowledge the circumstance.

### **Different Options for Conflict Management**

If the conflict is inherently destructive, then our efforts are bound to be directed towards suppressing or eliminating it. Such endeavours will probably uplift than lower the level of strain. If we view conflict as usual and inescapable, then the challenge lies in overseeing it productively. The problem is not the elimination of conflict, but rather, how to adequately address conflict when it arises (Visscher et al., 2008). In general, to mitigate conflicts, there are many suggestions and approaches. In the light of Visscher, Warner, & Bustamante, R. (2008) has have identified similar techniques to resolve the local level dispute in the context of Bangladesh. Thus, it is crucial to discuss conflict management process suggested by Visscher and his associates;



**Figure 1:** Conflict Resolution in Water Sector

Source: Adapted from Viñuales and Celaya, 2008.

Utilising power or significantly counter-roughness to resolve the conflict, regularly disregarding the interests of the weaker parties may term as a force. A peaceful illustration of power is utilising the strength of the water supplier and setting association charges for more impoverished individuals in a group. Litigation, Adjudication implies involving judge or magistrate, forcing a choice in the wake of listening to constitutional contentions from gatherings included in the conflict. This links to the complex field of water legislation. In arbitration, an external party (accepted by the parties to the dispute) and may involve imposing a decision after hearing the arguments of the parties involved in the conflict. Conciliation involves a neutral party acting as a mediator to go-between the parties (Viñuales and Celaya, 2008). The process has no legal status, and the conciliator meets with parties, helps them to list and clarify and reframe their objectives, and tries to come to solutions meeting consecutively with partners (shuttle diplomacy). Successful conciliation ends with the signing of a binding agreement between parties. Mediation involves a neutral party providing procedural assistance which is a voluntary process based on vesting of decision-making authority in the parties involved in the conflict (Rauchhaus, 2006). The mediator structures the process and creates a safe environment for parties to discuss the dispute and jointly find solutions. Negotiation is the process in which parties resolve their conflict without help from outside. It refers

either to competitive processes (positional bargaining) or cooperative efforts (interest-based bargaining). In positional bargaining, parties make offers and counteroffers and typically start to converge on a solution which both parties find acceptable (Zartman, 2007).

Water conflict in the slums thus involves for multiple reasons, and it varies based on the context. Especially, conflict over water in urban areas has a different dimension, and its nature of the conflict is different. In here, open conflicts can be easily linked to the diverse actors directly or indirectly involved. In other cases, people may not even realise that they are part of a dispute or adding inputs to the conflict. The paper first systematically explains the nature and possible reasons for future conflict.

### Methodology: Study Area and Data Collection Techniques

The study draws on the argument about the dialectics of water conflict management, i.e. the politicized inter-dependencies between society, nature and the state and is focused on the tangible situation of the two randomly selected slums; Balur Maat (Hazaribag) and Companyer Haat (Middle of Hazaribag and Kamrangir Char) tenements at old Dhaka City, Bangladesh. These two slums are different from each other on their size, nature of house building and income level. Most importantly, the distribution of water is entirely dissimilar. A brief profile of these two slums is given below:

**Table 1:** A General Profile of the Two Slums Investigated in Dhaka City

Name of the Slums	Balur Maat	Companyer Haat
Location	Hazaribag <sup>2</sup>	Between Hazaribag & Kamrangir Char <sup>3</sup>
Size: Acres(ha)	5.0 (2.0)	6.0 (2.43)
Inhabitants (appox.)	2500	2000
# of Household	600	400
Person/Household	4.2	5.0
Major Occupation	Rickshaw Puller 40%, Factory Worker (Tannery workers) 24%, Business 12%, Hawker/Vendor 10%, Day Labor 10%, Others 4%.	Rickshaw Puller 34%, Factory Worker (Tannery workers) 14%, Day Labor 32%, Business 8%, Hawker/Vendor 8%, Others 4%.
Nature of Household	Makeshift shack 100%.	Makeshift shack 100%.

The study is based on fieldwork conducted during January- February 2014 through in-depth interviews, and an opinion survey. A total of 12 in-depth interviews were held with different stakeholders. People associated with public utility service providers like municipal authorities and campaign activists; DWASA information officers, director, chief officer of Slum Development Corporation, the power elite, politicians, and NGO

<sup>2</sup> Area (Adjacent to Tannery related Industrial zone)

<sup>3</sup> (an outgrowth of Dhaka City opposite side of the Buriganga river) Scattered slum/s; 15-25 households in the cluster under a landlord/Patron



activists were interviewed to collect data. Besides, reviews of policy documents, archival documentation, published and unpublished materials were considered as a part of secondary data collection.

An attitudes survey was also conducted within the two slums to collect slum dwellers opinion about water quality, distribution, conflict and corruption-related issues. The respondents were chosen based on their income, sex, household size and education. Therefore, the stratified random sampling method was followed throughout the survey. A total of 100 survey forms were evenly distributed in two slums. The socio-economic status of the respondents of the study area based on their occupation, household size, and gender is known from the survey. For example; respondents of the two slums about 37% of the dweller's occupation is rickshaw pulling. Among other factory workers are 19%, business 10%, Hawker 9%, and day labour is 21%. In terms of household size; among 100 respondents of the two slums about 30%, 40 % and 18% respondent's household size were 3-4, 5-6 and 7-8 respectively. It shows that almost 88% respondent's average household size consists of 3-8 members. Similarly, gender-wise 62 are female out of 100 respondents which constituted 62% of total households. The reason behind choosing women respondents more the male respondents was, in Bangladesh female are engaged in household work and collect water regularly from water sources and involve in water-related conflict.

### **Nature of Water Conflict in the Dhaka City Slums**

As Dhaka megalopolis expands by size and population, demand for clean and safe water supplies and standardised sanitation and sewage disposal are becoming critical to public health and quality of lives in Dhaka. It is estimated that roughly 4 million squatters currently live in slums without adequate legal access to essential services like safe water and toilets (N. Islam et al., 2006). These unfortunate people should rely on untested and often unhygienic water supplies by slum lords or "water sharks" who peddle water by small vans with variable and unsafe containers. This crisis of water leads to water-related conflicts in the daily lives Dhaka in slums. During the last few years' intensity of water crisis and conflicts are increasing as the DWASA (Dhaka Water and Sewerage Authority) neither had the ability nor the obligation to supply an adequate amount of water to the slum households, which are de-facto illegal. Thus, the slum dwellers have no option but to depend on the slum owner, landlord and in some cases CBOs and NGOs for water supplies that do not keep pace with demand. During field research, it was found that almost 40% of inhabitants in two slums were involved in some conflicts (e.g. verbal abuse, force, small scale fights) related to water supplies in the slums. Collected information through survey revealed three types of likely sources of conflicts related to water access, distribution, and control.

### **Intra Slum Conflict**

Conflict occurs within the same slum dwellers for access, distribution and control over water — the most common cause in the study areas. Among the respondents, roughly 70% are found to be involved in such conflicts. However, the nature of the conflict is reportedly non-violent and confined to verbal abuse or slang. In most of the cases, both

male and female residents are involved in these conflicts. During the interview, one of the landlords mentioned that;

*I don't have any other choice. People who rent my makeshift do not want to pay the water bill separately. They want me to pay the water bill. Also, they want uninterrupted water supply. They have to understand that it is a slum, not a villa. Therefore, we some times involve in strong exchange of words but nothing serious<sup>4</sup>.*

However, on the contrary to the landlord view, we received an entirely different response from one of the slum dwellers. She mentioned that;

*I always pay my rent to the landlord or his followers in due time. However, when I told the landlord to improve and set up more water points, he never listens. He never thinks of us but only money. Therefore, we had to suffer a lot for drinking water most of the time (Personal communication, January 8, 2014).*

The ultimate result of these intra slum conflict ended with changes of slums as landlord force them to leave their place. Also, our study found that conflict also occurs between the slums residents while collecting drinking water from the water point.

### **Inter Slum Conflict**

Inter slum conflicts are frequent between the two different slum dwellers for access or control over the water supply point. This type of conflict occurs when slum dwellers try to control or access to a public water supply source or other non-traditional water supply sources point like a pond. Since the slum dwellers are often territorial that causes inter-slum conflicts, when a problem arises in a territorial water point people go to different water points for supplies and naturally engage in conflict as supply is limited. It is observed in some cases that the intensity of such conflict is average, and usually, people use muscle power to win. Both male and female are involved as the actors in such conflicts while men use muscle power women use tongue power, and both have a terrifying impact. According to one female respondent;

*We usually collect drinking water from the mosque as the quality is better than other sources. During pick time, we cue in a line and fill up our gallon in discipline manner. But sometimes we have some problems with the other slums as they also come to pick water from the mosque that reside in our area. The problem arises when they try to break the line and forcefully try to take water before us. Which I believe unfair (Personal communication, January 7, 2014).*

### **Slums Dwellers Versus Government and Non-Government Stakeholders**

The slum dwellers do not have any legal access to water supply for which conflicts arise between slums and government and non-government stakeholders. Past few years DWASA established few pilot projects with the help of DSK (Dushtha Shasthya Kendra) and few other NGOs through CBO initiative. But it is insufficient compared to the

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<sup>4</sup> Personal communication.

significant number of consumers. The respondents often show their anger over government initiatives or even against the NGOs like DSK in this regard.

### Leading Factors for Potential Conflict

Respondents in the slums mentioned several reasons for inter, intra slum and conflict against slum dwellers versus government and non-government conflict. Based on the response from the slum people, the following reasons are identified for intra-slum and inter-slums conflict for water. Some of the problems identified according to priority are-

- a) Long queue and waiting for supply
- b) Irregular supply
- c) Insufficient supply
- d) Unequal distribution
- e) Control of supply point
- f) Community members not paying the fees for water supply
- g) High price for water (10 times higher than DWASA)

However, analyzing these issues paper draws attention to four main factors/situations that may lead to potential conflict at the slums of Dhaka city in future:

#### 1. The Paradox of Demand and Supply in Water Consumption

The demand and supply of water in both slums is not satisfactory. In both areas people have shortage of water everyday based on their actual requirement. In Companir Haat slum where water supply situation is observed to be better as water is being supplied by submersion pump, compared to Balur Maat slum where landlords/slum owners control the water supply situation. The following table will give a clear picture of water consumption of the two slums as well as water demand and supply situation of the respondents:

**Table 2:** Daily Water Demand and Supply Per Household of the Two Slums

Name of the Slum	Drinking		Household Use		Shower and Toilet	
	Demand	Supply	Demand	Supply	Demand	Supply
<b>Balur Maat</b> (water in liter)	10-15	5-7	150-200	100-125	150-200	110-150
<b>Companyer Haat</b> (water in liter)	12-17	8-10	150-200	130-150	150-200	100-140

Source: Authors compiled these data interviewing slum dwellers.

These shortages of water involved people in conflict everyday while they collect water from the water point. It also linked the factors like long queue, irregular supply, insufficient supply and control of the water points.

## 2. Water Pricing: Issue Triggers Discrimination

In the study area, slum people must spend 200-250-taka monthly consuming less than the actual demand. On the other hand, Dhaka City middle-class household consumes ten times more water than the slum people and must pay a lesser water bill. As they must buy water at a higher rate, the slum people are aware of their demand, and they use it very sensitively. The slum people are infuriated about the water pricing and 75% of respondents think that people may involve in conflict with the government and non-government stakeholders very soon if they do not solve the water pricing situation.

**Table 3:** Water Pricing: Comparison in Different Study Areas

DWASA Water Pricing (Metered Connection) <sup>5</sup>		Study Area Water Pricing (Per Household) <sup>6</sup>	
Service	1000 Gallon/Liter	Name of the Slums	1000 Liter
Community	21.12 Tk.	Balur Maath	60.0
Religious	6.34 Tk.	Companyer Haath	70.0
Domestic	6.34 Tk.		
Commercial	21.12 Tk.		
Industrial	21.12k.		

## 3. Quality of Water

Only 55% of the poor households currently receive tap water in Dhaka City (Siddiqui, 2004). Most importantly less than 40% of the slum dwellers have access to safe drinking water (Rabbani, 2009). On the other hand, none of the slums gets proper sewerage services from WASA, and only 9% of this population manages to get robust waste management services. As a result, both household waste and human-generated wastes go directly or indirectly into the low-lying lands, open spaces or water bodies of the city. Besides, sterile, safe drinking water in slums, they drink and use dirty water and suffer from numerous health risks. In the study area, respondents are unhappy with the quality of water. Both DWASA and submersion pump water quality is not satisfactory. 85% think DWASA water is not suitable for drinking due to bad smell. In the Balur Maat Slum, 100% respondents must drink this water supplied by DWASA directly, as water filtration costs extra money. Table 5 indicates the opinion of the respondents over the quality of water in the study area.

**Table 4:** Quality of Water (% of Households)

Name of the Slum	Balur Maat		Companyer Haat		Total	
	Person responded	(%)	Person responded	(%)	Person responded	(%)
Satisfaction level						

<sup>5</sup> DWASA Water pricing for metered connection. For detail see DWASA Annual Report 2010-2011.

<sup>6</sup> Study area water pricing is being calculated by authors based on respondent's water consumes per day.

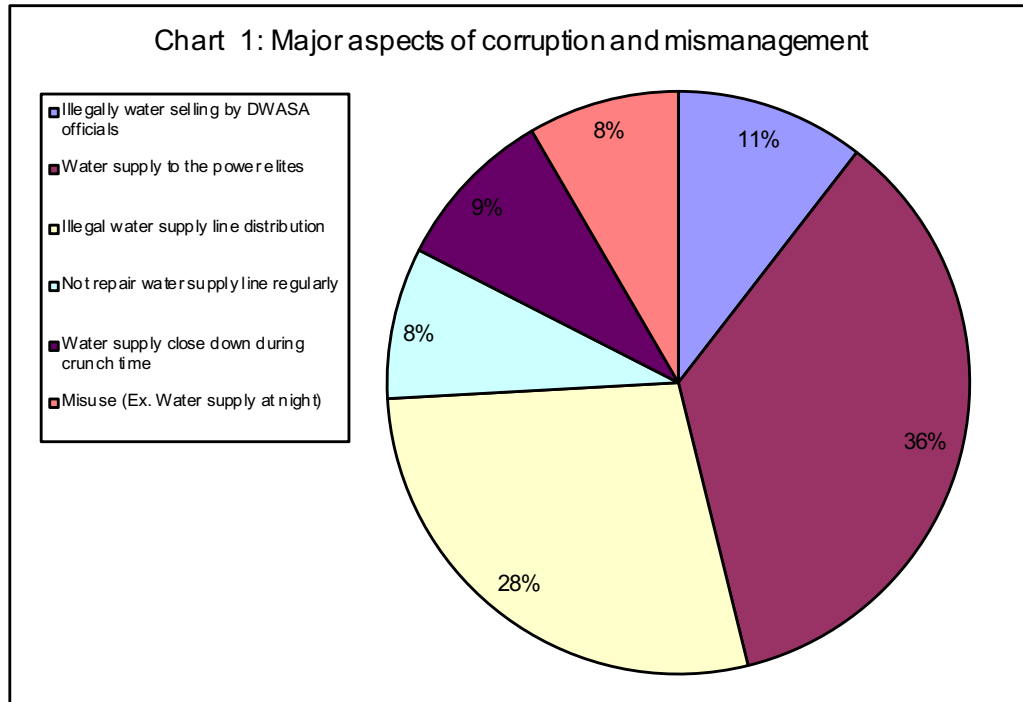
Very Good	0	0	5	10	5	5
Good	3	6	5	10	8	8
Moderate	15	30	25	50	40	40
Bad	27	54	7	14	34	34
Very Bad	5	10	8	16	13	13
<b>Total</b>	<b>50</b>	<b>100</b>	<b>50</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Attitudes survey.

As shown in Table 4, 40% of respondents think that water quality is moderate, but 34% think the quality is poor. In Balur Maat slum, 54% of the respondents believe that water quality is poor. Roughly, 50% of respondents feel that water quality could lead to water conflict with government and non-government stakeholders.

#### **4. Corruption of the Relevant Stakeholders**

The respondents have expressed their worries that the water crisis may lead to potential conflict. In their opinion, the corruption of DWASA officials and politicians who are involved in the water supply are to be blamed for it. The consensus is that if corruption cannot be controlled, it will be challenging for the slum dwellers to get the general service from the public officials. It complains that lack of accountability and mismanagement of DWASA officials together with the corruption of power elites, and DWASA officials is a regular practice. According to 68% of the respondents, the cause of an inadequate supply of water is corruption and to 26% is mismanagement of the DWASA officials. Most of the respondents opined that government control of corruption and mismanagement of the DWASA officials will ensure proper water governance and will generate extra revenue as it will encourage people to pay the legal authority rather than paying the power elites of the slums. The respondents also pointed out a few other causes for corruption and mismanagement of the DWASA officials, as shown in Chart 1.



Source: Attitudes survey.

As shown in the chart, 36% of respondents believe that water crisis originates due to interventions by power elites, but they cannot present any concrete evidence. Twenty eight percent claim that illegal water supply line/connections must be blamed for the crisis, and there is visible evidence behind this assertion. These along with other factors in their views are also responsible like- illegally water selling by DWASA officials (11%), reduced repair and maintenance of water supply line (8%), water supply close during crunch time (9%) and misuse (8%). These factors also forced the slum dwellers to be reluctant to depend on DWASA officials for water supply instead and forced them to rely on the power elites although they are aware of the exploit by the leader.

### **Managing Water Conflict in Dhaka City Slums**

Water distribution in Dhaka City is informally governed by various groups such as political leaders, power elites and mediators with the help of DWASA officials. In some slums, NGOs have been working for a long time. Although DWASA is responsible for water supply in DCC and Narayanganj, against 2120 million litres/day water demand, DWASA can provide only 1880 million litres/day. It means the demand and supply gap is 240 million litres/day (Roy and Dutta, 2017). In such a situation, it is challenging for slum people to get access to water regularly. DWASA is also unable to set up a water line on illegal land or without fair holding number. In some cases, DWASA supplies water to slum areas through CBOs. Street tapes are alternative opportunities of century-old traditions. These are also found in the two slums in studied.

### **a) Balur Maat Slum**

The slum owners and community leaders control the water supply in Balur Maat slum. The slum is situated on government land, and the local political leaders control it. They build 'Chapra Ghar'(shanty house of 100 ft<sup>2</sup> or so) and rent out these to the slum dwellers. House rents vary from Tk. 1500-2500/month including water supply bill (water bill Tk.200-250 per month). There are eight points of water distribution in the slum which is operated by three ways to mitigate conflicts in the slum.

#### **Water Distributed by Slum Owners**

There are sixteen slum owners, and each proprietor owns and operates 25-30 'Chapra Ghar'. Every four-slum owner combined installs a water point for the supply of water to their tenants. Maximum families of this slum are dependent on the process of water supply. It is found that 350 families out of 600 directly collect water from this process. Water supply in this process is frequent and sufficient for their daily household needs and drinking purposes. However, only tenants can collect water from these points. The process may be termed as patron-client based water distribution and conflict management. Water supply is often used as leverage to control the tenant by landlords when any disagreement like water price, house rent, disobedience between the owner and tenant arises. In these cases, the landlord often stops the water supply to the accused client. A landlord with 25 'Chapra Ghar' earns Tk. Five thousand for water supply/month. The rate is higher compared to a middle-class family in Dhaka city based on the amount of water use. However, the tenant must pay higher prices once they get a fixed amount of water for family need. It forced conflict management, where the patron-client relation is fragile. In this process, the landlord charges high rates for water and gets undue benefits, but the tenant has no alternative option. Nonetheless, they also have the benefit of continuous water supply. Thus, it is a 'win-win situation' in the conflict management process.

#### **Water Distributed by Mosque**

As mentioned earlier, DWASA does not have the legal authority to set up a water point in an illegal structure. However, they have the tradition to install water point in religious places like the mosque at a very minimum rate. Thus, DWASA encourages Community Based Organizations (CBO) to establish water points in a mosque in the slum area. In the studied slum, there is a water point in the mosque and a CBO called 'Masjid Committee' gets free access to water. This committee supplies water through pipeline twice a day at a specific time for half an hour each time. One family is allowed to get maximum 40-50-litre water at a time. The quality of water is good and usually used for drinking purpose without filtration or heat treatment. In this process, the slum people need to pay the minimum amount for water which is usually collected by the committee. The committee then pays the bill monthly. However, most of the committee members are landlords or leaders of the slum. This type of conflict mitigation process through negotiation is common in slums. It is found that the committee members are dealing with any problem regarding water supply in the slum.

**Table 5:** Conflict management process in Balur Maat slum

Water Distribution Process by	Actors	Conflict Management	Interest Situation
Slum owners	Slum leaders, landlord, local political actors	Force	Win-Win
Mosque	Masjid committee (slum leaders/landlord), DWASA	Negotiation	Win-Win
DSK	Slum leaders, landlord, local political actors NGO's (DSK)	Mediation	Win-Win

Source: Authors

### The DSK Model

DSK (Dushtha Shasthya Kendra), a local NGO, is working for the benefit of slum people for easy access to safe water and sanitation for the past few years. They are coordinating and cooperating DWASA to provide safe water in the Dhaka city slums, and their pilot project is known as DSK model (DSK acts as a guarantor of water bill on behalf of slum people). In the slum, four landlords are found to install three water points in 2009-2010 at street-side with the help of DSK. Roughly 150 families are found to get water supply from these points. However, the only renter has access to this water source. The landlord supplies water 2-3 times/day and water points remain locked rest of the times. Each landlord pays Tk. 10,000 to set up the pump. The slum household is bound to pay Tk. 200-250/month, if they want to get water supply. However, it may also be termed as a 'win-win situation' for both the parties. DSK's approach in conflict management is very crucial as they are working as a non-profit making the third party. It is identified as mediation in conflict management in the slum.

#### b) Companyer Haat Slum

Water distribution process in this slum is entirely different compared to that in Balur Maat. In this slum, no DWASA water pump or water point is directly linked with the slum households. The structure of this slum is different compared to other slums in Dhaka city. It is constructed on low land by the bamboo structure. In every cluster, there are 15-25 'Chapra's. The landlord of the slum establishes a submersion pump for each cluster. Altogether there are 20 structured bamboo clusters in this slum. The landlord does not charge a separate bill for water supplies; instead, it is incorporated with monthly house rent. The landlord reportedly invested Tk. 15,000 for installation. Regarding the entire process, one of the slum dwellers express his views under the following words;

*Compared to other areas, this slum is a good place to live. The rent here is cheap, and we don't have to pay water price separately. Although water quality is not entirely good, but we don't have any choice (Personal communication, January 7, 2014).*

The conflict resolution process in this slum is a mandatory negotiation process. Because slum dwellers do not have any option to negotiate with water pricing or billing, Whoever, rent the tiny bamboo structured room will automatically get access to the water from the submersion pump. However, the landlord controls the water supply as he had to



pay the electricity bill. Besides, he does not live the slum, and his followers manage rents and other managerial issues. Opinion from both parties suggests that the entire process is a win-win situation in managing water conflict.

## Conclusion

This study has made possible best attempt to focus on the role of various actors' involvement and influence to mitigate the water crisis in slums. The Dublin Principles on Effective Water Management indicates that the effective and fruitful participation of diverse organisations and stakeholders in water management is vital (Jønch-Clausen, 2004). This study has found that there are hidden problems in water management in densely populated slum areas in Dhaka city. However, informed management system addresses multi-faceted issues of the water crisis and plays a vital role in water conflict management. Corruption is found to be a factor, aggravating water management problems. It is found that the power elites of the slums control water distribution network and are supported by alleged corrupt DWASA officials. Water bills set by the power elites are not controlled or mutually agreed, and these are high for slums consumers. Public participation in decision-making is not practised or encouraged, and there are no accountability DWASA officials. Politicians only care about slum people when they act as 'vote banks' but seldom provide necessary services in the context that slums are illegal entities and public utilities are not offered to people living there. Moreover, water governance lacks transparency, accountability, legitimacy, and legality.

Active participation of stakeholders is found missing for accessing to, distribution of, and billing process of water supply in the slum areas covered through study. All these affect the slum dwellers negatively as long as they do not get adequate and affordable water. The study reveals that water conflict may cause more problems in future if it is not managed and mitigated adequately by associated authorities concerned. Therefore, it is recommended that the role of middleman/water business actors (slum leaders, slum owners, local political actors) should be abolished in a slum-based water supply system. The local community-based organisation could be called upon to supplement the concerned government officials for ensuring the supply of water to the slum dwellers. If the CBOs are transformed into private sector actors, using their social capital, then the Public-Private Partnership (PPP) can be a viable alternative to ensure slum dwellers' rights to a safe water supply. Given the severe water supply crisis in hundreds and thousands of slum dwellers in Dhaka city experience every day, the non-conventional PPP can be a role model with a more sustainable result in the case of safe drinking water. Instead of a patronising exploitative system, good governance should be executed in water management in slum areas in Dhaka city to provide poor residents with an essential need like water. Multi stakeholder's engagement empowering urban local government could facilitate resolving the emerging problem in the slum areas. Moreover, better management of slums is the demand of time.

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## **A Spatial Disparity Dimension of Infrastructural Facilities in Rural and Urban Area of Shibpur Upazila, Bangladesh**

**Shahina Akter\***

**Abstract:** The development processes often create an immense spatial disparity among various cities and regions. Therefore, some areas may emerge to get more than their average share of the same facility and it is commonly visible in developing countries where the urban centres usually have centralization of essential goods and services at the cost of their rural counterparts. The main goal of the study is to define the level of spatial disparity dimension of infrastructural facilities in a rural and urban area at Upazila level in terms of the development pattern. The primary data were collected by using the structured questionnaire whereas, secondary data were gathered from relevant sources such as Upazila head quarter, articles, journals, books and Websites. The study applied Lorenz Curve and Gini coefficient as main analytical technique for the primary data analysis. The result shows that in overall levels of infrastructural facilities disparity had been highly visible in both rural and urban area. The relation of education and occupation also shows an unbalanced spatial pattern of infrastructural development. On the basis of the findings, this research proposed that community development process should be taken up such areas that would be helpful to decrease the level of spatial disparity dimension. Such types of development process should be encouraged by the government through the provision of financial sanction and technical assistance for a balanced infrastructural development.

**Keywords:** Spatial, Disparity, Urban – Rural, Infrastructure, Development Pattern.

### **Introduction**

In the process of development, spatial disparities are the results of uneven distribution of various facilities such as socio-economic and infrastructural facilities. Moreover natural resources and regional differences are other vital causes of disparity in the history of human development. Certain development issues, environmental factors, and operation of economic, cultural and political processes with other things often produce an espatial area of concentration and specialization. Thus infrastructural facilities are not equally spread over an area. The phenomenon of inequality is extensively acknowledged in Shibpur Upazila and it was increased because of the unplanned infrastructural development. Disparities were most visible in the commercial, industrial and urban growth centres along with both urban and rural areas. There was also an unequal entrance to productive resources, and basic infrastructures such like as schools, health centres, roads, educational institutions, and other facilities (Akpan, 2014). On the other hand, inadequate and low qualities of infrastructures could have immense implication for welfare and resolution of poverty. It is a consensus among scholars Hu, et al (2013) that infrastructures are the basic criteria for the success and prosperity of public and private efforts aimed at speeding up to economic development. It is certain that without adequate provision for infrastructural facilities any area cannot expect rapid socio-economic

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development. Omofonmwan (2004) had asserted that inadequate infrastructural facilities are some of the main critical factors which contributed to the high level of rural poverty. In the overall economic growth and development, the role of infrastructural facilities cannot be overemphasized. United Nation (2011) had commented that in poverty reduction, economic growth and employment for the masses, infrastructure plays a critical role. Moreover, Ale, et al (2011) expressed the similar opinion that the provision of basic infrastructures is an essential requirement for developing economies to raise economic growth and reach the state of economic recovery and poverty elimination through increasing and diversifying agricultural outputs. Also, (Fernández-Manso, 2010) identified that the provision of infrastructures is also an inseparable part of an integrated strategy. It combines the development of various domain of life including different sphere like agricultural, educational, health, nutrition, electrification, water supply and cooperatives in a reciprocal way. This serves as a holistic approach to a large extent towards solving the regional problem. Bamboye (Fujii, 2012) commented those individuals are poor as they do not have entry to infrastructural services for improving quality of life. Similarly, ("Household Amenities and Urban Infrastructure Development of Hisar City, 2010", 2015) had remarked that adequate infrastructures can reduce the price of production which affects productivity and employment. Socio-economic and infrastructural facilities are the fundamental necessity for the residents of any city in the world which is the prerequisite for a standard of living environment in the city which also affects the regional patterns of developments and also environmental impacts. Therefore, adequate and equal distribution of infrastructural facilities is one of the most notable tasks of planning.

### **Objectives of the study**

The main objective of the research was to determine the Spatial Disparity Dimension of Infrastructural Facilities development in a rural and an urban Area of Shibpur Upazila, Bangladesh. The specific objectives are

- To identify the level of disparities between rural and urban area of Shibpur Upazila and
- To examine the spectrum of problems concerning changes in terms of infrastructural facilities.

### **Literature Review**

One of the most common problems faced by developing countries is the insufficient provision and maintenance of infrastructural facilities and the needful condition of infrastructures in many areas is causing a great challenge to economic development efforts especially the level of agricultural and industrial productivity (Kyriacou, 2013). It was remarked that the infrastructural facilities should serve as the catalyst in the process of agricultural production. They are either not available or inadequate and can hinder socio-economic transformation (Larghi, Lemus, Moguillansky & Welschinger, 2015). The development of infrastructure must be considered as an important part of the entire economic growth and development. A major problem is the pattern of distribution of

these basic infrastructures which displays urban bias; hence poverty is more prominent in the rural areas than urban areas. A considerable measure is placed on the development of urban infrastructure neglecting the rural areas (Lee & Hong, 2013). Apart from poverty problem, the major factor for the rural-urban exodus is the attraction of the infrastructural facilities provided in the few urban cities and this tendency will continue until such facilities are fairly provided and sustained in the rural communities. (Madiasworo, 2018) remarked that the hopes and aspirations created in the minds of rural folks have been eluded by the sustainability of the provision, operation and maintenance of appropriate rural infrastructures. (Manggat, Zain & Jamaluddin, 2018) viewed that rural infrastructural development has not been considered seriously and it is often hard to quantify its direct influence on the quality of life in rural areas. Rotimi (1994) had assumed the fact that transport and communication were capable of assisting the diffusion of ideas and innovation, The role of transport and communication in the development process cannot be overemphasized in that they assist in no small measure to spread the benefit of development from the industrial urban centre to the rural hinterland usually in form of spread effects. In addition, World Bank World Development Report 2018 mentioned a notable opinion when he remarked that the functions performed by the banks in the modern society include operating current, saving and deposit accounts, money transfers, purchase of drafts, procurement of loans for a large variety of purposes and opening its door to business in community, is greatly viewed as vehicle of ushering in growth and development. Umoh (2000) estimated the impact of rural electricity and roads as facilitators of socio-economic development of rural areas. At the same time, Umoh discovered that the current installation of rural electricity supply and construction of access roads as increased volume of investments has contributed to economic growth in general. Eight types of infrastructures were surveyed in the study namely road, health centres, market centres, water supply, electricity, banks, communication gadgets and education, and their influence on the agricultural productivity. Similarly, Ale et al (2011) experimented the significance of rural infrastructural development in solving the problems of food security and city congestion, where he pointed out that many rural households move to the cities in search for good living where infrastructures are adequately provided at the expense of food production.

### **Conceptual Framework**

Idachaba (2017) had presented the classification of the infrastructures into three categories, namely, first: physical infrastructures consisting of roads, bridges, storage facilities, dams, irrigation, water facilities, and other forms of processing facilities. Second, social infrastructure like health and medical facilities, educational facilities and third, institutional infrastructure which comprises cooperative societies, farmers' unions, financial institutions like banks, agricultural extension and training services. This classification is of huge significance as the socio- economic status of people largely depends on the quality of infrastructural facilities provided with good maintenance culture. The basic physical, social and institutional forms of capital, which develops production, distribution, consumption activities and ultimately the quality of life (Poku Boansi & Amoako, 2015) are called Infrastructures. Essentially, it comprises the facilities such as basic services without which primary, secondary and tertiary productive activities

cannot function (Madu, 2012) Infrastructures forms the useful ingredients to motivate the people to be more productive and acquire relative self-reliance (Egbetokun, 2017). In other words, infrastructural facilities are aspects in the package of basic needs which a community would like to obtain for better living (Olayiwola and Adeleye, 2005). It is observed as those facilities and services that are necessary to improve on the quality of life of the people. Abumere (2002) put infrastructure to incorporate the system of physical, human, and institutional forms of capital which enables rural residents to perform better in their production, processing, and distribution activities, as well as help to develop the overall quality of life. In addition, infrastructure can be better understood when those specialized elements in the development process bring about improvements in the socio-economic welfare of the masses. Bamboye (2007) had assisted in categorizing the infrastructural facilities to involve - economic such as credit, loan, production support; physical infrastructures such as roads, electricity, water and sanitation facilities and recreational facilities and capacity building in terms of training, information dissemination; and support service like market services, and access to basic social services

### **Location of the Study Area**

The Shibpur is the second biggest upazila of Narsingdi Zila considering its area which came into existence in 1918 and was upgraded to upazila in 1984. Shibpur Upazila (Narsingdi district) is located in between 23°56' and 24°07' North Latitudes and in between 90°38' and 90°50' East Longitudes which has an area of 206.89sq. Km. It also has 9 Wards, 9 Unions, 132 Mouzas and Mahallas, and 194 villages (BBS, 2011). It is bounded by Monohardi Upazila on the North, Raipura, Narsingdi Sadar and Palash Upazilas on the South, Belabo and Raipura Upazilas on the East, Palash and Kapasia Upazilas on the West (Figure 1.1) There are total 65,094 households at Shibpur Upazila and the average size of households is 4.64 surveyed by BBS (2011). The Total number of population is 3,03,813 and the number of male is about 1,48,419 along with female having total number 1,55,384. It has adequate educational institutions having 113 Government primary school, 31 Non-government secondary schools, 5 governments and Non-government College, 11 Madrasa, and 1 technical and vocational institution. There are 7 filling stations, 1 fire brigade station, 3 police stations etc. along with 1554 ponds and a river flow named Arial Kha.

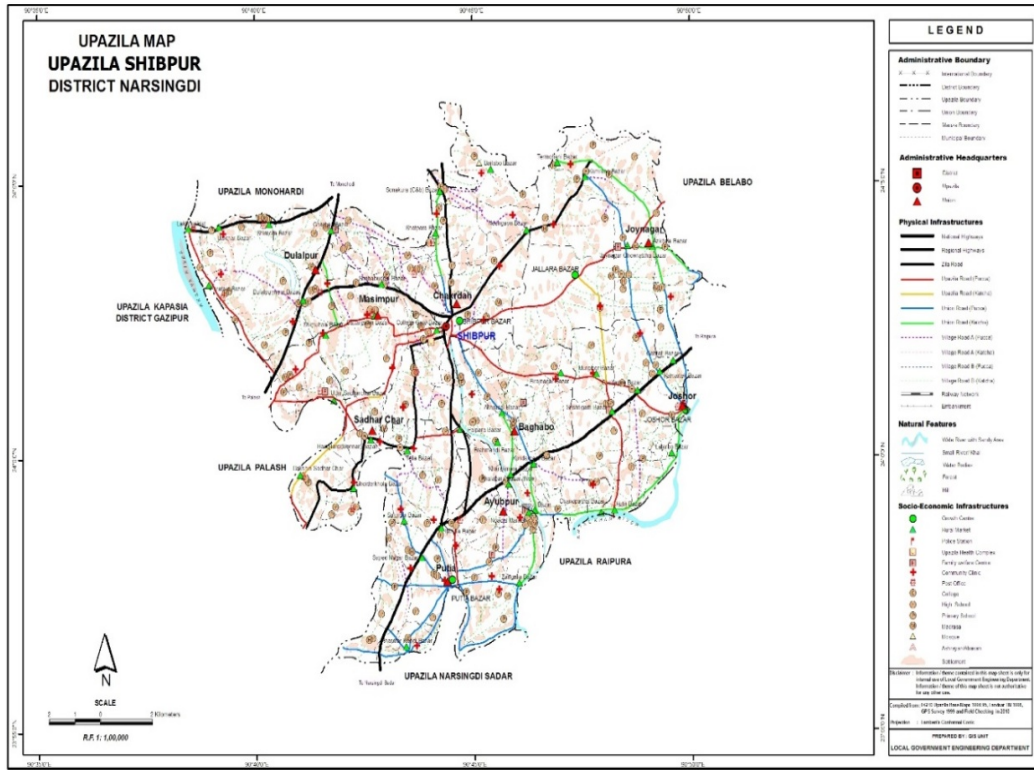


Figure 1.1 Location of the study area (Shibpur Upazila)

**Methodology**

In this research, Lorenz Curve and Gini Co - efficient was the main analytical technique used for showing the disparity dimension of infrastructural development of both urban and rural area. The Gini – Coefficient ratio are calculated on the basis of Lorenz Curve. By using the Lorenz curve the Gini – Coefficient formula (Rycroft, 2003) are given below

$$\text{Gini Co - efficient} = A / (A+B)$$

Here, A= Area of A (in the Lorenz Curve) and

B = Area of B (in the Lorenz Curve).

Generally, the Gini Co - efficient ratio indicated an index or percentage. The Gini Co - efficient ratio ranges are depends on between 0 and 1; while as a percentage it ranges between 0 and 100%. When the Gini Co - efficient ratio is 0, its presents the perfect or ideal equality whereas it is 1 its present the ideal or perfect inequality. On the other hand, when the Gini ratio is closer to 0, it indicates more egalitarian in an area. Similarly if Gini ratio indicates the closer to 1, it indicate the level of disparity or inequality. Moreover, this study had been followed the mixed method which is the qualitative and quantitative approach. First of all, Qualitative data were collected by using the Participatory Rural Appraisal (PRA) method where two tools, i.e. Resource Mapping and Focus Group



Discussion (FGD). And other secondary data were collected from various sources such as books, journals and from the websites. Primary data were collected from the questionnaire survey.

**The calculation of sample size:**

To determine the minimum sample size the following formula had been followed, which is

$$n = \frac{z^2}{d^2} pq \quad (\text{Snedecor \& Cochran, 1982})$$

Where,

$n = \text{Sample size}$ ,

$z = \text{Statistical certainty chosen}$ ,

$p = \text{Coverage rate/estimated prevalence}$ ,

$q = 1 - p$  And

$d = \text{precision desired} : 0.05$

Considering 97% Confidence Interval

Let,  $p = .5$  and  $z = 1.96$

$$\Rightarrow n = \frac{1.96^2}{0.03^2} \times .5 \times (1 - .5)$$

Or,  $n = 1067$

Considering Finite Population Correction (FPC), the adjusted the sample size was calculated.

For the Urban area of Shibpur Upazila the sample size is

$$n^1 = \frac{n}{1 + \left(\frac{n}{N}\right)}$$

$$\Rightarrow n^1 = \frac{384}{1 + \left(\frac{384}{4278}\right)}$$

$$\Rightarrow n^1 \cong 352$$

For the Rural area of Shibpur Upazila the sample size

$$n^1 = \frac{n}{1 + \left(\frac{n}{N}\right)} \Rightarrow n^1 = \frac{384}{1 + \left(\frac{384}{60816}\right)}$$

$$\Rightarrow n^1 \cong 381$$

So, the total no of surveys is calculated using a 95% confidence interval and  $\pm 3\%$  precision level. The stratified sampling technique is further implemented for collecting samples from all the sub zones such as wards and unions of Shibpur Upazila and finally, the total sample size was selected 300 for urban and 300 for rural areas. SPSS 20 software had been used to prepare the database from the questionnaire survey.

## Findings

The data were gathered from 9 Wards at Shibpur Municipality/Pourashava referred as an urban area and from 9 Unions of Shibpur Upazila includes as a rural area. Some major notable infrastructural facilities such as road network, educational facilities, electricity facilities, and sanitation condition, medical and recreational facilities were selected both in an urban and a rural area.

### Types of Road

In an urban area, about three - fourth of the total road is the bituminous road. Concrete made roads are the second highest in an urban area which represents that in urban area road condition of Shibpur Upazila is satisfactory. Besides, in a rural area, the percentage of bituminous made or concrete made road percentage is almost the same which represents that road condition in both urban and rural area is almost the same. In rural area a significant percentage of roads are katcha that represents the fact that some steps could be taken for the development of these roads (Figure: 1.2).

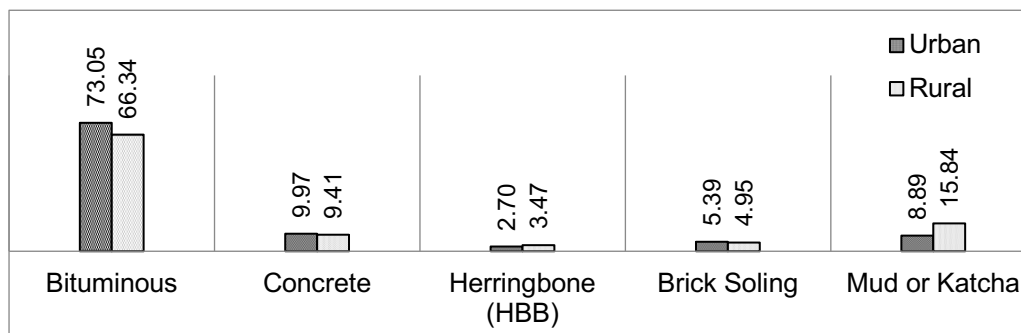


Figure 1.2 Types of Road (Source: Field Survey, 2017)

### Mode of Access to Main Road

It has been found that about two - thirds of total households in urban area got access to the main road through the footpath, whereas in a rural area about the percentage is about half of the total respondents. This is because, in an urban area, there are sufficient establishments has been made as footpath than in the rural area. In rural area, most of the households went to the main road by *Halot* or field boundary (Figure: 1.3).

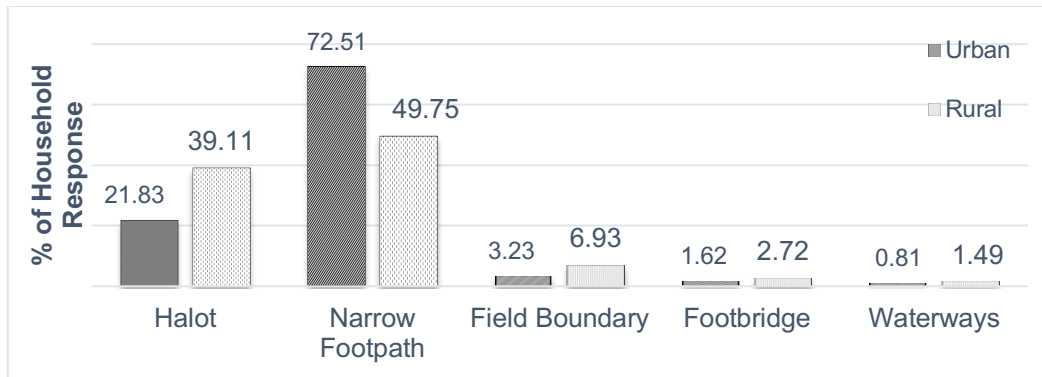


Figure 1.3 Mode of Access to Main Road (Source: Survey, 2017)

**Condition of Road**

In an urban area, about one - third of the total road’s condition is good, on the other hand, more than about half of the total roads have been reported as deteriorated. This represents the situation that there is not enough maintenance for the urban road though about two - thirds of the total urban road is made by the bituminous. On the other hand, the percentage of deteriorated road is lower in rural area than urban area, but there is about four times higher destroyed roads in rural area which needs quick maintenance before totally destroyed condition. The percentage of seasonal waterlogged road in rural area is about three times higher for than urban area. Besides, the percentage of good roads is also not much significant in rural areas than urban area. In a nutshell, it can be easily understood that enough maintenance of road is not present in both of rural and urban area. But the condition in rural area is worse than urban area. (Figure: 1.3, 1.4). From the Gini Co – efficient ratio of 0.3791 and 0.326 indicates that there are very less disparity between urban and rural area of Shibpur Upazila.

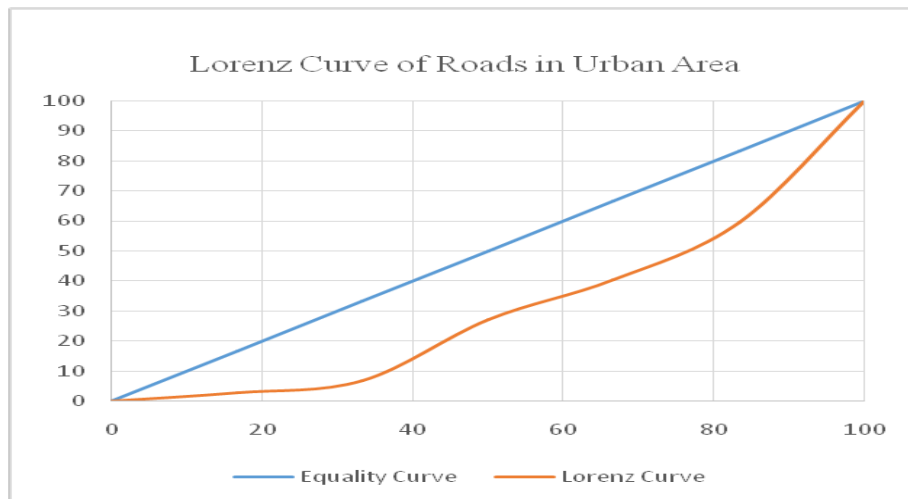


Figure 1.4 Access to road facilities in an urban area. Gini Co - efficient = 0.379133

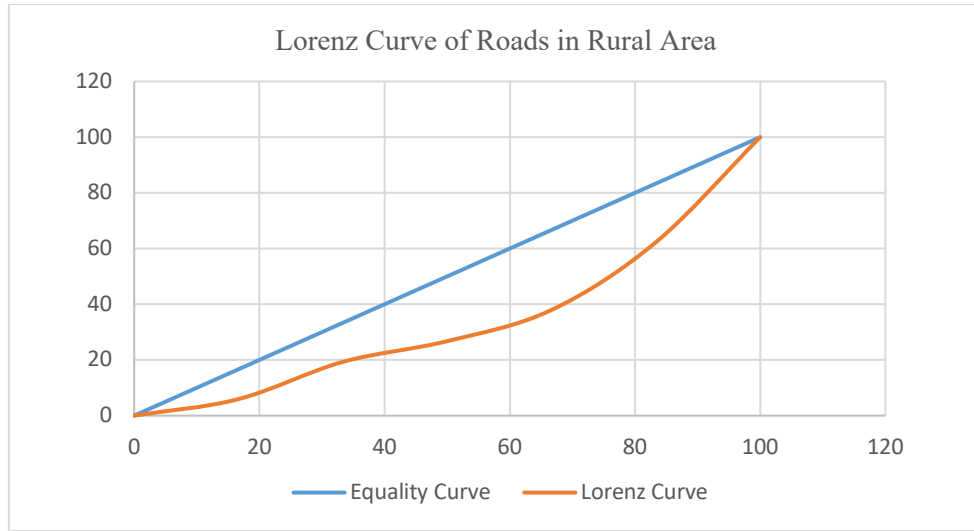


Figure 1.5 Access to road facilities in a rural area. Gini Co-efficient = 0.326

**Maintenance of Road**

As from the previous section discussion, it has been proved that enough road maintenance has not been carried out in both urban and rural area, the below Figure: 3.22 again proved that. There is almost never annual maintenance has been carried out for both urban and rural area. For about half of the cases irregular maintenance has occurred. In an urban area for about one fourth of the cases, roads are being maintained periodically 2-3 years. But the percentage is almost half in the rural area than in urban area. In the rural area, almost about one fourth of the cases roads are being again made by after extremely damaged. Thus, it can be said that effective regular maintenance should be carried out in both urban and rural area by the responsible authorities

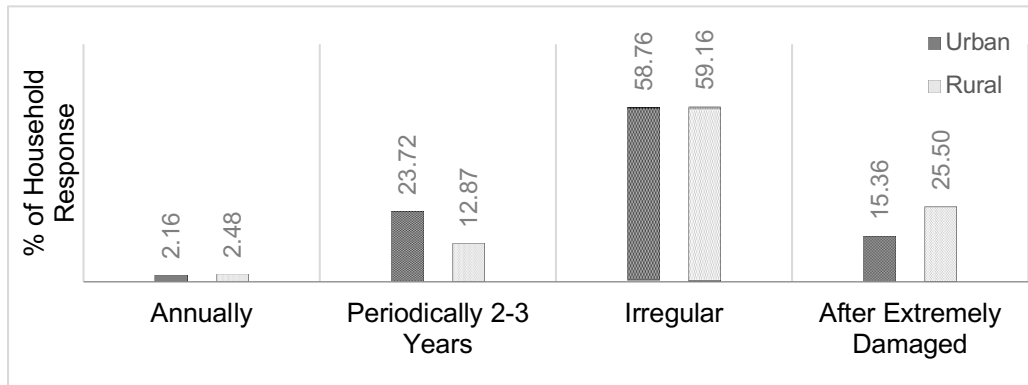


Figure 1.6 Maintenance of Road (Source: Field Survey, 2017)

### Level of Education

In Shibpur upazila, it had been surveyed that about half of the respondents are below the primary level of education in the rural or urban area. About more than one - third of total respondents are found to complete their Secondary School level of education both in the urban and rural area. The percentage of the number of people who completed SSC/HSC/Degree level of education is higher in an urban area than the rural area (please see Figure: 6.2) which indicates that people from an urban area is more attached to higher education than in rural area. Some initiatives should be taken to increase the percentages as about half of the total population is from below primary school level.

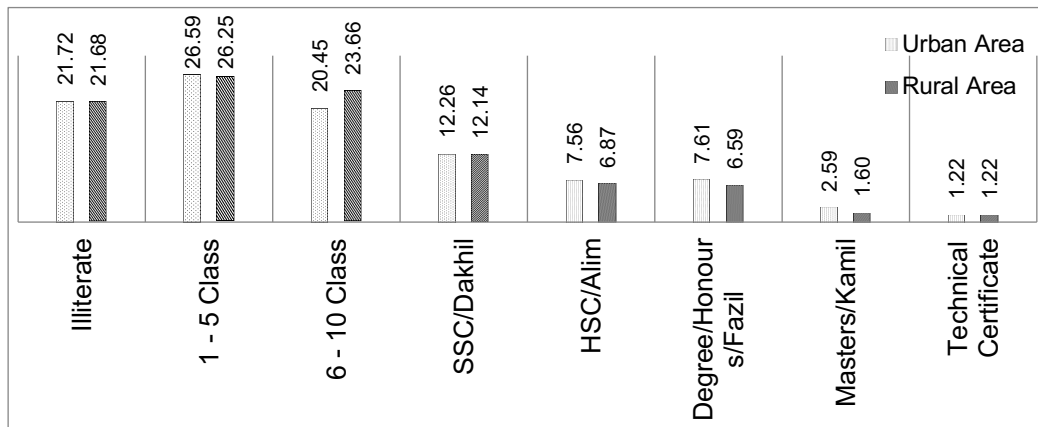


Figure 1.7 Level of Education (Source: Field Survey, 2017)

### Educational Facility

In Shibpur Upazila, it had been found that there was not enough qualified teacher. The dearth of this problem is about the same for both in urban and rural area. Moreover, the number of student against teachers is too high, which deteriorates the quality of education. In addition, lacking laboratory and library also hinders the quality education of Shibpur Upazila. But human resource development mainly depends on the formal education and educational facilities. From the figure 1.8, it can be assumed that access to educational facilities are unevenly distributed as a Gini Co – efficient ratio from the Lorenz Curve is 0.5225. This results also represent the disparities level of performance of the pupils. The various drawbacks are identified such as inadequate infrastructure, lack of library, laboratory, educational materials, Qualified teacher and unskilled management both urban and rural area. Figure 1.9 also shows the same near Gini ratio (0.4378). In rural area, the disparity dimension pattern almost same.

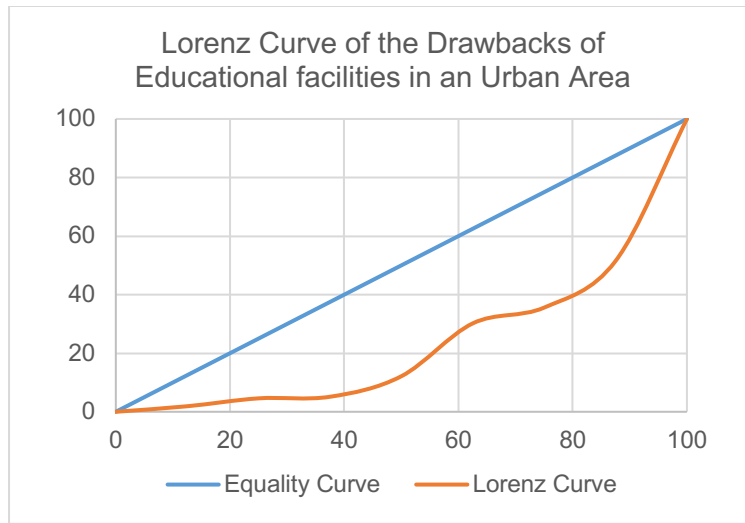


Figure 1.8 Drawbacks of educational facilities in an urban area. Gini Co-efficient=0.5225

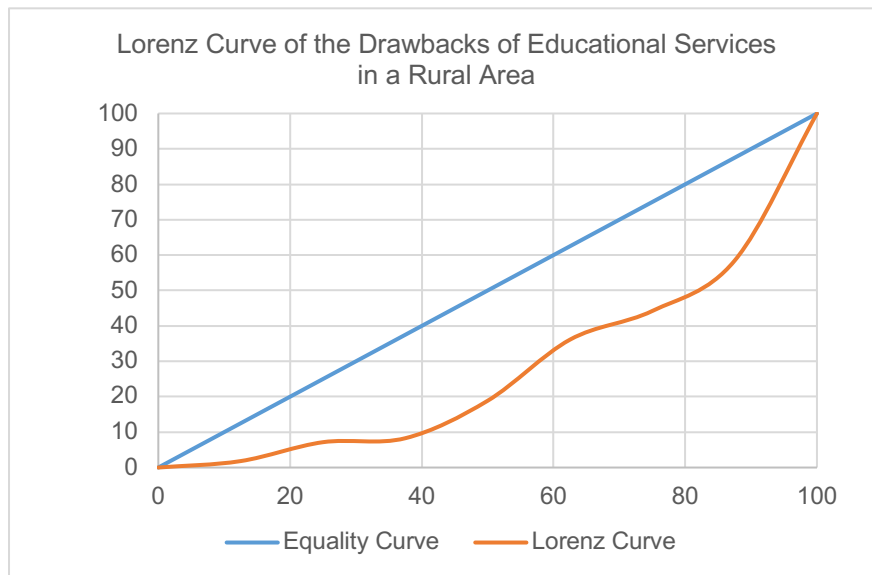


Figure 1.9 Drawbacks of educational facilities in a rural area. Gini Co-efficient = 0. 4378

**Types of Occupation**

Shibpur upazila, it has been noticed that most of the respondents (about 90%) in urban area are engaged in Job, Business and Labour types of occupation whereas, the rest of them are occupied with the vocational and traditional profession. The maximum percentages (about 40%) of respondents are from the business group in an urban area. Similarly, almost the same maximum percent of respondents are from labor class in the rural area. Further, about one third of the total respondents are engaged in Business types

of occupation in the rural area. Moreover, respondents involved in the vocational occupation are found about the double in rural area than the urban area (Figure 1.10).

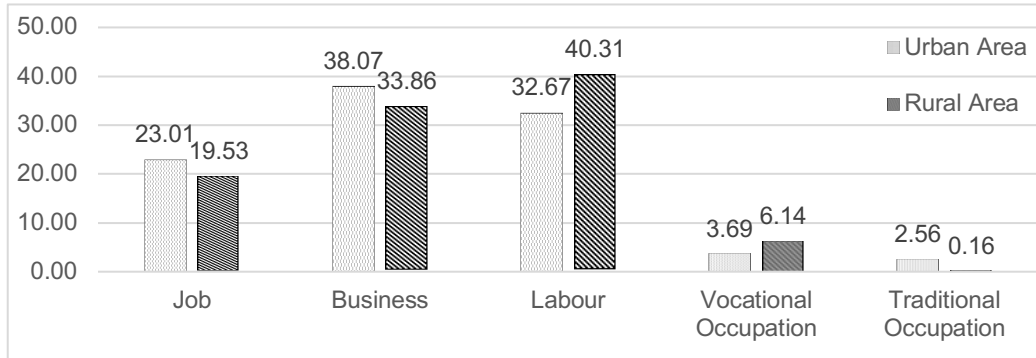


Figure 1.10 Occupations in Urban and Rural Area (Source: Field Survey, 2017)

### Relation of Education and Occupation

The relation between education and occupation pattern in both urban and rural area had also been identified. In urban areas, it has been noticed that people who even could not complete the primary level of education were **mostly** (about half) occupied with labor types of jobs. Some of them (about 10%) also preferred to earn their living as small entrepreneurs along with the involvement with Non-government jobs. Respondents who started their higher school but were not able to complete SSC had been found as remaining in the about the same types of occupation. A large number of them (about one - fourth) were engaged in various professions such as Hawker and small entrepreneurship. Surprisingly, respondents who completed SSC, about half of them are Shopkeeper, Small entrepreneur and Hawker. From above SSC level, the respondents started to be engaged in Government and Non-government jobs. Respondents having technical certificate mostly got engaged in non-government jobs (Figure 1.11). Figure 1.11 also depicts the less relation with the education and occupation in urban area. Showing Gini concentration ratio of 0.44 on the Lorenz Curve.

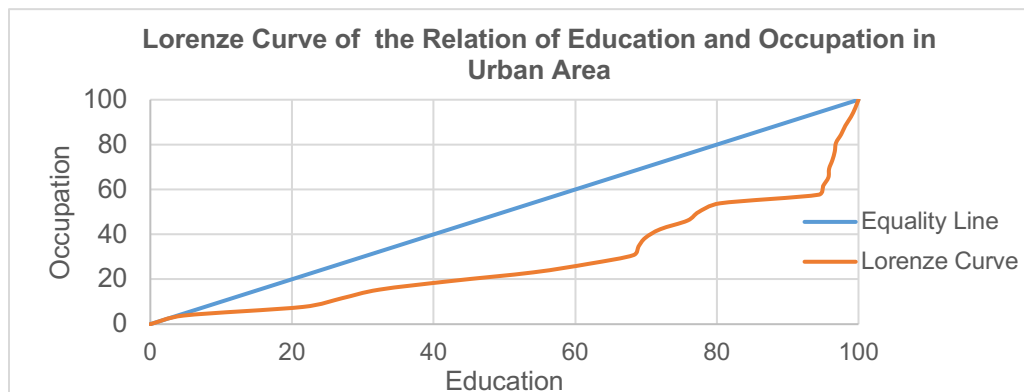


Figure 1.11 Relation of education and occupation in urban area Gini Co-efficient = 0.44

On the contrary, in rural areas, two third of the respondents having a technical certificate is engaged in Government and non-government jobs. Rest of them worked as an NGO worker and small entrepreneur. Respondents who completed the Masters Level of education, about 40% of them are found working in family works. Alike urban area, the proportion of engaging in Government and Non-government jobs also increased sharply in the rural area for those who completed their education above HSC. Most of the respondents from below HSC level of education started their small business and lead their life as small business holder. Among them, a large number were also engaged in agriculture and farming labor which is very much different than in the urban area. In an urban area, the percentage of the respondents in agriculture and farming is very low. Only 10.92 percent (rural and urban) of the total respondents are engaged in agricultural Labor. Among them only 1.28 percent of the total respondents is from an urban area and 19.18 percent is from the rural area, which represents that the rural area is the core working area for labors in agriculture and farming (Figure 1.12). It represents that the economy of agriculture based rural area provides more option to conduct business for small entrepreneurs. Again, those who are not literate, about half of them are day labor in agriculture and farming. A rural area the Gini Co-efficient ratio (0.4142) also the deduced the poor relation between education and occupation.

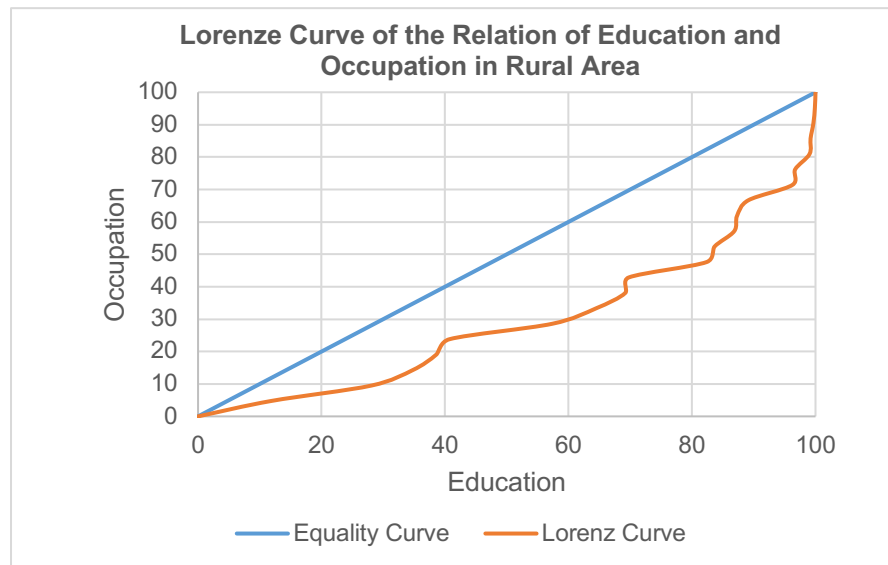


Figure 1.12 Relation of education and occupation in rural area Gini Co-efficient = 0. 4142

### Electricity Supply Status

Electricity supply in both in an urban and rural area is a very small percentage because of high load shedding and high pressure in peak period with insufficient electricity. Fewer portion households had said that they had enjoyed uninterrupted electricity supply. Oppositely, about half of the total respondents said that electricity is not regular in their areas. About half of the total respondents said that routine based frequent load shedding had occurred in their area. In rural area, a little number of households (about 7%) still



does not have or experience electricity facility in their households. And the scenario is almost the same without consideration of rural or urban areas in case of irregular or routine based load shedding (Figure: 1.13).

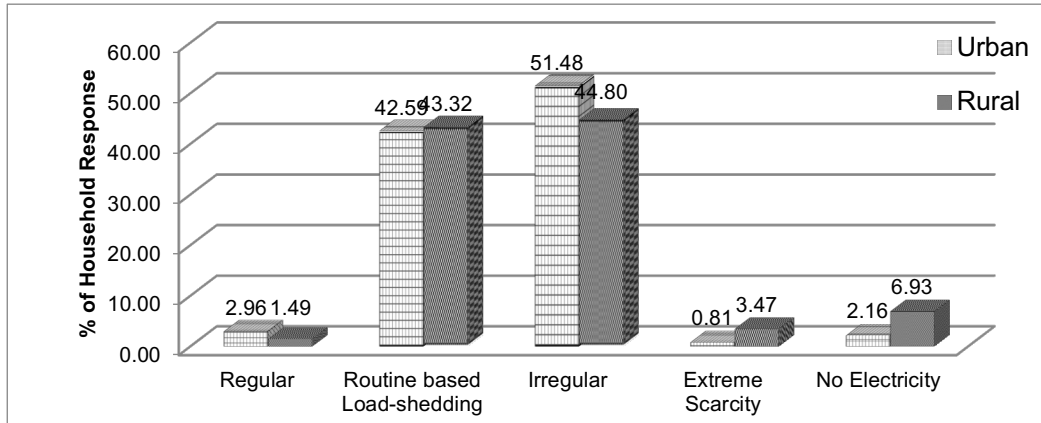


Figure 1.13 Electricity Supply Condition (Source: Field Survey, 2017)

### Drinking Water

#### Sources of Drinking Water

In Shibpur Upazila, almost all of the households (about 90%) in Shibpur Upazila use their own tube-well for the major source of drinking water. The percentage of having own tube-well is quite higher in both urban and rural areas as most of them lived in their own house. In an urban areas, a significant number of households (about 10%) use pipeline services for drinking water, specially those who are the new households living in urban area ( Figure 1.14 ).

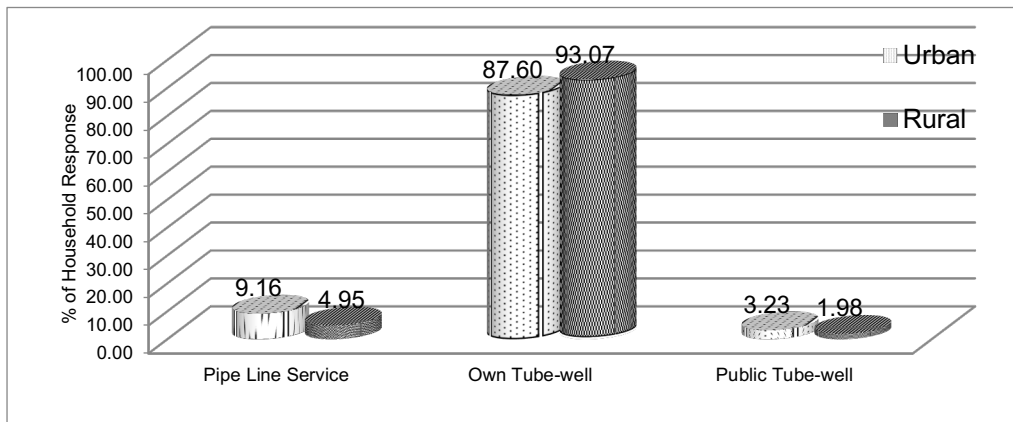


Figure 1.14 Sources of Drinking Water (Source: Field Survey, 2017)

**Sanitation Facilities**

In both urban and rural area, the percentage of using pit latrine is satisfactory. About almost all of the households use commode or pit latrine whereas, only a small percentage of households do not maintain healthy sanitation facilities and use an open toilet which is unhygienic. The percentage of using an open toilet is higher in the rural area than the urban area, therefore, awareness program can be carried out in a rural area about why and how to use healthy sanitation systems (please see Figure:6.6).

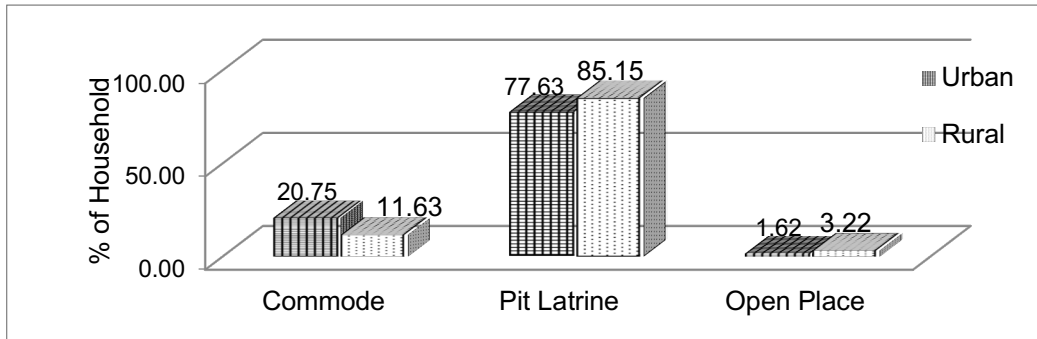


Figure 1.15 Sanitation Systems (Source: Field Survey, 2017)

According to the bar graph, absorb well sanitation system was used by more than about half of the households in both urban and rural area. About one - third of total respondents also used septic tank sanitation system which costs very expensive to install. The proportion of using different systems is almost similar in both urban and rural area. Thus no significant differences are noticeable in using sanitation system between urban and rural areas (please see Figure: 6.6).

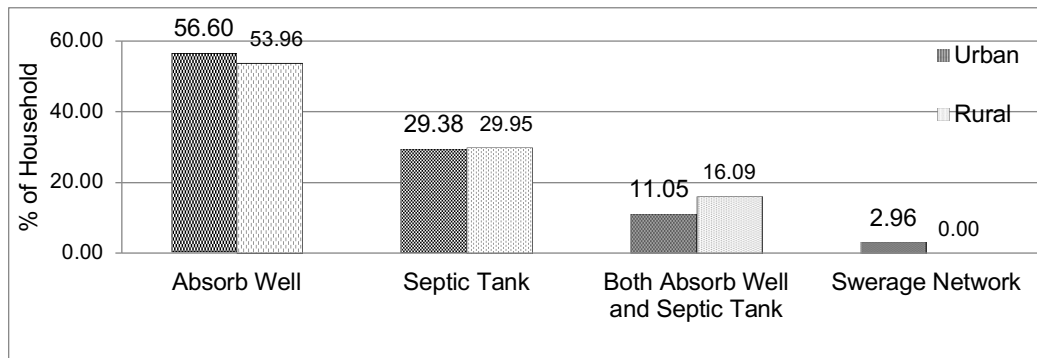


Figure: 1.16 Type of Sanitation Management System (Source: Field Survey, 2017)

**Medical Facilities**

It had been noticed that about more than two - thirds of total household in both of urban and rural are satisfied with the medication service provided by the health service centres. Rural people are generally highly satisfied with their services since the proportion of “Highly Satisfied” and “Acceptable” is higher in the rural area. So overall, it depicts the fact that though the medical centres did not have enough expertise for maternal and child

health, but satisfactory service for general health issues was provided by them. From the figure 1.17 and 1.18 represent the very less inequality between urban and rural area in terms of medical facilities whereas for the urban area Gini ratio is 0.523156 and for the rural area it is 0.682222. As a whole, drawbacks of treatment facilities are moderately occurred in both urban (figure 1.17) and rural (figure 1.18) area. Moreover, there was the need to address the imbalances in the provision of treatment facilities.

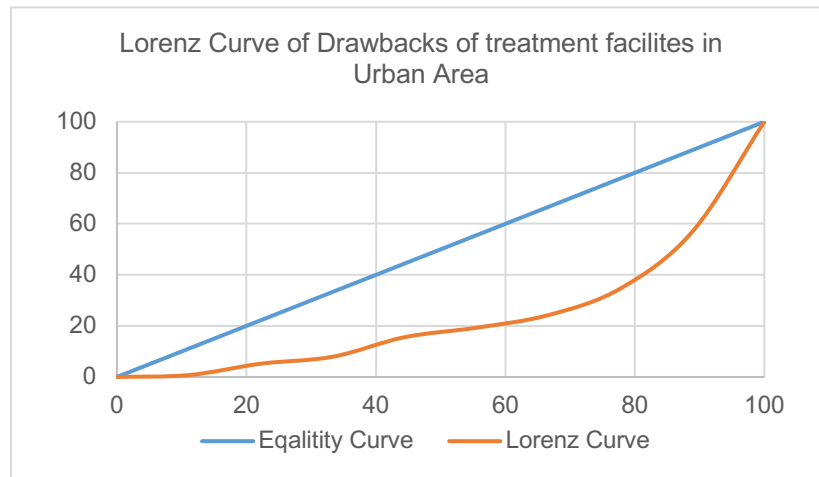


Figure 1.17 Drawbacks of treatment facilities in urban area. Gini Co-efficient = 0.523156

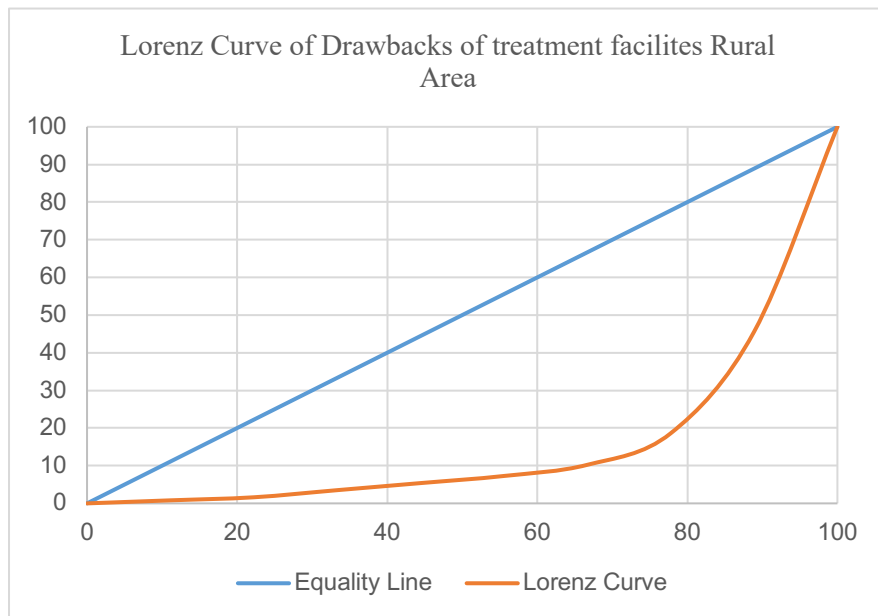


Figure 1.18 Drawbacks of treatment facilities in rural area. Gini Co-efficient = 0.682222

### Recreational Facilities

About half of total households in both urban and rural area anticipated that they were not provided with enough recreational facilities in their area. It is more prominent in the urban area than rural area as they lack space of open field in the area. Moreover, economic insolvency is another important reason for hindering outdoor recreation for some of the households of rural area, whereas in urban area lack of proper recreational environment and management of recreational areas are the major drawbacks of getting the recreational facilities.

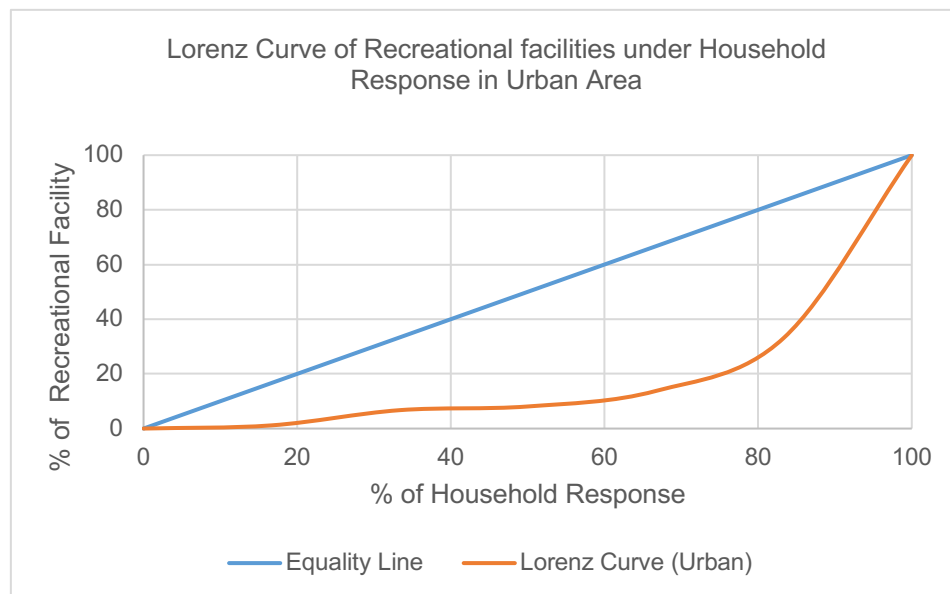


Figure 1.19 Access of recreational facilities facilities in urban area. Gini Co – efficient = 0.6238

Here (Figure 1.19) a total of 6 types of the recreational facilities with equal weight have considered. Picnic, Fishing, Visiting Park, Visiting Open Space, Watching Games, Playing all of the facilities have taken respect of percentage of household response. The Lorenz curve represents the deprived of recreational facility respect of percentage of household whose demand to get the facilities because the Gini ratio for an urban area is 0.6238.

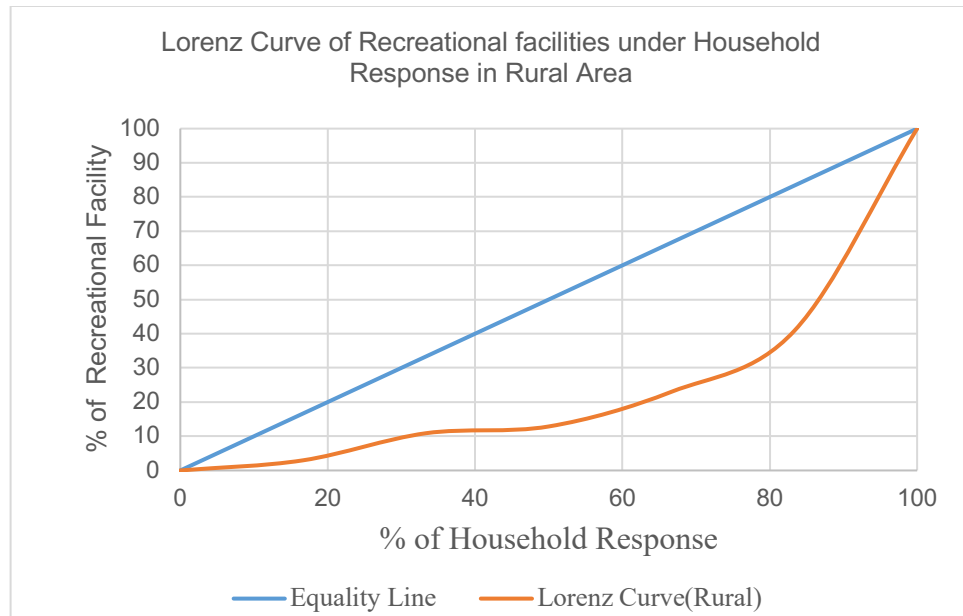


Figure 1.20 Access of recreational facilities in rural area Gini Co – efficient = 0.531367

Whereas from the figure 1. 20 show the depicting a Gini concentration ratio of 0.5313. A total of 6 types of recreational facilities with equal weight have considered as well as like urban area such as Picnic, Fishing, Visiting Park, Visiting Open Space, and Watching Games, Playing all of the facilities have taken respect of percentage of household response The Lorenz curve represent the more deprived of recreational facilities than the urban area respect of percentage of household whose demand to get the facilities.

### Existing Problems of the Area

In the earlier section of this chapter, it was discussed that load shedding is the topmost problem in both urban and rural area, which is generated from the imbalance situation of demand and supply of electricity. The proportion of having road related problems and water logging problem is almost the same for both urban and rural areas. In addition to it, the alarming finding is, one of the top problems in rural area is domestic violence on a female which needs to be uprooted. Therefore, the authority should give enough priorities to solve these problems (Figure 1. 21 ).

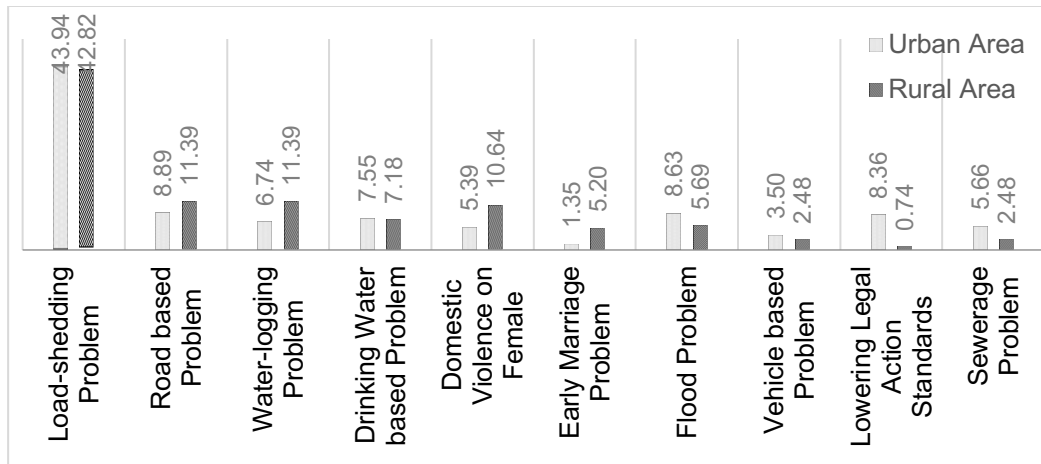


Figure 1.21 Existing Problems of the Area (Source: Field Survey, 2017)

### Expected Infrastructural Development

The people’s longing for the development of the area had also been collected from the respondents through various methods. It plays a notable role to represent the significance of different people’s aspiration to upgrade of the area. It had been noticed that about half of the total respondents first of all, wished for the improvement for their community service and electricity supply. In addition, about more than one - third of total respondents also wanted the development for road and transport, drainage and increasing the number of educational institutions. On the other hand, setting up new industries is the second last ranking among them (please see Figure 1.22 ).

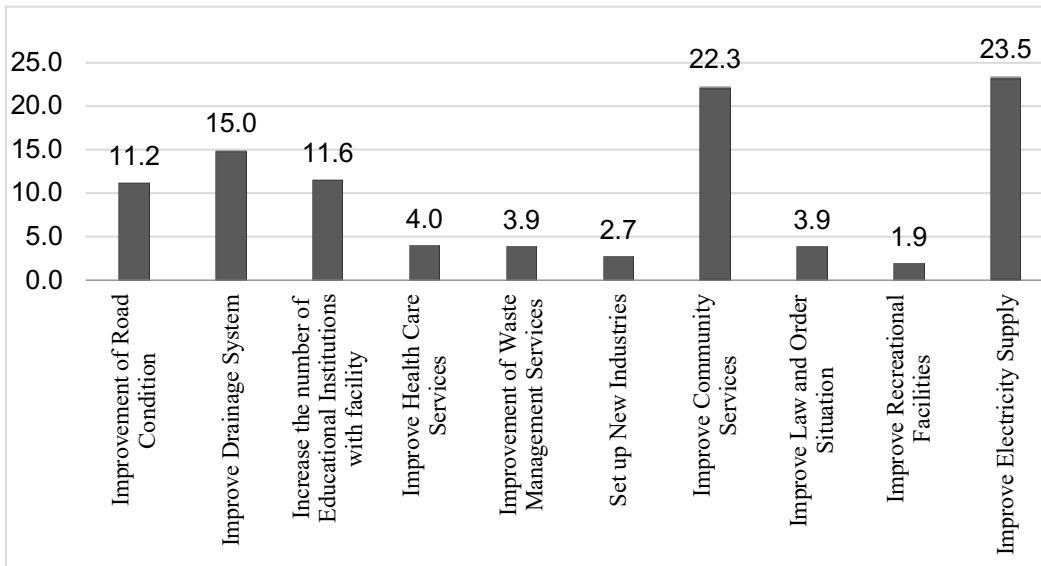


Figure 1.22 Expected Infrastructural Development of Shibpur Upazila (Source: Field Survey, 2017)

## Recommendations and Conclusion

The existence of spatial inequalities in the distribution of infrastructural facilities conveys the message to the planners that extending resources should be provided to less-privileged and deprived areas in order to promote balanced development. Both socio-economic and physical planners are needed to co-operate such as, if the socio-economic planner assigns the resource for a specific project, the physical planner should give the project to the best location. By doing so, the localization of the facilities in a few urban centres would be decreased. The community development policy should be accorded with the right attention since it has been realized that it is not possible for the government to provide all the needs of society. The communities that shouldered the construction of roads, bridges, supply of pipe-borne water and started electrification projects should be encouraged by the government through the provision of financial permission and technical assistance. This way, it would go for a long way to decrease zonal disparity between the privileged and underprivileged areas. From the above analysis and discussion, it is evident that inequalities exist in varying level among the local government areas. The results generally establish the view of the fundamental and periphery spatial pattern of development. Therefore, a basic challenge in the future development process is the narrowing of the gap between the privileged and underprivileged areas. It is quite demoralizing that the problem was worsened by certain government policies because of their non-pragmatic approach. For example, in our health-care delivery system the motto was “health for all by the year 2010” Unfortunately, this goal could not be attained successfully as theorized and widely circulated through out the place. These are commendable programs that should be backed with action but in the current system with the inauguration of the PTF programme, it will go far to bridge up to the gap. To correct the present imbalance between the advantaged and disadvantaged areas in terms of accessibility, similar radical policies are needed countrywide. Finally, if the government in every level is really serious by being moralist to achieve the goals, where no man is oppressed against sex, tribe, and religion nor discriminated against political affiliation, then there should be the reallocation of the national resources for the deprived regions to attain the goal of a balanced development. Shibpur is a densely industrial area and is a hub to many textile mills where Narsingdi gas field is located. So very soon. This Upazila has a huge number of employees in different sectors which have a major impact on the total regional employment growth and the development. Shibpur Upazila will enter in “Demographic Bonus” window within the coming years as the percentage of working people is high and increasing day by day. So, there is an immense need to build a skilled and educated youth generation. But it has been found that the level and the standard of education in this area is not satisfactory. Moreover, there are not enough vocational and youth training centres which are the means of theoretical and practical experience for different occupations. Two of the main reasons for the low standard of education behind it is the very high ratio of the students and teachers and lacking qualified mentors. So, concerned authorities should pay attention to the issues of the Upazila. Moreover, the major means of the communication of this Upazila is by road, and the condition of the road is not so good. Both rural and urban roads are deteriorating day by day because of the lack of regular maintenance and

supervision. So, road authorities should take some necessary measures regarding it. In addition, electricity supply condition in this area is another main problem anticipated by the most of the households especially in rural area, so Bangladesh Rural Electrification Board (BREB) should take some necessary steps which can reduce many other additional problems along with the main problems. In fact, progress and prosperity go hand by hand with the development of all the aspects of a particular area. Besides, the concerned authority should take some steps regarding the improvement of maternal and child health. This kind of unbalanced spatial pattern of development has the tendency to provoke the problem of regional imbalance which the Government should address with more seriousness.

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## Food Security in Bangladesh: Challenges and Way Forward

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**Abstract:** Bangladesh is considered as one of the most populated country in the world and also it stands among the list of the countries of highest density in per square kilometer. Besides it is one of the most vulnerable countries in terms of climate change and natural disaster. Recently The Rohingya Influx also increase its vulnerability in the context of human security where ensuring a hunger free life is a challenging task to the present government of Bangladesh for its huge population of almost 163 million. Food security is one of the major dimension of human security in 21<sup>st</sup> century encompasses with the availability of food, affordability of food, stability of quality and safe, nutritious food etc. According to the FAO, they emphasize on the food security to lead an active and healthy life. But a huge number of countries are struggling for ensuring food security for their people badly. The destitute population of Bangladesh still lack of sufficient resources to come up with money for food consumption of 2,122 kilocalories per day for per person alongside with other requirements, although the income growth of Bangladesh has been increased gradually from 1990 to till now. 50 percent of rural household who are involved in agricultural productions, are landless due to the failure of trade centric privilege, labour-oriented entitlement and transfer based entitlement. Unrestrained farming environment, lack of stress tolerant variations, periodic farming, improved farming pattern, unplanned industrial development and excessive urbanization prominently depends on availability of fresh water, indiscriminate use of natural resources, excessive use of agricultural inputs and uncontrolled agribusiness put barrier towards attaining food security in Bangladesh.

**Keywords:** *Food Security; Population Density; SSNP; Poor Governance; FAO and Public Policy*

### Introduction

In the 21<sup>st</sup> century, Bangladesh is considering as the 'New Asian Tiger' (Dhaka Tribune, 2017) in terms of maintaining a balanced GDP growth rate, political stability, democracy and macro-economic performance. Its economy is continuously growing with a significant change. (Saifullah, 2018) Development activity also go forward in the same line. Besides, ensuring Food Security all over the country is also a continuous process in this journey of sustainable development (Garber, 2017). But the overall scenario on ensuring food security is still a matter of great concern.

Bangladesh is considered as one of the most populated country in the world and also it stands among the list of the countries of highest density in per square kilometer. Besides it is one of the most vulnerable country in terms of climate change and natural disaster. Recently The Rohingya Influx also increase its vulnerability in the context of human

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security where ensuring a hunger free life is a challenging task to the present government of Bangladesh for its huge population of almost 163 million (GHI, 2018).

According to Bangladesh economic review 2018, during the last decade, Bangladesh economy has sustained its GDP growth rate more than 6% on an average where in 2017-18 financial year, Bangladesh achieved GDP growth 7.86%. Its current per capita national income is 1751 USD. Its total domestic savings is 22.83% of GDP where national savings is 27.42% of GDP (Ministry of Finance, 2018).

Just before entering the SDG global agenda for 2030, Bangladesh achieve a remarkable progress in Millennium Development Goals (MDGs). It has played a significant role to eradicate poverty (poverty reduction from 56.7% in 1991-92 to 24.8% in 2015) and reduced under 5 mortality rate which is now lower than that of India and Pakistan, decreased maternal mortality rate, increased the rate of primary school enrolment, rapid improvement made in health sectors and in immunization coverage, and also create impact in so many public sectors. In the SDG era, Bangladesh also progressing in a dynamic way to achieve the agendas within 2030 where ensuring food security is an important one. To achieve meals safety and zero hunger, United Nations has set up eight targets which fundamental theme is to end hunger, obtain food safety and accelerated condition of vitamin and nutrition and promote sustainable agriculture along with access to secure and nutritious food, eradicate malnutrition, ensure sustainable food productivity etc.

Food security is one of the major dimension of human security in 21<sup>st</sup> century encompasses with the availability of food, affordability of food, stability of quality and safe, nutritious food etc. According to the FAO, they emphasize on the food security to lead an active and healthy life. But a huge number of countries struggling for ensuring food security for their people badly. According to the Global Food Security Index 2018, Bangladesh placed 83<sup>rd</sup> position out of 113 countries where Bangladesh's score is 43.3 which is not up to the mark at all and lies in moderate food security areas (GFSI, 2018). Intending for achieving Sustainable Development Goals (SDGs) and 'Vision 2021' government has started various programs for ensuring food security in Bangladesh. Now among the various Programme of achieving 'Vision 2021' ensuring food security has become one of the key programs of the government of Bangladesh. But the overall scenario on ensuring food security is still a matter of great concern. In this regard, by taking this concern in mind, the aim of this paper is to explore the current situation of food security in Bangladesh based on food production, food availability and consumption. And also to find out the major challenges and possible way outs to address those challenges effectively.

### **Methodology of the Study**

The data are collected to achieve the result for the purpose and scope of this study. In this study secondary data are used to enrich the article. The secondary data are collected through different sources such as: journals, newspapers, magazines, thesis, census reports, press releases, NGOs reports and electronic resources.

## Country Context Analysis on Food Security

Food security as a thought emerged in the middle of 1970s when food crisis had become a concerning issue in the discussions of international food problems. The preliminary focus of food security refers to the problem of food supply. It also describes the food availability and price stability in the food market at national and international level. Along with food availability, accessibility of food and utilization of food also very much important in terms of food security (USAID, 1996) and all of them are inter-linked with each other. Food availability indicates the physical presence of food to the all citizen of the country by own production or market production where ability to maintain an appropriate and nutritious diet in the household level highlighted the term of food accessibility. Food utilization, which is considered as one of the major issue in terms of ensuring food security, refers to the appropriate food consumption, which includes the presence of proper food processing practice and storage capability, sufficient awareness and application of nutrition and adolescents care and adequate health and sanitation facilities (Begum, Hossain, & D'Haese, 2013).

Food security issue is so much concerning in Bangladesh after the birth in 1971 to till now. Negative impact of climate change, rohingya influx issue, sea level rise, soil and river pollution, increasing trend of country population made Bangladesh vulnerable in this sector. For this, the government of Bangladesh treat and work for this issue as most priority agenda. This threat against food security affects the agricultural production mostly.

The government of Bangladesh has taken lots of strategy in order to achieve food security all over the country. The vision 2021, vision 2041 and the Delta Plan 2100 is the key strategy of mitigating the treat of food insecurity. Ensuring food security is also a foremost objective of countries poverty alleviation plan. Again Bangladesh is considered as a country which will be mostly affected by the climate change effect. In line with climate change, Bangladesh is one of the most disaster-prone countries in the world as well. Here climate change-related disasters are likely to continue to undermine poverty reduction efforts. The government of Bangladesh continuously trying to diminish the negative impact of climate change in countries food security. In this context, the Government's Poverty Reduction Strategy continues to address these challenges through the National Food Policy. To realizing universal food security, strategic objectives already included in the food policy. It is pointed that, in terms of food production, the country needs to be not only self-sufficient but also manage equitable distribution of nutritious food. Ensuring food safety is particularly challenging given the multidimensional environment of the food security perception which covers food availability, physical and financial access to food, food consumption and food stability (Szabo, 2014).

Lack of food availability is a long term problem for Bangladesh. Food availability relates to the supply of food through food production, distribution and food exchange. The main crop of Bangladesh is rice which is cultivated almost 80% of the land area (Szabo, 2014). According to the Bangladesh Bureau of Statistics, in 2015, total food consumption is 2210.4 k.cal/day (BBS, 2016) which are alarming amongst the poorest segments of the

society, where a large portion of individuals do not meet their nutritional needs. Food access narrates to both physical and financial access. At the macro level, the ILO's LABORSTA index suggests that between 2002 and 2010, food prices almost doubled. Complementary analysis of the HIES data of Bangladesh Bureau of Statistics shows that around 60 percent of the Bangladeshi households spend 75 percent or more of their total expenditure on food (Szabo, 2014).

Again, the analysis of the Demographic and Health Survey (DHS) data discloses that food utilization measured by nutritional consequences remains a societal problem. Bangladesh faced problem in prevalence of wasting in children under five years. Wasted children are who have low weight for their height, reflecting acute under-nutrition. If we see the trends, there is an imbalance in last two decades, sometimes situation is upgrading and sometimes declining. In 2005, the rate of wasting children under 5 years old was 11.8% which was increased in 2010 at 15.7% and after 5 years, in 2015 it was again improved at 14.3%. The major concerning area in this sector is stunting in children under five years. Bangladesh seriously affected in this areas from previous decades. Several countries already successfully developed in this area even among that countries, some of them were behind Bangladesh once upon a time. 36.1% under 5 year's old children is in this criteria according to the average data of 2013 to 2017 (GHI, 2018). Besides Bangladesh stands in 109th position out of 113 countries in terms of food consumption as a share of household expenditure (GFSI, 2018).

Although the development progress of ensuring food security still alarming, Bangladesh ought to be identified that development has been made in a variety of areas, as reflected by tendencies in nutritional and hunger indicators while Bangladesh is relatively going to acquire its formidable 2021 universal food security goal. Key priorities for policy should include not only overall ensuring food sufficiency and poverty reduction but also focus on decreasing financial inequalities and complete disaster prevention strategies (Szabo, 2014).

### **Social safety Net and Its Implication on Food Security in Bangladesh**

The most critical challenge faced by the developing country is to make food available and accessible to all regardless of religion, race, caste, rich, poor, ethnicity, urban or rural. As per a concerted discussion, the level and the progress of income is consequential to making food accessible to most dominant determinants. The destitute population of Bangladesh still lacks adequate resources to manage food intake of 2,122 kilocalories per day for per person alongside with other requirements, although the income growth of Bangladesh has been increased gradually from 1990 to till now. 50 percent of rural household who are involved in agricultural productions, are landless due to the failure of trade centric privilege, labour-oriented entitlement and transfer based entitlement. 11 million agricultural families are landless in Bangladesh. Thus, under the constitutional obligations, some cost effective and productive social safety net programs are needed to ensure food security for the poor people to overcome them from organized and idiosyncratic shocks. This is because, at times of adversities, catalyst such as credit programs and insurance can be worthwhile and helpful in tearing down poverty chain and helping them to withstand sudden shock mechanisms.

It is important to mention that majority of the SSNPs undertaken by successful government are dealing with poverty and vulnerability of disadvantaged people and majority of this people are from rural areas which fails to address the quick evolution of urban poor living in urban settlements. Despite the increasing poverty, poor living conditions and fast migration from rural to urban areas, there is no complete policy on urbanization to address the necessities of the urban poverty reduction even though addressing the needs of urban poor are growing and are a major challenge. Most rural and urban poor vulnerable and suffering from food insecurity often seek employment and not food aid. Therefore, top priority should be given to the social safety net programs in addition to engage employment generation and create more opportunities for both after sudden shocks of nature and for employment in line with other relevant programs. In this regard, to ensure access of foods to all, social safety net programs should be practical and eradicate food insecurity by identifying root cause and enable them to sustain their livelihood (Siddiqui).

### **Climate Change Effects on Food Security in Bangladesh**

The system through which our food system is created is one of active relations within human surroundings. The food security may potentially be affected by disruption caused to the food system. Bangladesh's conventional food system relies greatly upon climate occurrences such as water level, soil condition, weather, climate, temperature etc. However, any climate change may contrastively impact the food system of Bangladesh due to the geographical location of the country. Reduction of production, lessening of income and loss of occupation are prime repercussions of climate change caused generally by periodic variability and salinity intrusion (Siddiqui).

Nationwide impact of climate change is apparent from the fact that food consumption continues to be vulnerable and endangered by floods and droughts, which in turn causes decrease in production of food other than cereals. Moreover, the country faced major hardship after two cyclones one in 2007 and another the cyclone in 2009 which significantly hindered agricultural production. As a consequence, this has made it challenging for the people to obtain suitable employment to ensure food security for their family. Furthermore, this massive impact has also principally affected their food consumption paradigm. In Bangladesh, because of coastal erosions and flooding, global food production trajectory has been forecasted downwards which main reason is climate change

In present times the food production has increased significantly. However, despite the fact that Bangladesh Government claims that around 3-4 million tons of rice are being produced in surplus of the demand of the country, a research by Bangladesh Institute of Development Studies (BIDS) proves to the contrary and terms it to be very high and unrealistic. Therefore, the path from the present to the future projection of climate change puts additional burden on the effort to secure food for the whole population of the country like Bangladesh. And this situation emerged for various reasons like unrestrained farming environment, lack of stress tolerant variations, periodic farming, improved farming pattern, unplanned industrial development and excessive urbanization which prominently depends on availability of fresh water, discriminate use of natural

resources, imbalanced use of agricultural inputs and extreme farming etc. In this context, a complete climate change policy by addressing all the relevant concerns are essentially required (Siddiqui).

### **Challenges and Way forward to Ensure Food Security in Bangladesh**

It is already mentioned in the earlier that the three main elements of food security are food availability, food accessibility and food consumption. Here this food security concern widens due to some reason like unequal income and savings which create negative effect on food consumption and food consumption depends on availability and accessibility. So, to achieve food security, ensure equal distribution of capital and keeping a sustainable economic stability internally and externally along with balanced economic growth (which is already maintaining) is the key priority for the government.

Again, corruption is another backdrops for ensuring food security. According to the last global corruption index prepared by the Transparency International, Bangladesh loses 6 position from the previous year and now stands in 149<sup>th</sup> position out of 180 countries (Transparency International, 2018). Corruption create economic degradation which is one of the key reason for the food insecurity. So, a corruption free system can ensure food security mostly.

To support food security and to ensure food supply of the extremely disadvantaged people, variety of social safety net programs such as grant for insolvent women, vulnerable group feeding (VGF), and old age allowances have been introduced in Bangladesh. To achieve food security, present government has given high priority to the social safety nets. But we cannot say this sufficient because a large number of people still live below poverty line. Government should adopt more initiative and allocate more financial assistance to create the ability of food consumption.

A regulatory framework is very much needed in order to monitor the development initiatives to make sure food security. Monitoring also needed in the food production sector. As Bangladesh is an agriculture based economic country so it is needed to plan how can increase our food production. In this regard, ensure the use of different fertilizer in scientific way is very important to keep the land's productivity as we have scarcity of land in a large scale.

Apart from those measures, present government is planning to provide easy access to new agricultural technologies to the farmers to increase food production. Recently Bangladesh has significantly improved its condition on food grain production. According to the Bangladesh Bureau of Statistics (BBS), the total food grain production in 2016-17 financial year is 413.25 lakh metric ton where in 2016-17 financial year, it was 386.96 lakh metric ton. Bangladesh government is taken several initiative for quality seed production which is the primary condition of increase food production. According to the data of Food and Agriculture Organization (FAO), Bangladesh have 24.8 million people whose caloric intake is insufficient, simply called them as the portion of population that is undernourished, which is 15.2% of total population and reduced from 20.8% in 2000. They also provide financial assistance and training both male and female community to

open up new employment opportunities. Besides, to ensure economic stability, present government takes the zero tolerance measure against corruption.

## Conclusion

Bangladesh is in good position of per capita income but the income and savings gap between the rich and poor, is very much concerning. Currently Bangladesh is in the top position in the quickest growth of ultra-wealthy people. At the same time, in 2018, Bangladesh was the 8<sup>th</sup> country in the list of highest number of people. So these create a huge imbalance in sustained economic growth which create negative impact on food consumption and also to ensure food security. In this context Bangladesh needs to work in a holistic approach by collaborating with private sectors, international agencies and local institutions to foster the present progressive journey of ensuring food security. Also it is essential to ensure strong institutions to manage a corruption-less ecosystem which can perform to maintain sustainable economic growth and equitable distribution of wealth and these are the major prerequisites of ensuring food security all over the country.

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## **Influences of SMEs on the Economic Development: Bangladesh Perspective**

**Md Ikhtiar Uddin Bhuiyan\***  
**Muhammad Kamruzzaman\*\***

**Abstract:** Bangladesh is one of the developing nations of South Asia. Over the last two decades it has achieved a lot of changes in its economy. After its independence in 1971 Bangladesh faced huge number of challenges for sustaining its economy as a whole. Over the decades, Bangladesh has come across a large number of problems by its rigorous policy and new idea that helps to be a flourishing economic hub of South Asia. This is undoubtedly an extra ordinary achievement of Bangladesh so far. The paper provides an overview of the economic development of Bangladesh and the role of SMEs sectors for the economic development of Bangladesh. The study also analyses the key challenges for the expansion of SMEs sector in Bangladesh and is discovered that, SME is still struggling to get a wider space across level to boost up the national economy. The study has been conducted based on content analysis and therefore a number of literatures in the form of text books, articles and newspapers were consulted and reviewed. The study also suggested some recommendations for the expansion of SMEs sectors in Bangladesh and how to expand the role of SMEs on the economic development of Bangladesh.

**Keywords:** *SME, SDG, MDG, GDP, NGO, NNP, Economy, Bangladesh.*

### **Introduction**

Bangladesh has become lower middle income country in 2016. Despite some impediments by dint of extreme poverty, over population, lack of energy infrastructure, natural disaster and political confrontation. Bangladesh is now booming as an economic zones in South Asia her gross domestic product (GDP) growth of over 6.0 percent over the last couple of years. Bangladesh achieved its independence in 1971 from Pakistan after nine months sanguinary war of liberation. This war destroyed the economy of Bangladesh. Bangladesh government took huge initiatives to enhancement its economy. As result of government initiatives Bangladesh has made huge economic advancements. SMEs are considered as the important factor for the economic development of countries (Buzavaite, Sceulovs and Korsakiene, 2019). SMEs works as a predominant form of business and employment. It also works as an actor for making inclusive and sustainable growth as well as increasing economic resilience. OECD SME and Entrepreneur Outlook (2019) shows that across the OECD, SMEs accounts for about 60% of employment and between 50% and 60% of value added are the major drivers of productivity in many regions. SMEs also accounts for 17% of Dutch gross exports. In this perspective SMEs can play pivotal role for the development of Bangladesh. The aim of this paper is to identify the prospects and major challenges of economic development of Bangladesh

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specially the role of SMEs sectors for the economic development of Bangladesh. To analyze the economic development of Bangladesh we will demonstrate these points:

1. Transformation of economic development of Bangladesh
2. What factors accelerate economic development of Bangladesh?
3. Role of SMEs in economic development of Bangladesh.
4. What are the major challenges for SMEs in Bangladesh?

Finally we will show some potential sectors and put some recommendations for sustainable economic development of Bangladesh.

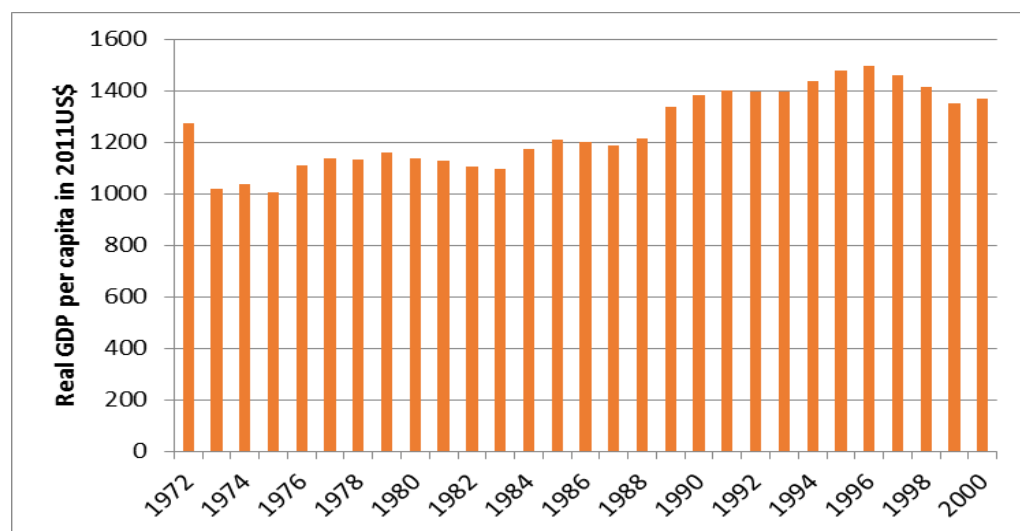
### **Transformation of economic development**

After independence agriculture was the major source of revenue of the country. About 80% of her population was involved in agricultural sector. Poverty rate was so high. Although half of the population is women but women has less participation in economic sector. In the early 1980's government took initiative to establish readymade garments industry and took privatization policy. This was the turning point for economic development of Bangladesh. In 2005 government introduce industrial policy and emphasized on small and medium enterprises. SMEs become major sector for economic development of Bangladesh.

### **Bangladesh's first two decades economic development**

At the time of independence in 1971, the population density was over 500 persons per km<sup>2</sup> growing at 3% annually. The cultivable land frontier was exhausted as only 6% of the GDP originated from modern manufacturing (mostly jute and cotton textiles) and jute goods which had weak international markets. During liberation war production potentiality decreased and most of the rails and roads collapsed. Government took socialist economic policy and nationalized most of the industry to overcome the economic crisis. As a newly emerged country government faced multi-dimensional economic problem.

Consumer goods ran between 300 and 400 percent. In 1972 the real per capita GDP was \$ 1273.



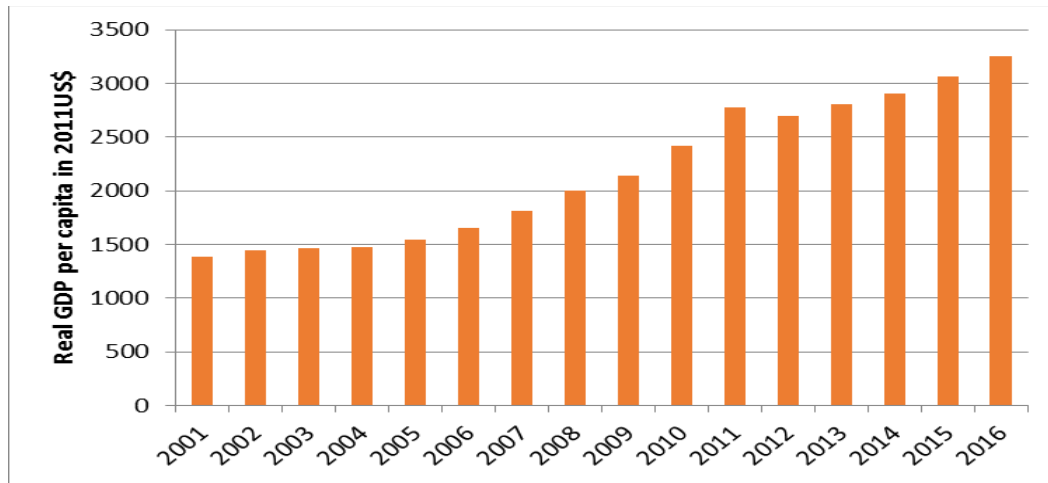
Source:

Maddison Project Database, version 2018. Bolt, Jutta, Robert Inklaar, Herman de Jong and Jan Luiten van Zanden (2018), "Rebasing 'Maddison': new income comparisons and the shape of long-run economic development" Maddison Project Working Paper, nr. 10, available for download at [www.ggdc.net/maddison](http://www.ggdc.net/maddison).

Government nationalization policy was failed due to inefficiency and corruption. The per capita GDP again decreased in 1975 and became \$1004. In 1976 government took new economic policies which encourage the entrepreneurs to invest in economic sector. A large number of government industries had been privatized like jute industry, telecommunication and banking sector. In this circumstance the per capita GDP increased up to \$ 1136 in 1977. It remained stagnant up to 1989 due to military interference, inefficiency of employees, political instability, and natural disasters corruption, lack of infrastructure and lack of natural resources. In 1991 democratic government came into power through a successful democratic movement against military ruler. The new government focused on eradicating corruption and encouraged foreign direct investment (FDI). As a result Per capita GDP increased in 1992. But the growth rate was not increased at the level of expectation.

### Recent trends of economic development of Bangladesh

In recent years especially after 2006 the economic growth was expanding very rapidly. In 2009, civilian government came into power and government took liberalization economic policy to encourage foreign direct investment. The amount of foreign direct investment in Bangladesh was not noteworthy until 2006. Bangladesh did not get priority for foreign direct investment (FDI) due to its turmoil politics. Both China and India started to invest in a mega amount in Bangladesh from the year 2007. According to Bangladesh Bank report 2018, in 2006 China's FDI was only US\$181.26 million, and it increased to US\$239.28 million in 2007. In 2018, The People's Republic of China and Netherland were highest FDI countries in the globe consecutively.



Source:

Maddison Project Database, version 2018. Bolt, Jutta, Robert Inklaar, Herman de Jong and Jan Luiten van Zanden (2018), "Rebasing 'Maddison': new income comparisons and the shape of long-run economic development" Maddison Project Working Paper, nr. 10, available for download at [www.ggdc.net/maddison](http://www.ggdc.net/maddison).

In 2006 the real per capita GDP was \$1657 but within ten years it triggers went up to \$ 3250. Economic policy and some other factors drives this development. Good governance is the precondition for economic development. Government focused on privatization policy and took some initiatives to establish economic zone and export processing zone.

### What factors propels Bangladesh economy?

A lot of factors contributed to economic development of Bangladesh. The most important factors for economic development are-

- a) Small and Medium Enterprise(SME)
- b) Readymade garments industry
- c) Remittance
- d) Agricultural sector
- e) IT sector
- f) Service sector (Transportation, Banking and Telecommunication)

In this section I will explain small and medium enterprise(SME) contributions to economic growth of Bangladesh. Although a lot of service sector and agricultural sector has been established as small and medium enterprise.

### SME Sectors in Bangladesh

SME plays pivotal role in economic development by creating new enterprise, generating new employment, reducing poverty. This role is widely recognized globally. Bangladesh government introduced new industrial policy and recognized small and medium enterprise as the thrust sector for achieving balanced and inclusive industrial development. Now this sector is becoming a driving sector for economic development. It is indeed gratifying to note that a comprehensive new SME Policy 2016 is in the offing

under a constant vigilance and guidance of the Ministry of Industries, Government of Bangladesh to spearhead the move towards achieving the middle income country (MIC) status by 2021 through ensuring inclusive and sustained development of the SME sector

Bangladesh government has established The SME foundation as the National Apex body to promote Small and Medium Enterprises (SMEs) for alleviating poverty, generating employment and thereby accelerating economic growth (SME, 2018).

### Definition of SME in Bangladesh

SI	Type of Industry	The amount of investment (Bangladesh currency, Taka)	Number of employed workers
1	Cottage Industry	Below 1 million	Number of workers not exceed 15
2	Micro Industry	1 million to 7.5 million	16 to 30
3	Small Industry	Manufacturing	7.5 million to 150 million
		Service	1 million to 20 million
4	Medium Industry	Manufacturing	150 million to 500 million(0.5 billion)
		Service	20 million to 300 million
5	Large Industry	Manufacturing	More than 0.5 billion
		Service	More than 300 million

Source: National Industrial Policy 2016

### Booster Sectors of SME (Provided by Ministry of Industry)

For providing promotional support, the following 11(eleven) emerging sectors have been invented by “The Industrial Policy 2005” of the Government of Bangladesh and the list would be reviewed every three years:

- (i) Electronics and electrical
- (ii) Software development
- (iii) Light engineering and metal-working
- (iv) Agro-processing/agri-business/ plantation agriculture/specialist farming/ tissue-culture and related business
- (iv) Leather-making and leather goods
- (v) Knitwear and ready-made garments
- (vi) Plastics and other synthetics
- (vii) Healthcare and diagnostics
- (ix) Educational services
- (x) Pharmaceuticals/cosmetics/toiletries
- (xi) Fashion-rich personal effects, wear and consumption goods

## The program for SME development in Bangladesh (Government and NGOs)

The government and the non-government organizations in Bangladesh have initiated various programs for the SME development in Bangladesh. As various types of industries and business enterprises have grown in the SME sector the government has given priority for the promotion of this sector both for industrial and also economic development in the country. Special emphasis has been given to the growth of women's entrepreneurship in SME and this has added to the attraction of different opportunities provided especially for the women in business. Initiating with the SME Task Force and later with the SME Advisory Panel, the SME Foundation was formed by the Government and has been in operation since 2006 with specific objectives to look after policy, drawing up a reliable strategy for SMEs and conducting country-wise study.

## Ownership of SME sectors in Bangladesh

Women involvement in small and medium enterprise has been increased over the last decade. It also empowers the women in Bangladesh. Already Bangladesh has achieved target no three of millennium development goal due to increase the ownership of women enterprise in small and medium sector. SME ownership is showing that this sector is becoming popular among the young groups.

Ownership (Male Headed/Female Headed) - ( Division Wise)

Location	Total			Cottage			Micro			Small			Medium			Large		
	Total	Male Headed	Female Headed	Total	Male Headed	Female Headed	Total	Male Headed	Female Headed	Total	Male Headed	Female Headed	Total	Male Headed	Female Headed	Total	Male Headed	Female Headed
Bangladesh	7818565	7255197	563368	6842884	6316956	525928	104007	96242	7765	859318	829931	29387	7106	6909	197	5250	5159	91
Barisal	368129	344869	23260	335605	313140	22465	3066	3029	37	29128	28375	753	252	248	4	78	77	1
Chittagong	1327629	1185633	141996	1142924	1005626	137298	15371	14906	465	167226	163022	4204	1253	1235	18	855	844	11
Dhaka	2541033	2374915	166118	2166733	2009346	157387	36155	35368	787	331391	323614	7777	3466	3360	106	3288	3227	61
Khulna	997086	920105	76981	906578	832234	74344	7624	7421	203	81876	79464	2412	623	606	17	385	380	5
Rajshahi	1160669	1089176	71493	1041705	972978	68727	17825	17453	372	100028	97667	2361	804	775	29	307	303	4
Rangpur	1022040	961707	60333	889786	845754	44032	20059	14233	5826	111531	101080	10451	487	468	19	177	172	5
Sylhet	401979	378792	23187	359553	337878	21675	3907	3832	75	38138	36709	1429	221	217	4	160	156	4

Source: Economic Census-2013, Bangladesh Bureau of Statistics(BBS)

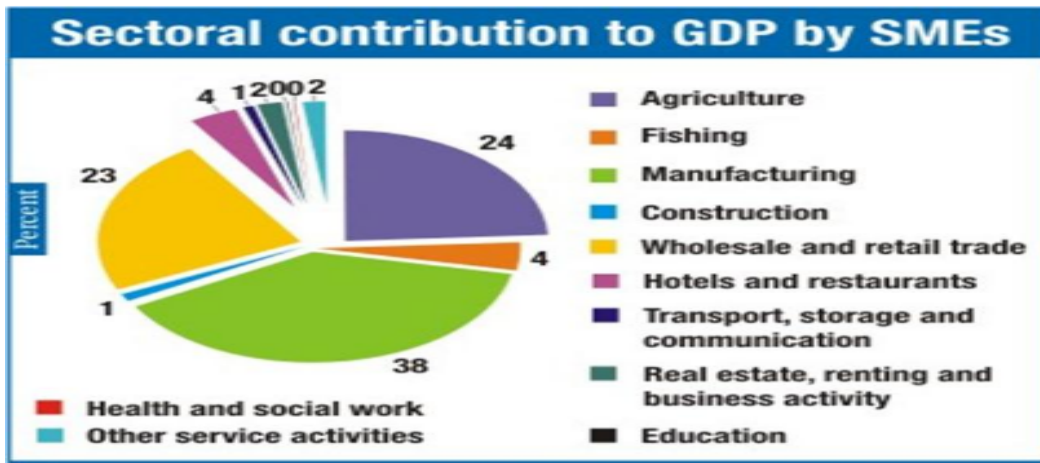
Powered by: SME Foundation

## Role of SME sectors in economic development

According to Bangladesh Bureau of Statistics (BBS) Bangladesh will achieve a GDP growth of 7.65% in the current fiscal year of 2019-2020. The growth of the industries sector for this fiscal has been predicted to be 11.99%. There are nearly a million small and medium enterprises contributing GDP. Nearly 80% of all the jobs in the industries sector are offered by the SMEs (Dhaka Tribune, 2018). According to the national economic consensus 88% of the economic entities are cottage enterprises, while 11% are SMEs. But in reality 99% of Bangladeshi formal business enterprises are SMEs (ADB

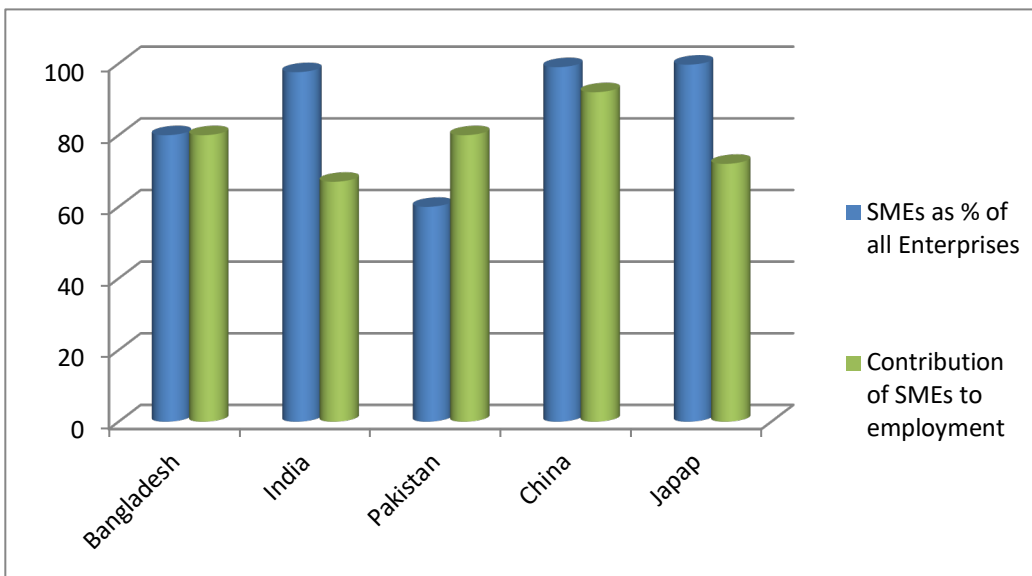
Institute, 2016). SMEs are contributing to generating employment and GDP growth. There are about 69,902 SME enterprises employing approximately 1,937,809 workforces (the independent, 2018). The report also shows that their annual turnover is about BDT 573,510 million per year. Most of the portion of government revenue in different forms (Income tax, VAT, Customs duty etc.) comes from these small and medium enterprises. But no significant government support is visible to develop or promote SME Clusters / entrepreneurs.

Different sectors contribution to GDP by SMEs is following



Source: The Daily Star, 2011

The following chart shows that contribution of SMEs in employment in Bangladesh is higher is almost similar with Pakistan, even higher than India and Japan.



Source: Chowdhury,S.R.,Azam, K.,G.,& Islam,S.(2013)



### Major challenges for SME development in Bangladesh

Despite taking special initiatives by Bangladesh government to make SME friendly policy, there are remaining some major problems like this.

Core challenges	Issue specific challenges
Absence of skilled manpower	<b>a.</b> Absence of modern machine operators and trouble shooters <b>b.</b> Absence of qualified managers and innovators <b>c.</b> Absence of trained designers and researchers <b>d.</b> Higher educated but unemployed young generation
Use of old machineries	<b>e.</b> Poor quality of products <b>f.</b> Low productivity <b>g.</b> Higher cost of production <b>h.</b> Wastage of raw materials and other resources
Lack of product diversity, new product design and development	<b>i.</b> Same products being saturated over time <b>j.</b> Small product basket <b>k.</b> Lack of product diversification
Lack of information	<b>l.</b> Lack of market access <b>m.</b> Lack of market share
Poor quality of products	<b>n.</b> Inability to achieve quality certification <b>o.</b> Limited ability to meet buyer specification <b>p.</b> Losing market share to imported products
Limited and complicated access to finance	<b>q.</b> Absence of promotional schemes like startup financing, credit guarantee, export guarantee, modernization of machinery, innovation product development etc. <b>r.</b> Limited investment capacity <b>s.</b> Higher interest rate
Limited support from regulatory government agencies	<b>t.</b> SMEs are yet to receive proper support from law enforcement agencies, the department of environment, the department of inspection for factories, NBR and other government agencies
Absence of harmonized tariff and non-tariff policies	<b>u.</b> Tariff on raw materials and finished goods yet to be harmonized <b>v.</b> Many investment promotion commitments of the governments are yet to be implemented by NBR and other regulators
Absence of export oriented SMEs	<b>w.</b> Single product dependency to export <b>x.</b> Rural SMEs are outside export business circle <b>y.</b> Limited export destinations

Source: The Daily Star, March 1, 2017

In the above table highlights that, there are some challenges in the economic fields of SMEs. But government and other agencies should be given emphasis on SMEs further recovery by joint initiatives for better economic progress in the upcoming days. This paper found that two types of challenges those are core and some are specified. Moreover, challenges are like as old machineries, inefficient labor force, low productivity rate, absent of export oriented SMEs policy, interest rate is very high, investment capacity is low, law and enforcement agencies, the department of environment, NBR and other government agencies direct support is absent in the time of inspection. So that government should be given emphasis and prioritizes on these above issues for the better outlay to this sector. Literate people and skilled manpower is the precondition for economic development of a country. Skilled workforce can ensure to adopt new technology and new ideas and they can enhance the productivity of their firms. Most of the East Asian countries achieved higher growth rate by emphasizing training for small and medium entrepreneurs. In Japan government established 64 branches of Japan Finance Corporation to disperse loan as well as to deliver training to the small and medium entrepreneurs. Ahmed (2019) shows that according to Labor Force Survey, in 2017, 86% of the total employed population aged 15 and above was in the informal sector. He also shown that about 13000 private and public training centers is providing training to make skilled workers but it is not sufficient for making skilled manpower. Bangladesh government can take more initiative for making skilled manpower in SMEs sectors. Limited and complicated finance is one of the major challenges for the expansion of SMEs in Bangladesh, though the government initiated a lot of projects to boost up SMEs sectors. In Japan, 44 thousands companies got long term loan for starting small and medium enterprise in the year of 2017(Japan Finance Corporation, 2018). The report also shows that average loan amount per client is 97 million yen, average term of loan is 8 years and 1 month, average amount of capital per client is 43 million yen and approximately 79% of outstanding loans are loans to companies with 20 employees and more. But in the case of Bangladesh, SMEs have to face a lot of formalities to get a loan from the Bank, though the interest is more than 10%.

In Bangladesh, most of the SMEs are one product oriented but in East Asian or developed countries export oriented SMEs are contributing for their economic growth. To understand the comparative picture we show some data in the context of economic development in Japan in the year of 2017, manufacturing oriented SMEs received 46.9% of Japan finance corporation loan. Due to the lack of market access, SMES are not getting interest to initiate new business.

Chowdhury, S.R., Azam, K., G., & Islam, S. (2013) have demonstrated that the major obstacles faced by the SMEs in getting loan. Shown according to them (Field survey) –

Major obstacles getting loan	% of respondent
Lack of collateral assets	20%
High interest on govt. bonds	20%
Lack of ability to draw business plan	20%
High rate of nonperformance loans in banking sector	10%
Lack of long term relationship	30%

Due to the above limitations, SMEs sectors are not flourishing in Bangladesh. In Japan, the interest rate for long term loan is only 0.3%(Japan Finance Corporation,2018) but in Bangladesh the interest rate is more than 10%, in some cases it becomes 13-15%. Moreover, entrepreneurs are required to maintain huge formalities like collateral agreement.

### **Recommendations**

Most of the countries have specific policy instruments to stimulate SMEs to overcome perceived barriers and internationalize their business activities through exporting or investing abroad (Chong, Hoekstra, Lemmers & e., 2019). In Japan each year government publish white paper on SMEs and found that SME labor productivity explaining their efforts for revision of operating processes, ingenuity in making use of human resources, utilization of IT, business investment, and M&A-based business reorganization and mergers. In this way, they are boosting up their SMEs sectors. In Bangladesh, the research on SMEs sectors is not sufficient. In most of the cases, government is not aware about the solution to promote SME sector. To increase the SMEs in Bangladesh, government can address the above problems and take some steps to solve the problems. Despite taking some government initiative, problems are still in acute level. In order to overcome the problems the following suggestions are recommendations

1. Government should ensure uninterrupted supply of raw materials for SMEs. Due to government support OECD countries SMEs are playing pivotal role in their national economy.OECD(2019) shows that in 2017, in Germany SMEs export accounts for US \$ 158470 million, in France- US \$ 51226.2 million, in Italy- US \$ 140948.0 million, in Canada SMEs exports accounts for US \$ 60951.0 million. To increase the amount of export oriented product, Bangladesh government should make uninterrupted supply of raw materials for SMEs sectors.
2. Government, financial institutions and Non government organizations should come forward to finance in SMEs.
3. Women entrepreneur should be encouraged to establish SMEs and women should include in policy making process.
4. Government may introduce one stop service to eliminate red tapes to get loan from different financial institutions
5. Government can introduce single digit interest of loan for SMEs
6. Government may introduce mortgage and guarantee free loan under the credit guarantee scheme. Japan Finance Corporation dispersed loan without any mortgage even they dispersed the loan on the interest rate of 0.3%. In this way, they are boosting up their SMEs sectors.

**Conclusion:** As Japan and Thailand succeed in SMEs which greatly contributing to their economy, Bangladesh government can resolve the above structural problem of SMEs by taking lessons from Japan and Thailand. Although Bangladesh economy is growing rapidly; some challenges may hamper this growth.Rapid shrinkage of agricultural land, impact of climate change and shortage of technology may pose challenges for economic development. Despite the challenges, Bangladesh has achieved major millennium

development goals. Political stability and good governance can lead economic development of Bangladesh.

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## **SDG and the Selection of Development Projects at Local Government: The Case of a Union Parishad**

**Dr. Muhammad Sayadur Rahman\***

**Abstract:** Sustainable development is the process of development without compromising the needs of the future generation. After a remarkable success of Millennium Development Goals (MDG) widely, the international communities have taken another development agenda globally which is called Sustainable Development Goals (SDG) with some predetermined goals, targets and indicators for the long term development of global community. Bangladesh is one of the major stakeholders of SDGs who signed in this global commitment. Bangladesh has a successful history behind the implementation of MDGs. On that process, the government is trying to formulate and implement different policies, laws, projects and programs relating to the goals and targets of SDGs. In this global commitment of Bangladesh, local government institutions are the most important actors whose have a big role to implement all the goals and targets of SDGs. Local government institutions especially union parishad is the focal point which tries to meet the needs of the remote area of Bangladesh. Union Parishad is the most significant actor of localizing SDGs at grassroots level. Because of this, SDG related policies and programs need to be included in the development projects of Union Parishad in Bangladesh. Therefore, this study aim to exploring the importance of SDGs whiles the selection of development projects of local government institutions like union parishad. The study finds that all the stakeholders of UP do not know about the concept of SDGs. The development projects of UP are mostly formulated on the basis of the decisions of ward Shaba, sometimes those projects depend on local politics and peoples representative's choice. There is no direct connection of UP's development projects to the goals and targets of SDGs. They do not give importance to the SDGs while selecting the local development projects of UP. They focus on some limited areas like construction of roads and culverts, social safety net programs, public health and public services and education in the selection of development projects. Sometimes those projects of UP are matched with SDGs goals and targets coincidentally. They just work in traditional way where the implementation of SDGs is global commitment of the government of Bangladesh. Local government institutions (UP) should be empowered to attain the agenda of SDGs.

### **Introduction**

Sustainable Development Goals (SDG) is an integrated development plan, conceived by the United Nations which is to be achieved by 2030. The SDG is a new integrated development plan which is replaced on Millennium Development Goals (MDGs). The Goals and targets are more comprehensive and interrelated in comparison with the MDG. The SDGs like MDG will continue the fight against extreme poverty, adding the challenges of ensuring more equitable development and environmental sustainability (Datta & Rabbany, 2016). The SDG model enables policy makers and planning officials at all levels of governance to understand the interconnectedness of policies designed to achieve the SDGs and test their likely impacts before adopting them. Bangladesh is a

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major stakeholder of the goals that has been set as integrated plan. Among 17 goals, 15 have been set by the choice of Bangladesh. Bangladesh will try to achieve these goals by the national and local governments. Local government is one of the important actors of the development policy formulation and implementation in Bangladesh. Particularly Union Parishad selects and implements various developmental projects and programs by its own and fund from other sources. However, it is not clear to us how far they are aware on the SDGs and how far they emphasize the SDGs during the selection of development projects in local government? Thus, this study intends to address this academic gap. Because, local governments particularly, Union parishad is one of the important development actors of the implementation of these development goals. The consciousness of the development goal setter to address the SDG and nature of the development goal choice is important in this regard. Thus, this study aims to explore the awareness on the SDG to the selection of development project at local government particularly, at Union Parishad (UP).

### **Objective of the Study**

The general objective of the study is to explore the importance SDG while the selection of the development projects in local government in Bangladesh. At the same time it also aims to identify the concepts of social and economic development projects of the people's representative at local government in Bangladesh.

### **Methodology of the Study**

This study has been conducted on the basis of qualitative analysis of social research by following survey method. Primary and secondary data have been used in this study. Purposive method of sampling has been used for primary data collection. Secondary data has been collected from different books, journal articles, news papers, and internet sources. The sample size of this study was 100 respondents including UP chairman, members and secretary, local people and local politicians. The study was conducted at Baraid Union Parishad which is located at Saturia Upazila under Manikganj district. The data are tabulated and analyzed mathematically as range and percentage. The data collected through observations are also analyzed qualitatively. The computer software program like Ms Word, Ms Excel, is used as tools of analysis and presentation of the survey data in this research.

### **Sustainable Development Goals (SDGs): Conceptual Framework**

The concept of Sustainable Development (SD) emerged in the 1970s simultaneously with the increasing industrialization. The concept of SD refers the principles of increasing development in consideration with the environment. In 1987, the Brunt Land Commission introduced a report of "Our Common Future" in an effort to link the issues of economic development and environmental stability. This report conceptualizes SD as development that meets the needs of present without compromising the ability of future generations to meet their own needs (UN General Assembly, 1987). This concept of conserving resources for the future generation is one of the major features that distinguish

sustainable development policy from traditional environmental policy which also seeks to internalize the externalities of environmental degradation. The long term stability of economy and environment is the main goal of SD (Cerin, 2006). Sustainable development is the development that continuous (World Development Report, 1992). In 1992, Rio Declaration on Environment and Development adopted a set of principles to guide the future development where SD defines as long term continues development of the society aimed at satisfaction of humanity's need at present and in the future via rational usage and replenishment of natural resources, preserving the earth for the future generation. Thus, SD may be understood as the process of economic development and structural changes helping to broaden human possibilities (Petkeviciute and Svirskaitė, 2001). Similarly, Sustainable development goals were born at the United Nations (UN) conference on sustainable development in Rio de Janeiro in 2012. The basic objective was to produce a set of universal goals that meet the urgent environmental, political and economic challenges facing our world. The agenda of sustainable development goals is centered on the millennium development goals which were officially established following the millennium summit of the UN in 2000 ([www.usccb.org](http://www.usccb.org)). The legacy and achievements of MDG provide us with valuable lessons to begin work on the new goals. The UN implemented a more open and expansive process to develop the SDGs with the Rio+20 summit and a committee representing 70 countries. This bold initiative of UN inflated the number of goals from 8 to 17 and the number of targets rose from 18 to 169. The draft SDGs maintain slightly the revised version of 8 MDGs and add new goals and targets (UNDP, 2016).

Sustainable development goals otherwise known as global goals are a universal action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. On 25 September 2015, the member state have adopted the declaration "Transforming our world; the 2030 agenda for sustainable development" with 17 goals and 169 targets to succeed the MDGs and to guide global development over the next 15 years till 2030 (Bhattacharya, 2016). The above declaration of UN stated 17 goals of sustainable development as follows

- End poverty in all its forms everywhere
- End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- Ensure healthy lives and promote well-being for all at all ages.
- Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
- Achieve gender equality and empower all women and girls.
- Ensure availability and sustainable management of water and sanitation for all.
- Ensure access to affordable, reliable, sustainable and modern energy for all.
- Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
- Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.



- Reduce inequality within and among countries.
- Make cities and human settlements inclusive, safe, resilient and sustainable.
- Ensure sustainable consumption and production patterns.
- Take urgent action to combat climate change and its impacts
- Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
- Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
- Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
- Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development (SDG report 2017)

### **Sustainable Development Goals in Bangladesh and the Role of Local Government**

Bangladesh has made outstanding progress in the era of MDGs. It has become a role model to the international community (Datta and Rabbany, 2016). After the success of MDGs, It is all about one and half year is gone to set targets, output, and outcome etc. tools to measure the achievement of SDGs. Like other 193 countries Bangladesh is also working out to adopt SDG focused policies, action plans etc. Although we are enacting SDG oriented policies, projects, laws and so on and so forth. But the reality is that a country like Bangladesh has limited resources to focus on all these 17 goals at a time (The Daily Independent, August 21, 2017). Three overreaching challenges emerged for countries which signed on to SDGs especially for Bangladesh, the serious shortfall in financing SDGs in Bangladesh (The Daily Star, August 12, 2017).

From the 241 indicators of SDGs, the Planning Commission study 2017 indicates that data related to 70 indicators (or 29 percent) is readily available and that of 63 (26 percent) is not available. Data for the remaining 108 (45 percent) is partially available. However, data gap for some of the SDGs is more acute than others. In terms of data gap, goal 12, “Ensure sustainable consumption and production patterns,” ranks highest since 69 percent of data of indicators related to this goal is not currently available. This is followed by data gaps in measuring and monitoring goal 14, “Conserve and sustainably use the oceans, seas and marine resources,” and goal 13, “Take urgent action to combat climate change and its impact”. In view of these unmet needs, the government must soon outline a game plan to address the data gaps (Planning Commission, 2017). The government and its agencies are still at a loss in terms of coming to agree on a unifying theme to manage the “synergies” (targets that reinforce each other) as well as “trade-offs” (targets that conflict with each other) and “enablers” (targets that are preconditions for others) (The Daily Star, August 12, 2017).

Government of Bangladesh has tried to shape institutional framework for SDG implementation. In November 2015, an inter-ministerial committee was established on “SDGs monitoring and implementation” as part of government highest level commitment. The committee has already started working on priority setting and contextualizing global goals with the national ambitions and requesting all ministries to identify relevant goals and targets and relates these to their respective sectorial plans (Bhattacharya, 2016). The government has identified its main agencies alongside their potential roles for the implementation of SDGs. The development of SDG monitoring system is under process. Web based data collection system termed as “SDG tracker” has been developed. For achieving SDG, 7<sup>th</sup> Five Year Plan has been taken by giving priority to the SDGs goals. In the 7<sup>th</sup> five year plan, efforts have been initiated to improve planning and budgeting capacity at the local level. Some measures have been taken to increase the transparency and accountability of local government institution like UP for example Union Information Service Center (UISC) have improved transparency at the local level (The Daily Independent, March 26, 2018). So local government is an important institution in Bangladesh in achieving the targets of SDGs particularly, Union Parishad. It is the oldest unit under local government emerged with the name Chawkidary Panchayat in 1870 as watchman. A local body ‘Union Panchayat’ emerged with more respectable role under the influence of Lord Ripon’s famous Resolution of Local Self-government in 1882. The Chawkidary Panchayat and Union Panchayat were combined with a new name ‘Union Board’ under ‘The Bengal Village Self-government Act 1919’ (Ahmed, 2012). From 1960 to 1962 it was in the name of union council consisted of 10 members (Siddiqui, 2005). After the liberation war of Bangladesh, the government dismissed the Basic Democracy and introduced Union Panchayat in place of union council (Wahhab, 1980). According the local government ordinance 1976, a lot of changes were made in the structure and composition of Union Parishad (Khan, 2011). At the present time, UP is the lowest tier of local government and very popular to the general people. The UP is thus currently made up of 13 members. Among the 13 members, 1 Chairman, 9 general members – 1 from each of the 9 wards, and 3 women members elected to reserved seats each covering 3 wards (Talukdar, 2009). The main functions of UP are Maintenance of law and order and assistance to administration for this purpose, adoption and implementation of development schemes in the fields of local economy and society, Performing administrative and establishment functions and Providing public welfare services (UP act 2009, 47-1).

Although primary accountability for the SDGs belongs to nations, the SDGs explicitly call for action by local authorities. At least 12 of the 17 SDGs (all excepting 9, 12, 13, 14 and 17) require integrated strategies at the community level to overcome the interlinked challenges of poverty, ill-health, social ills, poor governance and environmental destruction (THP, 2017). Fortunately, Bangladesh’s constitution wisely placed key responsibilities for social and economic development including the preparation and implementation of plans relating to public services and economic development at the level closest to the people with the local government bodies, particularly the Union Parishad (UP), the body at the doorstep of the people (Constitution of the People’s Republic of Bangladesh, 1971, Article 59(2)(C)). This constitutional mandate makes it imperative that Bangladesh localize the SDGs. It must equip the UPs with the skills and

resources to analyze their local situation, set priorities for each of the relevant SDGs and track and report their progress (THP, 2017).

### **SDG and Union Parishad Development Projects: Major Findings and Analysis**

It is widely acknowledged that Local government institutions like UP can be termed as the keystone of good governance to attain political, economic and social welfare of people within the state. They are essential for promoting inclusive sustainable development within their territorial jurisdiction. By creating broad based ownership, commitment and accountability, they are vital partners to the implementation of SDGs (The Daily Sun, June 21, 2017). Local government functionaries from selected districts of Bangladesh have been oriented with the new sustainable development goals and its implications at the grassroots. Under local government division (LGD), a workshop has been arranged recently by the upazila governance project (UZGP) and union parishad governance projects (UPGP). According to a UZGP statement they have made the key local government functionaries aware of SDGs goals and targets and responsibilities of local government institutions in implementing those goals (The Daily Star, November 11, 2016). This is for the first time they organized such type of workshop directly linked to SDGs. The Upazila Governance Project (UZGP) and Union Parishad Governance Project (UPGP) under Local Government Division (LGD) have jointly organized the ToT aimed to orient and make the key local government functionaries aware about new global 17 goals and 169 targets and roles and responsibilities of local government institutions (LGIs) in implementing and localizing the goals (UNDP, 2016). The government has signed an agreement with the United Nations Development Programme (UNDP) for a new local government project aligned with the SDGs. Aligned with the SDGs and 7th Five Year Plan of the government, the new project aims “to further strengthen planning and budgeting system at Upazila and Union Parishads with SDGs orientation and localization and pro-poor service-delivery mechanism (The Daily Star, July, 2017).

It's only 1.5 years from setting this global agenda, the local government institution like UPs have not taken any major initiatives except different workshop, training etc. for achieving such global targets. On the other hand, the local government institution are facing a lot of problems like very little budgetary allocation, limited income sources, central control over them and political interest (Siddiqui and Ahmed, 2016) which are also the obstacles behind achieving the new agenda of SDGs. So government needs to focus on those issues for ensuring the ways by which the country will achieve the new agenda of SDGs. All the Sustainable Development Goals are normally included in the social development plan. As a part of central government, the local government institutions especially Union Parishads play vital role in the social development plan and its implementation. On that note, union parishad is massively responsible with central government for implementing the commitment of SDGs by 2030. For this reason, the researcher tried to find out the importance of SDGs while selecting the development projects of Union Parishad by conducting a survey. The field data are analyzed below

### Analysis of Demographic Variables

This study includes demographic variables like education, occupation and gender of the respondents. Demographic information provides data regarding participants and it's necessary for the determination of whether the individual in a particular study are a representative sample of the target population for the generalization purpose (Salkind, 2010). Following table represents the respondent's categories on the basis of demographic variables.

**Table: 1.1**

**Categories of the Respondents by Demographic Variables**

<b>Variables</b>	<b>Number</b>	<b>Percent</b>
<b>Education</b>		
Illiterate	15	15%
Primary-secondary	33	33%
Higher Secondary	20	20%
Graduate+	32	32%
Total	100	100%
<b>Occupation</b>		
Agriculture	41	41%
Service	17	17%
Business	20	20%
Others	22	22%
Total	100	100%
<b>Gender</b>		
Male	85	85%
Female	15	15%
Total	100	100%

Source: Field Survey 2019

The presented data on the table shows educational qualifications, occupational status and gender of the respondents of this study. The first one is educational qualification of the respondents. 15 (15%) respondents of this study were in the category of "No Education". Most of the respondents of this study like 33 (33%) were in between Primary-Secondary, the second category of education. In the category of "Higher Secondary", 20 (20%) respondents were belonged to. 32 (32%) respondents of this study were in the category of "Graduate+". So most of the respondents of this study were bellow SSC passed. In the case of second variable, most of the respondents were farmers, 41 (41%) respondents were belonged to the category of "Agriculture". 17 (17%) respondents were in the category of "Service". 20 (20%) were businessman and 22 (22%) of the respondents were

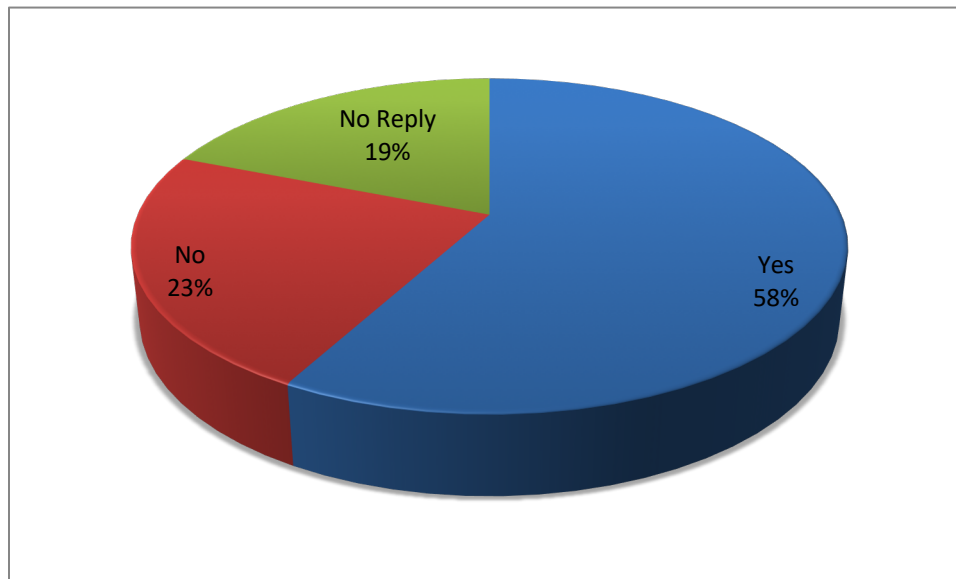
from the others professions. Most of the respondents were farmers of this study. In case of last variable, most of the respondents of this study were male, 85 (85%). Rest of the sample were female, only 15 (15%) respondents were in this category. All the data of this table represents that most of the respondents were not higher educated, majority of the respondents were farmers and male is the dominant category in the variable of gender.

### Respondent's Views on SDGs

It's necessary to know about the concept of SDGs where we are committed to implement such agenda. Researcher wanted to know that this global agenda of sustainable development goals, how much popular to the stakeholders of union parishad because union parishad is the root level actors of localizing SDGs. For this reason, a question was asked the respondents that do you know about SDGs?

**Figure: 1.1**

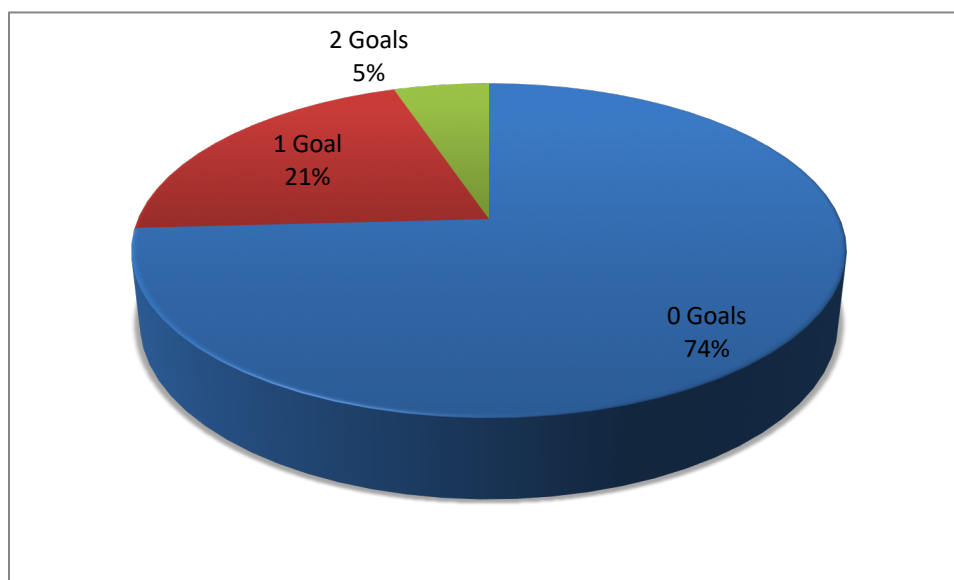
**Respondents Views on SDG by Percent**



Source: Field Survey 2019

The presented graph represents that the idea of respondents about SDGs. Most of the respondents like 58% of the total respondents said they know about SDGs. 23% respondents of this study reported that they don't know about SDGs. and 19% respondents of this study didn't give any reply against the question. Researcher threw a contingency question to those respondents who said they know about SDGs. The contingency question was like if answer is yes, please say some goals of SDGs. The following graph figures out the responses of the respondents.

**Figure: 1.2**  
**Categories of the Respondents of Knowing the Goals of SDG**



Source: Field Survey 2019

Among the 58% of the respondents who said they know about the SDGs, 74% of them could not say any goals of SDGs, only 21% of them said only 1 goal and 5% respondents of them said only 2 goals of SDGs. So the scenario is clear that the concept of SDGs is still unknown to the general people, people's representatives (members and chairman of UP) and local politician. They don't know about the goals and targets of SDGs. It's a big challenge for implementing and localizing SDGs.

### **Formulation Procedure of Development Projects: Ward Level**

Union Parishad is composed of nine wards. Every ward takes some development projects for local development. But the question is how does the ward formulate and implement such development projects and on what basis? The respondents were asked such questions. The following table shows the respondent's opinions in this case.

**Table: 1.2**

Respondents Views on Formulation of Ward Level Development Projects (Multi Responses Count)

<b>Development Projects</b>	<b>Number</b>	<b>Percent</b>
By the own choice of Peoples Representative	52	52%
By the decision of ward shabha	55	55%
By the influence of local politics	20	20%
Don't Know	13	13%

Source: Field Survey 2019

The data presented on the table states that 52 (52%) respondents said the ward level development projects are formulated and implemented by the own choice of people's representatives. Most of the respondents, 55 (55%) reported that those development projects are formulated and implemented by the decision of ward shabha. ward level development projects are formulated and implemented by the influence of local politics said by 20 (20%) respondents. 13 (13%) respondents do not know how to formulate and implement such development projects. Above table figures out that although the decision of ward shabha get priority in the formulation and implementation of development projects but there is a strong presence of own choice of people's representatives and influence of local politics. There are no such policies or programs in ward level projects formulation and implementation, which directly related to the goals and targets of SDGs.

### **Formulation Procedure of Development Projects: UP Level**

Same questions were asked the respondents about the UP level development projects. How does the UP formulate and implement such development projects and on what basis? The following table shows the field data on this issue.

Table: 1.3 Respondent's Views on Formulation of Union Level Development Projects  
(Multi Responses Count)

<b>Development Projects</b>	<b>Number</b>	<b>Percent</b>
By the own choice of Peoples Representative	29	29%
By the decision of ward shabha	57	57%
By the influence of local politics	24	24%
Do not Know	5	5%

Source: Field Survey 2019

The above table represents the respondent's views on the formulation procedure of union level development projects. 29 (29%) respondents from the total sample said that the union level development projects are formulated and implemented by the own choice of people's representatives. Most of the respondents like 57 (57%) respondents stated that those projects are formulated and implemented on the basis of the decisions of ward shabha. By the influence of local politics, union level development projects are formulated and implemented reported by 24 (24%) respondents of this study. 5(5%) respondents of this study said that they do not know about the procedure of formulation and implementation of such development projects. Above discussion concludes that the ward shabha plays vital role in the formulation and implementation of union level development projects. On the other hand, the own choice of people's representatives and local politics have a massive influence on those development projects formulation and implementation. There is no application of such mechanism of SDGs that directly controls the union level project formulation and implementation.

### Area of Interest of People's Representatives in taking Development Projects

The willingness or tendency of people's representative of union parishad is an important element to implement SDGs related projects and programs at the local level. This is why, researcher wanted to know, what are the areas of interest of people's representative in taking development projects? The following table represents the responses of the respondents of this study.

**Table: 1.4**

Respondent's Opinions on The areas of Interest of People's Representatives in taking Development Projects (Multi Responses Count)

Areas of Development Projects	Number	Percent
Construction and Repair of Roads and Culverts	85	85%
Implementation of Social Safety net Programs	69	69%
Public Health and Public Services	48	48%
Education and Public Awareness Building	43	43%
Arbitrary and Prosecuting	50	50%
Religious and Sports	22	22%

Source: Field Survey 2019

The presented table shows that the area of interest of the public representatives while taking local development projects. Construction and repair of roads and culverts are the main areas of interest of people's representatives said by 85 (85%) respondents of this study. 69 (69%) respondents of this study said that people's representatives take development projects on social safety net programs like VGD, VGF, TR, FFW etc. Public health and public services are the areas of interest to take development projects said by 48 (48%) respondents of this study. 43 (43%) respondents reported that people's representatives take development projects on the issues of education and public awareness building. 50 (50%) and 22 (22%) respondents of this study said about the arbitrary and prosecuting and religious and sports respectively. The above analysis concludes that the people's representatives of union parishad have no tendency to take SDGs related projects and programs while taking the development projects of UP, in fact they have no knowledge about the goals and targets of SDGs which is found earlier. They take the development projects mostly on the construction of roads and culverts and social safety net programs and sometimes they focuses on the public health and public services, education and public awareness building, arbitrary and prosecuting and religious and sports while taking the projects at the local level. Sometimes, those areas of interest of people's representatives in taking local development projects are being matched with the goals and targets of SDGs coincidentally not intentionally.

### Major Findings

- i. The local people, local people's representatives (Members and Chairman) and the local politicians whose are the major stakeholders of localizing and implementing



- SDGs at the local level don't know about the concept of such global agenda of SDGs and its goals and targets. A little amount of them just heard the term 'SDG'.
- ii. Although the union parishad level as well as ward level development projects are formulated and implemented on the basis of the decision of ward shabha but still there is a strong influence of the interest of people's representatives and local politics. There are no such tools that will direct the UP to focus on SDGs related policies or programs while taking such local development projects.
  - iii. A little amount of areas are there where local people's representatives have the interest to take development projects. Construction and repair of roads and culverts and social safety net programs get priority in most of the time. But the most interesting thing is that sometimes those little areas of local development projects are coincidentally matched with the goals and targets of SDGs but not intentionally.
  - iv. UP does not give the importance to the policies programs and different mechanism that holds the goals and targets of SDGs in selecting its development projects.

## Conclusion

The SDGs built on the success of MDGs but aims to go further. No countries are legally bound to implement SDGs. However it is a global commitment by global leaders to make a better world for the future (Datta and Rabbany, 2016). Bangladesh is a signatory to this global agenda of SDGs and committed to implement the goals and targets of it. With the central government, the local government institutions are the major actors of implementing such goals and targets. Union Parishad is one of the biggest stakeholders for localizing the SDGs by taking different development projects at the local level. On that note, this study was conducted to explore the importance of SDGs while selecting the development projects of UP. Unfortunately, the local representatives, local people and local politicians have no idea about SDGs. Very little of them just know the name "SDG". The UP takes the development projects by the decision of ward shabha, sometimes it depends on won choice of people's representatives. Local politics has also an influence in taking such development projects. People's representatives have no interest to take SDG related development projects at the union level, in fact they have no idea on it. Most of the time, they take such projects to construct roads and culverts and repair of it, some others area they focus like social safety net program, education, health, services and sports. SDGs do not get any priority in the selection of development projects UP. But UP needs to be empowered in achieving such global agenda where it is very doorstep to the local people. All the staffs of UP (Chairmen, Members, and Secretary) need to know the SDGs goals and targets clearly and work on it. Financial support need to be increased and SDG related policies and programs should be taken at the UP level. SDGs demand concerted and collective efforts with strong political commitment at all levels.

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