



Impact of Climate Change on Urban Slum Dwellers in Bangladesh: A Case Study of Four Selected Slums in Dhaka City

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Introduction: The climate in Bangladesh is changing and it is becoming more unpredictable every year. The nature of relationship between climate change and livelihood assets of urban poor was experimented by the study.

Aims: To understand the dynamics of climate change of urban poor and assess their livelihood strategies to the effect of climate change.

Study Design: The study was done by quantitative and qualitative survey.

Place and Duration of Study: The study was conducted in the four slums of Dhaka city namely Korail, Sattala, Nakhhalpara and South Begunbari to assess the impact of climate change on the livelihood of urban poor from July, 2014 to January 2015.

Methodology: A combination of quantitative and qualitative research methods was followed for the study. Impacts of climate change were assessed purposively on three livelihood capitals namely financial, social and human. Stratified Random Sampling method was applied for questionnaire survey. The four slums were selected regarding location, type of structure, density and size. The workable sample size of household (HH) was determined to be 374 for four slums. This total Household was equally distributed among selected slums according to the household number of each slum. The distributed household sample size for Korail slum was 140, sattala 172, Nakhhalpara

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27 and south begunbari 35. 3 Key Informant Interview (KII) and 8 Case Study were conducted for qualitative research.

Results: The results illustrate that the poor are more vulnerable to climate change effects due to their poor livelihood conditions like deficient social network, low income, illiteracy, etc. The study identifies that due to change in climate, the majority of respondents (94.1%) suffered illness in last one decade. During hazardous conditions in slum they are deprived of regular food. They have limited access to information. They face problems in their work and lose savings with decreasing income.

Conclusion: The slum dwellers are enduring and combating with the daily livelihood problems and the adverse effect of climate change put them in to a difficult state.

Keywords: Climate change; slum; urban poor; livelihood.

1. INTRODUCTION

In terms of the impact of climate change few places in the world will experience the range of effects and the severity of changes that will occur in Bangladesh, which will include: temperatures rise; extreme hot and cold spells; less rainfall, yet more in the monsoon; powerful tornados and cyclones; and sea level rise, turning freshwater saline and facilitating storm surges. The impact will be intensified by the fact that Bangladesh is both one of the most populated and one of the poorest nations on earth [1]. Low elevation, rapid population growth (particularly slum dwellers) and limited adaptive capacity could put more people and property at risk of flood in the event of climate change [2,3] if effective countermeasures are not taken. In Dhaka, severe floods, particularly in 1988, 1998 and 2004, caused by the spill-over from surrounding rivers have had major economic impacts. Large sections of the city are only a few meters above sea level, and the combination of sea-level rise and increased frequency and intensity of storms are likely to greatly increase these risks [4]. Slum people invariably live below the poverty line and have little access to employment in formal sectors. Households in slums of Dhaka are very sensitive to hazards, as slums provide only poor housing with extremely high population densities as well as poor water, sanitation and health services [5]. The majority of households in the slums of Dhaka have already experienced at least one major flood in and around their dwelling [6]. They have failed to secure a sustainable livelihood in the city despite living for a long period of time [7]. The present research is aimed to give details about slum dwellers financial, social and human capital scenarios brought by climate change in Dhaka city. The findings will give a conclusion about the

nature of relationship between climate change and these livelihood assets of urban poor of slums.

2. BACKGROUND INFORMATION ON THE ASSESSMENT OF CLIMATE CHANGE IMPACT ON LIVELIHOOD OF URBAN DWELLERS

2.1 Livelihood Concept

A livelihood may be defined as all capabilities, assets (including both material and social resources) and economic and social activities for obtaining all necessities for life [8]. As a tool for understanding and assessing livelihoods the UK Department for International Development (DFID) developed the Sustainable Livelihood Approach in the 1990s (Fig. 1). The core of the framework is formed by five livelihood asset-types (Human capital, Social capital, Natural capital, Physical capital and Financial capital) which are transformed when applied into livelihood outcomes [9]. For this study three livelihood capitals were selected purposively are Human capital, Social capital, and Financial capital.

2.2 Analytical Framework

Based on the theoretical insights of DFID sustainable livelihood approach discussed above, a model was developed to assess climate change effect on livelihood of urban slums (see Fig. 2). The trend of climate change has been collected from the secondary source. The impact of these climatic events on livelihood capitals is collected from selected slums. Fig. 2 exhibits the climate change extreme events causes an impact on livelihood.

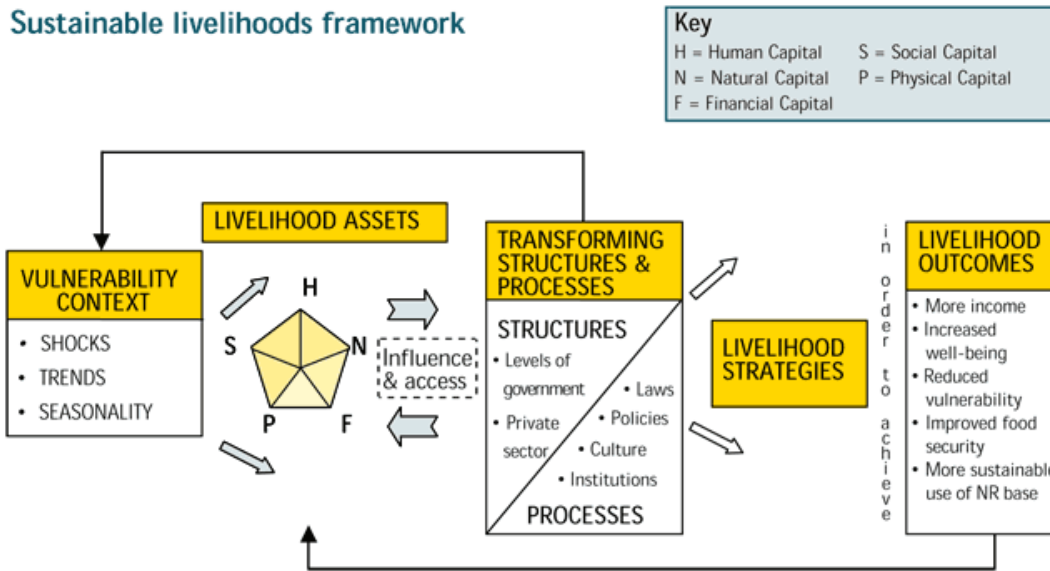


Fig. 1. The sustainable livelihood framework
 (Source: [9])

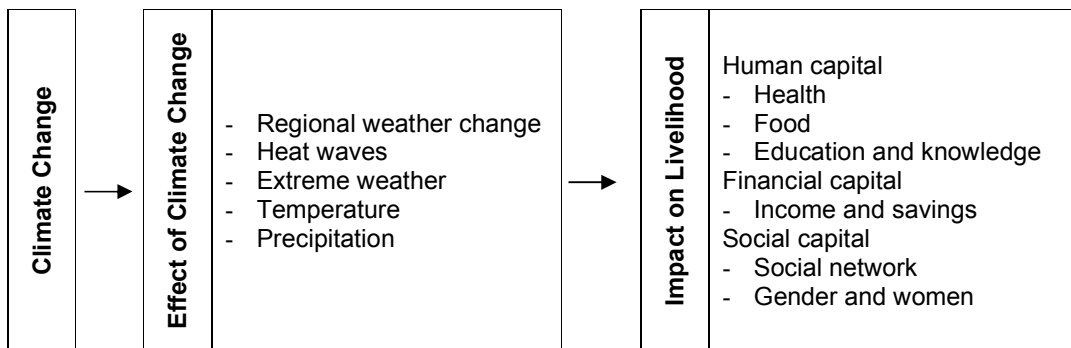


Fig. 2. Framework for assessing the climate change effect on livelihood of urban slums

3. METHODOLOGY

3.1 Study Area

For the research four slums of Dhaka city namely Korail (Boubazar slum), Sattola IPH slum, Nakhhalpara slum and South Begunbari were selected (Fig. 3, Fig. 4). The slums were selected regarding location, type of structure, density and size. Korail is one of the largest slums in Bangladesh and is located under wards 19 and 20 of Dhaka City Corporation, adjacent to Gulshan-Banani Lake. "Sat-tala Bastee" ("Sattala" slum or slum behind seven storied building) located at Mohakhali, Dhaka which is one of the largest slum areas on government land in Dhaka city. Around 50,000 peoples live here. Nakhhalpara slum lies on Tejgaon industrial

area in Dhaka. About 4000 peoples live in here. A lot of slums have been built along with railway lines. Begunbari is one of populated slum and around 1,00,000 people lives here. About 45,000 live on the south part of Begunbari slum.

3.2 Sampling Procedure and Methods of Data Collection

In this study both qualitative and quantitative approaches were used. For quantitative method, sample survey was conducted with selected respondents. The qualitative approach has been applied to understand the experiences of the affected slums and also for verify and enrich the quantitative results. The respondents for questionnaire survey were selected using a Stratified Random Sampling method. The

questionnaire was pre-tested before final data collection. The study consists of 374 respondents of which 80.21 per cent are females, 13.37 per cent are males, 5.35 percent adolescent girl and 1.07 per cent children. The overall proportion of the younger age groups is substantially larger than that of older age groups for each sex. A questionnaire was prepared to collect data for survey. The survey was conducted during July, 2014 to January 2015.

Besides quantitative survey, some qualitative studies were performed using Participatory Assessment (PA) tools. 3 Key Informant Interview (KII) and 8 Case Study were conducted for qualitative studies. For Key Informant Interview (KII) a short questionnaire was developed focusing key issues and it was administered on community leaders. Altogether 3 community leaders from each slum were interviewed for KII. Individual observation study can well delineate livelihood scenarios. Altogether 8 case studies (three in each slum) were conducted.

From the total household of four slums a 95% confidence level and 5% non-response error

were considered. For determining a representative sample size following statistical formula was used for statistically valid sample. The sample size of the research was calculated by following the formula [10] where

$$n = \frac{X^2 \cdot N \cdot P \cdot (1-P)}{ME^2 \cdot (N-1) + (X^2 \cdot P \cdot (1-P))}$$

- n = required sample size.
- X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).
- N = the population size.
- P = the population proportion (assumed to be .50 since this would provide the maximum sample size).
- ME = the degree of accuracy expressed as a proportion (.05).

Thus, a workable sample size has been determined to be $n=373.78 \approx 374$. After getting the sample size the number was equally distributed among selected slums according to the household number of each slum. The distributed sample size for Korail slum was 140, Sattala 172, Nakhla para 27 and South Begunbari 35.



Fig. 3. Karail (Boubazar) slum and Sattala IPH slum in Gulshan Thana

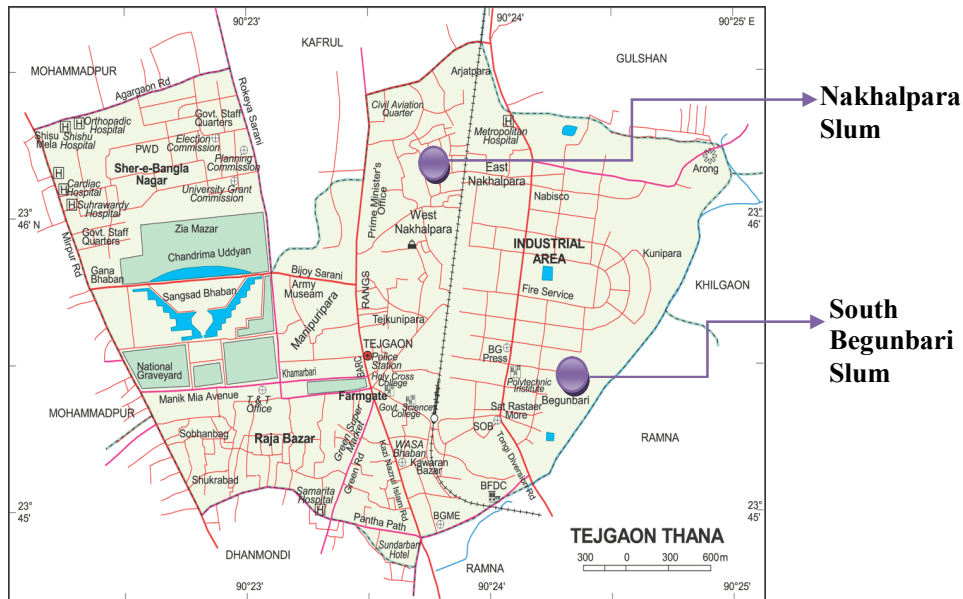


Fig. 4. Nakhalpara slum and South Begunbari slum in Tejgaon industrial area

Table 1. List of variables and indicators for the study

Variables	Indicators	Description
Human capital		
Health	Disease occurrence	- Major climate-sensitive diseases suffered by the respondents - Percentage of respondents who suffered from climate-related diseases
	Admit to hospital and able to meet expenditure	- Percentage of respondents admitted in to hospital due to poor health - Percentage of respondents capable to meet the expenditure of medical treatment
	Effect of temperature and water logging	- Percentage of respondents faced health problem due to temperature variation and water logging
Food	Dietary practice	- Consumption pattern of respondent living in four slums
	Food problems faced	- Able to eat normal amount of food during water logging and rainfall - Percentage of respondents faced problem in food preparation, storage and collection
Education and Knowledge	Education status	- Level of education
	Knowledge and information sufficiency	- Percentage of respondents exchange knowledge between each other - Percentage of respondents having lack of information
Social capital		
Social network	NGOs and Govt. Organizations activities	- Household Visiting by the social workers - Distribution of relief and aid from organizations
	Gender and women vulnerabilities	- Women take parts in decision making activities - Gender based vulnerability due to lack of security - Impediment to women's income and employment
Financial capital		
Income and savings	Occupation	- Occupation status of the slum dwellers
	Income	- Income status of the slum dwellers
	Savings	- Saving status of the slum dwellers
	Work, income and savings problems	- Problem face in work - Less income - Loss of savings

3.3 Variables and Indicators

In congruence with the scope of the assessment, all relevant variables and associated indicators have been developed for studying the four slums. The variables and indicators used are presented in Table 1.

3.4 Methods of Data Analysis

The primary information was collected, compiled and analyzed. The data obtained from the survey method were analyzed statistically using statistical computer software IBM SPSS statistics 21. Finally the analyzed data have been presented as tables and graphs.

4. RESULTS AND DISCUSSION

4.1 Impact in Terms of Human Capital

4.1.1 Health

The incidence of some of the major climate-sensitive diseases at the selected slums has been presented in Table 2. From four slums it has been found that a major percentage of the respondents; (73.5%) suffered from diarrhea and also a noticeable percentage of respondents suffered from skin diseases and cholera. 6.1%, 8.8% and 12.8% respondents of four slums reported that they have suffered from malaria, dengue and acute respiratory infections respectively. Other diseases as fever, headache, vomiting, tiredness etc. are common sickness among 97.3% respondents and the reasons identified by the respondents are heat stress, decayed food, impure water, stuffy household environment etc.

The participants who suffered from climate-related diseases have been presented in Table 3. The Table reveals that 94.1 percent respondents became ill due to climate variability in last one decade.

Respondents of the study expressed that water logging condition, temperature variation, heat stress, and poor sanitation conditions increase the emergence of diseases. Opinion about causes of health related problems, hospital admission and medical expenses by the respondents has been presented in Table 4. A major percentage of respondent 90.9% identified the reason of illness as temperature variations. The study found that 74.6% respondents fall sick when there is water logging. Due to poor health 36.1% respondents became admitted in to hospital and only 4.0% respondents are capable to meet the expenditure of medical treatment (see Table 4). Mosquito breeding sites were found in area adjacent to heaps of waste, poor sanitation and polluted ditches. The slum dwellers visit local pharmacies, quack doctors and traditional healers for health problems. For serious illnesses, they go nearby or major public hospitals.

[11] were reported that Health problems increase vulnerability and reduce the capacity of individuals and groups to adapt with climate change. [12] examines the health, nutritional status, and health care seeking behavior of a community based sample of 122 postpartum women from an urban slum in Dhaka, Bangladesh and malnutrition was found to be widespread. Similar observation was found by [13] that diseases such as diarrhea and vomiting, malaria, pneumonia, skin problems (scabies, ringworms) and common colds/coughs are related to the unhygienic living environments, lack of water and inadequate sanitation in the slum area of Dhaka city. [14] examine that the women of migrant slum in Sylhet, Bangladesh are not aware about the hygienic conditions and dump garbage here and there so that they incessantly suffer from a variety of diseases like headache, skin diseases, worm (an intestinal parasite), fever, cough and cold, gastric/ ulcer, blood pressure, toothache, diarrhea, jaundice and dysentery.

Table 2. Major climate-sensitive diseases suffered by the respondents

Area	Korail slum (Boubazar) (%) (n=140)	Sattala IPH slum (%) (n=172)	Nakhalpara slum (%) (n=27)	South Begunbari slum (%) (n=35)	Total (%)
Disease					
Diarrhea	70.7	77.9	70.4	65.7	73.5
Malaria	7.1	5.2	0	11.4	6.1
Cholera	28.6	20.9	3.7	25.7	23.0
Dengue	10.0	9.3	7.4	2.9	8.8
Acute respiratory infection	11.4	15.1	11.1	8.6	12.8
Skin infection	41.4	36.6	18.5	5.7	34.2
Others	97.1	97.7	96.3	97.1	97.3

Table 3. Respondents who suffered from climate-related diseases

Slum name	Yes		No	
	Number	Percent	Number	Percent
Korail (Boubazar) (n=140)	132	94.3	8	5.7
Sattala IPH (n=172)	160	93.0	12	7.0
Nakhalpara (n=27)	26	96.3	1	3.7
South Begunbari (n=35)	34	97.1	1	2.9
Total	352	94.1	22	5.9

Table 4. Effect of climate change on health

Characteristics of problems	Survey result (%)				Total (%)
	Korail (Boubazar) (n=140)	Sattala IPH (n=172)	Nakhalpara (n=27)	South Begunbari (n=35)	
Health problem for temperature variation	90.7	90.1	92.6	94.3	90.9
Health problem at water logging condition	75.7	75.6	74.1	65.7	74.6
Admitted in to hospital due to poor health	43.6	33.1	11.1	40.0	36.1
Capable to meet the expenditure of medical treatment	3.6	4.1	3.7	5.7	4.0

Box 1. Murshida of Nakhalpara slum

Murshida, 38 years old woman lives in Nakhalpara basti with her family. She has been living in Dhaka for the last 10 years. In her family she has two daughters and one younger son. Her husband works as security guard though he does not give family expenses regularly and ultimately Murshida bear almost all the expenses of her family. She sells vegetable near slum area and her elder daughter works as maid servant at nearby area. Her living room is situated near rail line area. She is in constant fear of eviction. The households are closely adjacent with each other in the slum. At high temperature in summer she felt lots of problem in slum household due to stuffy environment and contiguous slum households. Water and sanitation are common problems in slum areas. Skin infection is a common problem she faces year round. She did consult with doctors for this problem but slum environment keep her vulnerable to this problem.

4.1.2 Food

Respondents of the households take three meals in a day and extremely poor slum dwellers could not manage three meals per day and could only afford low quality food items. Table 5 shows trend in food consumed by respondents. In slums, consumption pattern of slum dwellers depict that rice and vegetable are consumed on daily basis. Food composition sometimes is only rice with peas or fish which are cheap to them. A few respondents (16.6%) take bread daily

followed by 64.2% respondents take bread once or twice a week. 40.4% and 56.4% can manage fish once or twice in week and month respectively. The consumption pattern of meat and poultry is mainly once or twice in a month or sometimes on special occasion like Eid festival. According to respondents these are expensive food item and most of them cannot afford it. Also the study reveals that 19.3% respondents eat fruits once a month and 36.4% once a week. In this case, they can afford mainly banana which is relatively cheaper than other seasonal fruits.

Table 5. Consumption pattern of respondent living in four slums (n=374)

Food consumed	Daily (%)	Weekly (%)	Monthly (%)	Special occasion (%)
Rice	100	0	0	0
Bread	16.6	64.2	19.3	0
Vegetable	98.7	1.3	0	0
Pea	0	77.8	22.2	0
Fish	0	40.4	56.4	3.2
Egg	0	21.7	71.7	6.7
Meat/Poultry	0	0.3	54.0	45.7
Fruits	2.1	36.4	60.7	0.80

It is evident from the findings that 33.2% households are unable to eat normal amount of food during hazardous condition (Fig. 5). Food collection and preparation become difficult by the dwellers during water logging condition. Slum dweller face problem to go outside for food collection. At high temperature and heat stress condition the people of slums face the problem of food decaying. The food spoils as they have no alternative storage facilities like refrigerator.

The study showed that 63.1% respondents faced problems in food preparation and 67.4% respondents face problem in food collection during water logging condition followed by during heat stress at slum household where 49.7% respondents face problem of food storage and decaying (See details at Table 6). Due to lack of pure water and food preparation arrangement they face problem in food consumption. At first few days of water logging condition they consumed the food which they already have in household but if the condition continues for long time they fall in to worse situation and children become most sufferer for the situation.

[15] studied on the 354 respondents of urban slum of Dhaka where they found that 56.2%

households were food insufficient and 43.8% households were food sufficient. [16] examines flood-induced vulnerabilities among women in northern Bangladesh and found that the face difficulties in finding adequate shelter, food, safe water, and fuel for cooking, as well as problems in maintaining personal hygiene and sanitation, prevent women from performing their usual roles at home.

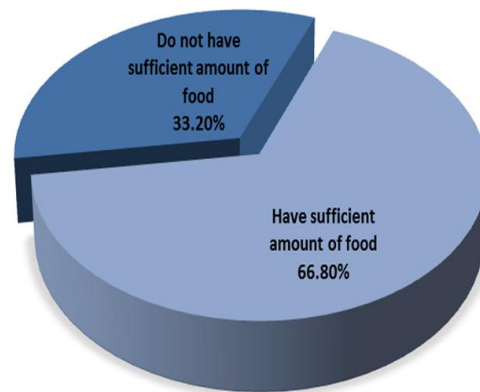


Fig. 5. Percent of respondents who faced food associated problems in hazardous situations (n=374)

Table 6. Effect of climate change on food

Characteristics of problems	Survey result (%)				Total (%)
	Korail (Boubazar) (n=140)	Sattala IPH (n=172)	Nakhalpara (n=27)	South Begunbari (n=35)	
Able to eat normal amount of food during water logging and rainfall	64.3	68.0	51.9	82.9	66.8
Problem faced in food preparation during water logging and rainfall	63.6	61.0	63.0	71.4	63.1
Problem faced in food storage and decaying during heat stress	50.0	52.3	33.3	48.6	49.7
Face difficulty in food collection during water logging and rainfall	67.1	66.3	66.7	74.3	67.4

4.1.3 Education and knowledge

Education has significant influence on knowledge and livelihood strategies. The study shows that none of the respondents had attained an undergraduate or graduate education. On the other hand, about 21.4% respondents have completed primary level education followed by 5.9% up to class eight, 2.1 per cent S.S.C and 0.8 per cent H.S.C. The study shows that 15.5% respondents did not get formal education but they have little education achieved from home or non-formal education systems. Due to lack of available support from family they were unable to continue their higher study. Another significant finding is that more than 54.3% of the respondents never attended any school/madrasa/formal educational institute (Fig. 6, Table 7).

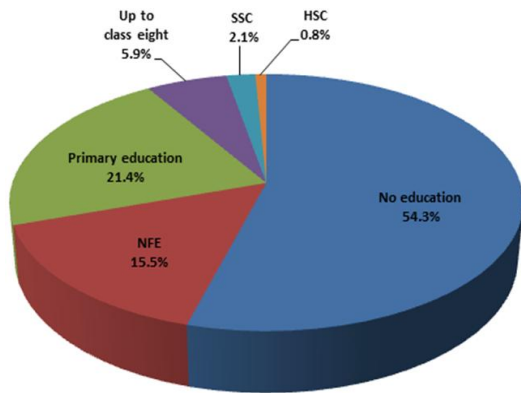


Fig. 6. Education status of the respondents (n=374)

The level of education of four slum respondents has been presented in Table 5.

It reveals from the findings that about 66.3% respondents believe they lack information on subjects like NGO activities, policies related with

land and housing, rights issues, opportunities available in surroundings (Fig. 7, Table 8). Most of the slum dwellers are aware of important information but their access to information is limited. Though with the help of television and radio, they keep up to date of many daily events but important information do not go to them properly, like entrepreneurship development such as WatSan awareness, health bulletin etc. They feel the importance of these facts as well as seek information and awareness how to gain access to their basic rights and standard way of living for household development.

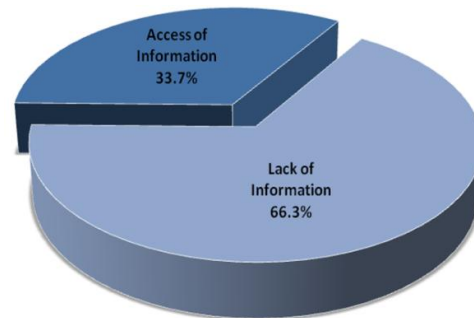


Fig. 7. Information accessibility (n=374)

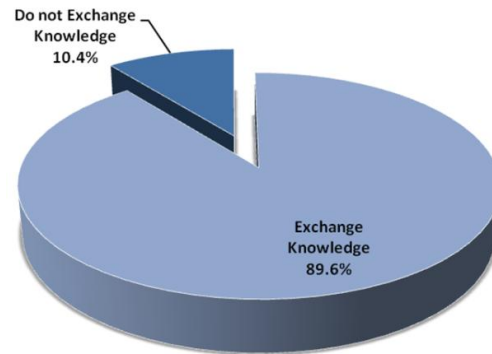


Fig. 8. Knowledge exchange (n=374)

Table 7. Level of education

Particulars	Korail (Boubazar) (%) (n=140)	Sattala IPH (%) (n=172)	Nakhalpara (%) (n=27)	South Begunbari (%) (n=35)	Total (%)
No education	56.4	49.4	66.7	60.0	54.3
Non Formal Education (NFE)	14.3	15.7	18.5	17.1	15.5
Primary education	19.3	26.2	11.1	14.3	21.4
Up to class eight	5.7	6.4	3.7	5.7	5.9
S.S.C	2.9	1.7	0	2.9	2.1
H.S.C	1.4	0.6	0	0	0.8
Graduation	0	0	0	0	0
Masters	0	0	0	0	0

Data from four slums (Fig. 8, Table 8) showed that most respondents (89.6%) exchange information between them, which is very useful for social dynamics, since knowledge exchange and support among slum dwellers has a positive effect in addressing adverse situations. Only 10.4% of the people in the sample say that they do not participate in knowledge exchange with other households.

A similar study was conducted by [17] where they collected data from 130 slum households of Dhaka North city corporation slum area and found that educational qualification having 26.92 percent of the respondents had fully illiterate, 16.15 percent respondents can sign only, 30.77 percent in primary educated, 22.31 percent in secondary level educated and only 3.85 percent had higher secondary level educated. [18] studied on slum areas in Dhaka city and found that there have no available formal education facilities.

4.2 Impact in Terms of Financial Capital

4.2.1 Income and savings

Occupation of different earning members in slum households is one of the determining factors of livelihood status. Most of the slum dwellers are unskilled, and involved in the informal sector, such as rickshaw pullers, van pullers, garment

workers, household help and some pursue small business, like selling fish and vegetable in nearby markets. Occupational status of the household members is shown in (Table 9, Fig. 9). The study exhibits a significant variation in occupational pattern. Women respondents are engaged in several income generating activities like men. Among the households 33.9% and 23.5% respondent are supporting their families by engaging as garment worker and maidservant. Besides these occupational groups, about 2.6% are unemployed. On the other hand, 7.4% respondents served as a housewife in the respective family. It was also observed that respondents are engaged in petty business, service, rickshaw pulling, day laborer etc.

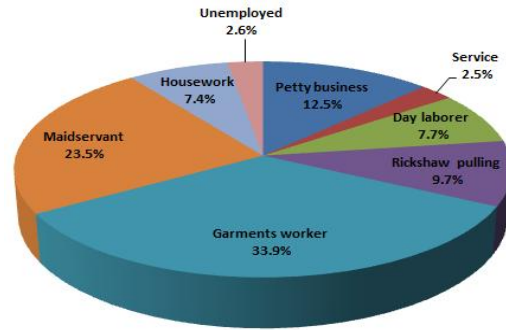


Fig. 9. Occupation status of the slum dwellers (n=374)

Table 8. Information and knowledge status in the slum area

Characteristics of problems	Survey result (%)				Total (%)
	Korail (Boubazar) (n=140)	Sattala IPH (n=172)	Nakhalpara (n=27)	South Begunbari (n=35)	
Lack of information	69.3	64.0	59.3	71.4	66.3
Knowledge exchange	90.7	89.5	81.5	91.4	89.6

Table 9. Occupation status of the slum dwellers

Particulars	Korail (Boubazar) (%) (n=140)	Sattala IPH (%) (n=172)	Nakhalpara (%) (n=27)	South Begunbari (%) (n=35)	Total (%)
Petty business	9.3	0.6	25.9	14.3	12.5
service	2.1	1.2	3.7	2.9	2.5
Day laborer	10.0	1.2	11.1	8.6	7.7
Rickshaw pulling	13.6	12.2	7.4	5.7	9.7
Garments worker	21.4	25.0	40.7	48.6	33.9
Maidservant	29.3	49.4	3.7	11.4	23.5
housework	12.1	8.1	3.7	5.7	7.4
unemployed	2.1	2.3	3.7	2.9	2.6

The slum dwellers in survey area represent lower income group. According to survey data, 12.97% of respondents have income less than Tk. 5000, 59.3% have income Tk. 5000-10,000 and 25.7% have income Tk. 10,000-15,000. On the other hand only 1.6 % respondent income is within the range of TK 15,000 to TK 20,000 while only 0.5% of the household income is more than 20,000 (See Table 10).

Children under 18 years are involved in income generating activities in the study area. The monthly household expenses are almost equal to the monthly household income for the inhabitants. Majority of the respondent (75.2%) cannot save any money at the end of the month (Table 11). Main expenditure sectors are house rent, utility, food, clothing and treatment. During any disaster situation, work and wages become scarcer for the urban poor. Respondents also lose assets due to the hazardous situation. Some women involving with petty business complained that they unable to continue their earning activities during hazards.

For hazardous events at the slums, dwellers saved little money and expend at shelter construction, medical expenditure etc. 80.8% respondents of the study answered that they lost their savings due to climate change related problem at slum. Very few households can save from what they earn. Some household monthly expenditure exceeds their earning and they manage the extra expenditure by owing from their neighbors or relatives. All of the respondents face problem in their work where 34.5% respondents said that their income become less during high rainfall, heavy rain and heat stress (Table 12).

Similar study of Dhaka North city corporation slum area from 130 slum households by [19] identified that the annual income of the respondents ranged from 54 thousand to 130

thousand with mean of 84415.38 Tk. 51.54% of the respondents were found to have low annual income while 20.77% had medium annual income and rest of them (27.69%) had high annual income. According to [17] survey the urban poor are involved in street selling and other petty retailing, repairs and personal services, crafts and other manufacturing, construction and transport work. Home-based work provides the major source of poor urban women's involvement in the household-reproduction sphere in the 'local space' [20,21]. It has also been argued in previous studies that despite the gender gap female employment has shown surprisingly rapid growth in recent years, particularly in garment factories where the employers discriminate positively in favor of women [18,22,23] also found that slum people in Dhaka city engaged in rickshaw pulling, day laborer, petty business, small job services etc. [24] examine that due to severe floods on households in Dhaka's slums dwellers faced a significant decrease in income, unable to continue working, loss savings and valuable assets. A study on slum dwellers of Dhaka city by [25] identified that the reason behind the poverty of slum dwellers of Dhaka city are low economic growth, inequitable distribution of income, unequal distribution of productive assets, unemployment and underemployment, high rate of population growth, low level of human resource development, natural disasters, and limited access to public services.

4.3 Impact in Terms of Social Capital

4.3.1 Social network

The service providers from the public, private and NGO sectors are active in slums are operating non-formal education program for the working children, health center activities focusing on pregnant mother, some skill based/technical training and micro credit support for the

Table 10. Income status of household in BDT

Slum name	≥5000	5000-10000	10000-15000	15000-20000	20000≥
Korail (Boubazar) (%) (n=140)	5.7	59.3	31.4	2.9	0.7
Sattala IPH (%) (n=172)	5.2	50.0	40.1	3.5	1.2
Nakhalpara (%) (n=27)	29.6	59.3	11.1	0	0
South Begunbari (%) (n=35)	11.4	68.6	20.0	0	0
Total (n=374)	12.97	59.3	25.7	1.6	0.5

Table 11. Savings status of households at the end of the month

Slum name	No saving	500	500-1000	1000-2000	2000-3000	3000-4000	4000-5000	5000
Korail (Boubazar) (%) (n=140)	76.4	7.9	10.7	2.1	0.7	0.7	0.7	0.7
Sattala IPH (%) (n=172)	69.8	10.5	11.0	4.1	1.7	1.7	0.6	0.6
Nakhalpara (%) (n=27)	88.9	3.7	7.4	0	0	0	0	0
South Begunbari (%) (n=35)	65.7	22.9	11.4	0	0	0	0	0
Total (n=374)	75.2	11.25	10.13	1.55	0.6	0.6	0.33	0.33

Table 12. Effect of climate change on work (%)

Characteristics of problems	Survey result (%)				Total
	Korail (Boubazar) (n=140)	Sattala IPH (n=172)	Nakhalpara (n=27)	South Begunbari (n=35)	
Problem face in work	100	100	100	100	100
Loss of savings	84.3	82.0	74.1	82.9	80.8
Less income	32.9	34.9	44.4	31.4	34.5

Box 2. Miraj sheikh of Begunbari slum

Miraj sheikh, 35 years old man lives in Begunbari basti with his family. He has been living in Dhaka for the last 13 years. He has come from Kathalia village of 5 No. Union in *Sathkhira coastal* area. In his family he has four children, 2 daughters and two sons. He is a petty businessman in kitchen market near Begunbari. His wife works as a domestic worker. His elder daughter works at garment factory. His younger daughter and son reads in class six and class two respectively. He is unable to save money after paid 2,200 taka per month for house rent and other expenses. His wife is unable to feed her properly. At slum, electricity line is not well designed and protected. Use of energy for cooking is complex and having risk of fire hazard. During high temperature, dense populated and polluted environment condition, sickness like diarrhoea, skin infection and fever are common in his family. His younger son constantly suffers from malnutrition, fever, and vomiting. Miraj seikh is unable to meet the medical expenses due to lack of money and remain worried about his family health. For free treatment of his son he goes to nearby government hospital. Miraj seikh want to stay in Dhaka until his children fully grown up in spite of the sufferings and sorrows in the slums.

community people etc. Some of the NGOs are working with sanitation system and made some community latrine, water point and drain-pavement inside the slum. Though the coverage is very limited but the initiative is very remarkable. This study has shown that 22.5% of households have been visited by the social workers. NGO services are generally only available during working hours. A low percentage of respondents (9.1%) answered that they got relief and aid from NGOs or community and Govt. Organizations during hazardous condition. [7] found that the poor communities are vulnerable in terms of their physical and social capital.

4.3.2 Gender and women

The present study shows that 51.1% respondents think women are not involving with decision making activities. Both of employed and unemployed women are performing multiple responsibilities at home in spite of day long outside work. They are ensuring their family daily sustenance and ensuring food security, child health and education care as part of regular domestic work. Women respondents expressed that they are engaged in several income earning activities to support their families particularly for food. However, they are often unable to carry out their daily jobs due to hazardous condition and

Table 13. Social network condition in the slum areas

Nature of social implication	Survey result (%)								Total (%)	
	Korail (Boubazar) (n=140)		Sattala IPH (n=172)		Nakhalpara (n=27)		South Begunbari (n=35)		Yes	No
	Yes	No	Yes	No	Yes	No	Yes	No		
Household Visiting by the social workers	22.9	77.1	22.7	77.3	14.8	85.2	25.7	74.3	22.5	77.5
Distribution of relief and aid from organizations	10.0	90.0	9.3	90.7	3.7	96.3	8.6	91.4	9.1	90.9

Table 14. Effect of climate change on gender and women

Nature of social implication	Survey result (%)								Total (%)	
	Korail (Boubazar) (n=140)		Sattala IPH (n=172)		Nakhalpara (n=27)		South Begunbari (n=35)		Yes	No
	Yes	No	Yes	No	Yes	No	Yes	No		
Women take parts in decision making activities	58.6	41.4	42.4	57.6	18.5	81.5	65.7	34.3	51.1	48.9
Gender based vulnerability due to lack of security	95.7	4.3	95.9	4.1	100	0	97.1	2.9	96.3	3.7
Impediment to women's income and employment	89.3	10.7	90.1	9.9	92.6	7.4	88.6	11.4	90.2	9.9

lack of security. It has been found that 96.3% respondents face gender based vulnerability in slums. The women work in the informal sector and typical activities such as home-based income generation, travelling to factories and house work, small business all get affected during hazardous conditions. Thus climate change impedes women's income and employment opportunities (Table 14). Respondents reported the harassment of their daughters and women by rogues and local goons in the shelters which become increasingly hazardous events. The slum dwellers seek shelter at neighboring slum when the height of water logging condition remains high at heavy rainfall. Due to limited space, the slum dwellers irrespective of gender and age had to sleep near one another, leaving young girls and single young women (without male guardians) vulnerable especially after dark.

The gendered division of labor becomes critical as gender roles are often re-enforced and even intensified – due to the additional work and changes in environment brought on by a disaster. It has been argued that violation of women's rights becomes more prominent due to crises created by climate change [26]. [27] found that particular group of people including children, elderly, chronically ill people and women are most vulnerable to climate change and extreme climate variability. A similar study by [16] found

that poor and disadvantaged women are more vulnerable to disasters than men due to the conditions that predispose them to severe disaster impacts. [28] identified that Bangladesh has become synonymous for climate change induced natural disasters. The research reveals that disasters reinforce, perpetuate and increase gender inequality which making bad situations worse for women.

5. CONCLUSION AND RECOMMENDATION

The findings of the study provide an overview of the livelihood strategies of slum dwellers and how climate change impacts them. It has been found from the study that prevalence of diarrheal diseases increased during extreme temperature and heat stress. The prevalence of different diseases is also increasing like diarrhea, cholera, skin diseases, dengue, malaria etc due to climate change effect. The study findings reveal that 94.1 percent respondents became ill due to climate variability in last one decade. The slum dwellers face problems in food storage, decaying, preparation and collection during water logging, heat stress and erratic rainfall. Most of the slum dwellers have little or no education and have lack important information. Most slum dwellers are not well educated and involved in the informal sector, such as rickshaw pullers, van pullers, garment workers, household help, small business, like

selling fish and vegetable in nearby markets etc. Their poor income and savings make them more poor to the hazard situation at slum. The coverage of Government and non-Government organizations in slums are very limited but the initiative is very remarkable. From four slums it has been found that a low percentage of respondents (9.1%) answered that they got relief and aid from NGOs or community and Govt. organizations during hazardous condition. From the household it has been found that 51.1% respondent think women are not involved with decision making activities and 96.3% respondents face gender-based vulnerability in slums.

Clear and forward-looking policies on urbanization and urban slum settlements are vital for long term thinking and interventions to improve the long-term prospects of people who live in slum settlements. The impact of climate change needs to be considered while formulating policies for all development sectors. The measures related to climate change impacts must be given a wide layout of different developmental activities like water and sanitation activities, health, food security, solid waste management, drainage system improvement, awareness rising etc for the wellbeing of the poor slum dwellers. More integration is necessary between the Government and NGOs programs and initiatives for better supporting to the urban slum community of Bangladesh. In order to establish the best paths to reduce the slum people's vulnerability to climate change, a comprehensive development initiative is needed to bring about changes in the slum situation. Further research is needed including more sectors of livelihood and climate change effect in wider aspects and producing more information. The results can be used as a benchmark study to be compared with future and more extensive studies.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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