Climate Change Effect in Physical and Natural Capital: A Study on Urban Poor in Dhaka City of Bangladesh

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Abstract

A study was conducted on the physical and natural capital in urban slum to assess the effect of climate change on the capitals. Four slums of Dhaka city were selected as the study area. The study was followed a combination of quantitative and qualitative research methods. A stratified random sampling technique was assumed to collect data from the slums. Focus Group Discussion (FGD), Key Informants Interview (KII) and case study tools were employed for the qualitative study. By following the DFID five sustainable livelihood approaches, the research was concerned with physical and natural capital. The main findings of this study revealed that the slum dwellers are normally victim of flood, water logging, heat stress and erratic rainfall effects in their household. The study identifies that due to change in climate, the shelter becomes affected by both heavy and normal rain and poor drainage systems of the slum make it more vulnerable and create water logging. It was found that slum dwellers face problems in water collection during high temperature and water logging. The present findings indicate that the slum dwellers are enduring and combating with the daily livelihood problems.

Keywords: Climate change; Slum dweller; Livelihood; Water logging

Introduction

Bangladesh is one of the most vulnerable countries in the world to climate change [1]. The effects of climate change are projected to be the highest on water-related disasters, particularly floods [2]. Climate change and widespread urban growth may intensify flooding in the coming years [3]. Although long-term annual rainfall patterns show a subtle variation, monsoonal rainfalls show an increasing tendency [4], indicating that the flood problem could be aggravated under climate variability. Dhaka is exposed to multiple types of climate-induced hazards including variations in temperature, excessive and erratic rainfall, water logging, flooding, cyclones, and heat and cold waves [5]. The dense concentration of urban populations can increase susceptibility to the disasters that are likely to become more frequent and more intense as a result of climate change [6]. In Bangladesh the poor mainly live in slums scattered throughout the Dhaka city. An estimated 7,600 households live in slums that are within 50 meters of the river and are in frequent risk of being flooded [7]. Around 40% of the population of Dhaka live in "slums" and squatter settlements; they draw their livelihoods from industry (e.g. garments, textiles, leather etc.), the transport sector, shopping centres, hotels and restaurants, the construction sector and as domestic workers. These people are severely affected by floods, water logging and other relevant problems. The slums are very diverse: there have wide intra- and intercity variations in population size, density, the percentage of urban populations living in slums, and sanitation conditions [8]. Slum dwellers have mostly settled temporarily on public or private land and they are often evicted from their settlements [9]. Climate change induced disasters destroy livelihood options and increase peoples' vulnerabilities. So it is important to understand the dynamics of climate change of urban poor and assess their livelihood strategies to the effect of climate change. The present study, thus, have designed to find out the urban poor livelihood strategies of physical and natural capital in context of climate change.

Materials and Methods

Study area

Four slums had been selected for the research (Table 1). Two slums have been selected from residential area (Gulshan Thana) and rest two slums have been selected from industrial area (Tejgaon Thana).

Quantitative and qualitative Study

In this study both qualitative approach and quantitative approach was used. For quantitative analysis a stratified random sampling technique was adopted. Target populations for this research were women, male, adolescent girl and the vulnerable inhabitants of selected slums. A questionnaire was prepared to collect data. Besides quantitative survey, some qualitative studies were performed using Participatory Assessment (PA) tools. 2 Focus Group Discussion, 3 Key Informant Interview (KII) and 8 Case Study were conducted as a part of qualitative survey. For determining a representative sample size for the study the sample size was calculated by following the formula Krejcie and Morgan [10].

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

n=required sample size.

Area	Name of slum	Address
Gulshan-Banani Lake	Korail (Boubazar slum)	Boubazar, korail, near Banani lake
Mohakhali	Sattola IPH slum	Near IPH building, Mohakhali.
Tejgaon	Nakhalpara slum	Beside Gulshan – 1,Nakhalpara, Tejgaon I/A.
Tejgaon	South Begunbari slum	Begunbari, near Hatirjhil, Tejgaon I/A.

Table 1: Four selected slum areas.

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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 0.50 since this would provide the maximum sample size).

ME=the degree of accuracy expressed as a proportion (0.05).

Thus, a workable sample size of household (HH) has been determined to be n=373.78≈374. This total Household was equally distributed among selected slums according to the household number of each slum. The following Table 2 shows the sample size of the study.

Variables and indicators

The DFID framework outlines assets in terms of five categories necessary for the pursuit of positive livelihood outcome are physical, social, natural, human and financial capital (Department for International Development, 1999). Based on the theoretical insights of DFID sustainable livelihood approach physical and natural capitals were selected for the research. The trend of climate change had been collected from the secondary source. The effect of these climatic events on livelihood capitals was collected from selected slums. In congruence with the scope of the assessment, all relevant variables and associated indicators had been developed for studying the four slums. The variables and indicators used are presented in Table 3.

Data analysis

The primary information was collected, compiled and analyzed. The data obtained from the survey were analyzed by using statistical computer software SPSS for subsequent analysis. Finally the analyzed data have been presented as tables and graphs.

Results and Discussion

The study consists of 374 respondents of which 80.21% are females, 13.37% are males, 5.35% adolescent girl and 1.07% children. The overall proportion of the younger age groups is substantially larger than that of older age groups for each sex. The average age of the respondents of Korail (Boubazar), Sattala IPH, Nakhalpara and South Begunbari slum was 34.73, 33.64, 33.37 and 35.00 year respectively. The household chosen for the study was 85.56% nuclear family and 14.43% joint family. The General particulars of sample respondents have been presented in Table 4.

Effects in terms of physical capital

Shelter: For shelter the materials mainly used as fence are bamboo and CI sheet and in very few cases, polythene fences are found. As roof, CI sheet is very common material and bamboo is also used in households. In korail (Boubazar) slum, 77.9% household fence and roof is made of CI sheet where 22.1% household fence is made of Bamboo and roof is made of CI sheet. In Sattala IPH slum, the roof and fence is made of CI sheet in 83.1% cases and fence is made with bamboo, roof with CI sheet in 16.9% cases. In Nakhalpara and South Begunbari slum, roof of both CI sheet and bamboo has been found and as fence CI sheet, bamboo and polythene are used as shown in Table 5.

20.7% and 20.3% respondents of korail (Boubazar) and Sattala IPH slum respectively answered that their house affected in normal rain. 51.9% respondents of Nakhalpara slum and 37.1% respondents of South Begunbari slum answered that their shelter effect on normal rain. All the respondents of four slums answered that their shelter affected by the heavy rain. Slum dwellers hung on to their own homes as long as possible until the water level compelled them to abandon their belongings. In slums, it was found that when water started pouring in, some families built bamboo platforms and shifted their belongings on it. In some cases, families raised their beds by putting bricks under it to raise the level of the beds and shifted to the roofs of their homes, if the roofs were sturdier. When everything was inundated, families reluctantly took shelter in nearby slum, schools, or empty under-construction buildings or on nearby embankments or culverts. Where these were not available, they moved to take shelter by the side of the highways in makeshift shelters made with plastic sheets on bamboo frames. Disaster is become quite uncommon now days. So they don't have to take and maintain any extra mitigation mechanism, though

Name of the slum	No. of HH (aprx)	No. of Population (aprx)	No. of HH taken as sample respondent
Korail	5180	16732	140
Sattala	6400	23400	172
Nakhalpara	1000	4000	27
South Begunbari	1300	6500	35
Total	13880		374

Table 2: Sample size of the study.

	Variables	Indicators
Physical Capital	**Shelter**	✓ Structure of shelter
		✓ Effect of rainfall on shelter
	Drainage system and sanitation	✓ Type of latrine
		✓ Mode of waste disposal
		✓ Opinion about Disruption of sanitation facilities
		✓ Problem faced with sewage and solid waste in water logging condition
Natural Capital	**Water source**	✓ Source of water
		✓ Quality of water
		✓ Opinion about effect of climate change on water
	Natural vulnerability and climate variability	✓ Major challenges faced due to climate variability in the last one decade
		✓ Opinion about temperature variation
		✓ Opinion about rainfall pattern

Table 3: List of variables and indicators for the study.

Particulars	Number	Respondents (%)	Respondent Households (%)
1. Type of Interviewees			
Women	300	80.21%	
Male	50	13.37%	
Adolescent Girl	20	5.35%	
Children	4	1.07%	
2. Type of Family			
Nuclear	320		85.56%
Joint	54		14.43%
Individual	0		0.00%

Table 4: General particulars of sample respondents.

	CI sheet both roof and fence (%)	Bamboo fence and roof with CI sheet (%)	Polythene fence and bamboo roof (%)
Korail (Boubazar) (n=140)	77.9	22.1	0
Sattala IPH (n=172)	83.1	16.9	0
Nakhalpara (n=27)	51.9	18.5	29.6
South Begunbari (n=35)	71.4	22.9	5.7

Table 5: Structure of house.

Slum name	Pucca (%)	Katcha (%)	Hanging (%)
Korail (Boubazar) (n=140)	12.1	76.4	11.4
Sattala IPH (n=172)	9.3	80.2	10.5
Nakhalpara (n=27)	74	63	29.6
South Begunbari (n=35)	14.3	71.4	14.3

Table 6: Opinion about effect of rainfall on shelter.

Nijam Uddin lives in karail basti. He is 32 years old. His wife's name is Rahela khatun. He has come from sukhchar village of 3 No. Union in *Bhola coastal* area. He came in to Dhaka eight years ago with a hope of ray for working opportunities and better life than village. After migrated in to Dhaka he took shelter in a semi-pucca single room at karail basti and started working as a day labourer. His wife is a housewife and cannot go outside for work due to children raring. Due to erratic and unexpected heavy rainfall Nijam Uddin fall in to problem in his slum's living room. Rain water enters in his living room from roof and at heavy rain water submerges the room due to bad drainage system at korail. "My house becomes submerged at heavy rain, there is no place to go, children fall in to sick and I cannot go outside for work regularly for the children" he said. During water logging condition he cannot give food properly to the children and pure drinking water also not remains available. "I don't like to live in Dhaka, But I have a dream to buy a piece of land in my village and then will go back to my village again."

Box 1: Nijam uddin sufferings in slum living room.

during rain water pours through roof and make life difficult for these extreme poor community (Table 6 and Box 1).

Drainage system and sanitation: In addition to poor housing, sanitation and drainage facilities is also neglected in slums. As the respondents live in the informal settlements, their place of defecation is very poor with unhygienic condition. Major respondents (10.2%) use pucca latrine, 78.3% use kutcha and rest use hanging latrine. Those who live on the elevated dwellings over water have no option except hanging latrine. Some NGO has constructed community latrine with the collaboration of Dhaka City Corporation. Most of the HH expected from government to help them for building latrines. Some latrines looked sanitary, but they mostly had no functioning water seal and were usually directly linked with the drainage system or with nearby water bodies (such as lakes, rivers and standing water) (Table 7).

In study area, there is no fixed place for waste disposal. Generally wastes are disposed wherever they live like on the ground or above the water body. Therefore, scattered wastes are found visible in open place. Some municipal dustbins are found in slum area for solid waste disposal, but not sufficient and the inhabitants have to dispose solid wastes in open spaces and road sides that are very vulnerable for the deterioration of environment. It indicates that adequate facilities of waste disposal as well as collection are almost non-existent in slum area. From the sample data, it has been found that a large number of households (88.0%) dispose wastes into the water body, while 10.7% of households dispose on the ground, mainly on the street. Though, only 1.3% of households have been found to dispose wastes in dustbin. Exposure to such dirty environment is very risky for children as they spend most of their time playing outside (Table 8).

The present study shows that almost all of the respondents gave their opinion that water logging condition is one of the main problems in their living slum. During water logging condition most of the respondents face problem with sewage and solid waste and disruption of sanitation facilities occur due to hazardous situation in slum. Drainage system was usually very poor in slums, and in most cases existing drainage was open and blocked with garbage. Even during light rain this created waterlogging and caused raw garbage and sewerage to overflow. Many slum houses were elevated over water bodies (such as lakes, rivers, canals, drains and standing water) and garbage dumping points. The opinions of respondents related with drainage system and sanitation problems has presented in Table 9.

Effect in terms of natural capital

Natural vulnerability and climate variability: People in the study area perceive that today's climate is different from the past, the seasonal cycle and rainfall pattern have changed and the average temperature has increased in the summer while winter has shortened. Almost all the respondents of the study feel that the summer is hotter and longer and winter is warmer and shorter than before. Among the respondents of four slums, 84.2% respondents feel the difference between current weather and earlier weather [11,12].

Most of the respondents (88.0%) think that temperature is rising day by day followed by very few respondents (12.0%) think that temperature is remaining constant like earlier and no respondents think that temperature is decreasing (Chart 1 and Table 10).

From the opinion of rainfall pattern it has been revealed that 87.2% respondents think rainfall is unpredictable and small numbers of respondents think that rainfall is remaining constant like earlier and no respondents think that rainfall is predictable as shown in Table 11 and Box 2.

Water: Slum dwellers have access to community based piped water supply by Water Supply and Sewerage Authority (WASA) and community based tube well. Most of the people of slum use WASA's supply pipe water for drinking. Tube well and supply water is the main water source of slums. In Korail slum, 87.9% of the respondents use supply water for drinking and other purposes and 12.1% uses tube well water. In Korail slum, dwellers pay double prices for water supply and often fall sick from drinking water. By drinking the water they

Slum name	Water body (%)	Ground/street (%)	Dustbin (%)
Korail (Boubazar) (n=140)	86.4	11.4	2.10%
Sattala IPH (n=172)	89	10.5	0.60%
Nakhalpara (n=27)	85.2	14.8	0%
South Begunbari (n=35)	91.4	5.7	2.9

Table 7: Type of Latrine.

Characteristics of problems	Survey result (%)							
	Korail (Boubazar) (n=140)		Sattala IPH (n=172)		Nakhalpara (n=27)		South Begunbari (n=35)	
	Yes	No	Yes	No	Yes	No	Yes	No
Disruption of sanitation facilities	84.3	15.7	86.6	13.4	100	0	85.7	14.3
Problem faced with sewage and solid waste in water logging condition	88.6	11.4	91.9	8.1	100	0	88.6	11.4
Excessive rain create water logging conditions	98.6	1.4	96.5	3.5	92.6	7.4	97.1	2.9

Table 8: Waste Management system.

Slum name	Increased (%)	Decreased (%)	Constant (%)
Korail (Boubazar) (n=140)	90.7	0	9.3
Sattala IPH (n=172)	84.9	0	15.1
Nakhalpara (n=27)	85.2	0	14.8
South Begunbari (n=35)	94.3	0	5.7
Total (n=374)	88	0	12

Table 9: Opinions of respondents about drainage system and sanitation problems.

Chart 1: Percentage of respondents feels changes between current and earlier weather.

Slum name	Increased (%)	Decreased (%)	Constant (%)
Korail (Boubazar) (n=140)	0	90.7	9.3
Sattala IPH (n=172)	0	84.3	15.7
Nakhalpara (n=27)	0	88.9	11.1
South Begunbari (n=35)	0	85.7	14.3
Total (n=374)	0	87.2	12.8

Table 10: Opinion about temperature variation in last one decade.

Slum name	Community based tube well (%)	Community based supply water (%)
Korail (Boubazar) (n=140)	12.1	87.9
Sattala IPH (n=172)	36.6	63.4
Nakhalpara (n=27)	0	100
South Begunbari (n=35)	8.6	91.4

Table 11: Opinion about Rainfall pattern in last one decade.

suffer from diseases like diarrhoea, jaundice or cholera etc. The illegal connection and pipe system is responsible for this.

Majeda Begum a 29 year women of two children lives in Sattala basti. Her Husband's name is Rashed miah. She has come from Kalkabari village of 1 No. Union in Mymensingh border area. Now she lives in a tin shed single room at Sattala basti. She does not able to give food properly to her family members. She dependent on the food received from the domestic help work and sometimes cooked at night. Both of their monthly total income is 8500 Tk approximately. They can't save money from their income after paying the household rent, children education expenses and daily household expenditures. They are facing lots of problems in their living house at slum. "In summer it's too hot in room and electricity remain only for few hour, children's become fall in to sickness and cant study properly also" she said. She not only face problem in her home but in work also due to hazard event. She becomes sick occasionally due to problems in slum house. For sickness she can't attend in her work regularly and she also lost her job for this reason for a number of times. She is now only surviving in this city life.
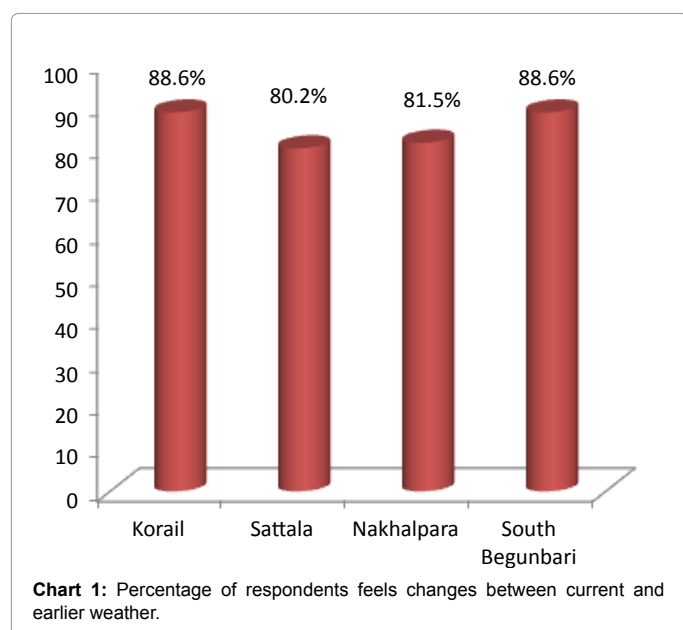
Box 2: Majeda Begum in Sattala slum.

The Water Supply and Sewerage Authority (WASA) in Dhaka has a policy to not provide water services to households without a legal land-holding permit, which effectively excludes informal settlements from access to a safe water supply (DSK-Shiree Project, 2013). The water runs through a thick plastic pipe that curls through the dirty slum paths. On certain spots the pipe is broken and taped. Bacteria can grow easily on those spots, also because water in the aboveground plastic pipe gets warm quickly. In Sattala IPH slum, 63.4% of the respondents use supply water where 36.6% use tube well water. On an average, considering one month of thirty days, Sattala IPH slum dwellers get available and normal water on fifteen days, dirty water on seven days and the water remain unavailable on rest seven days.

In South Begunbari slum, WASA is the main water supplier. There are common taps and tube wells for a group of people in this slum which are connected with the WASA supply line. 91.4% respondent of the slum collect water from tap and 8.6% respondent collect from community based tube well. People living in this slum suffer less scarcity of water. They get water almost all day long but water qualities do not remain in satisfactory level sometimes. In Nakhalpara slum all of the respondents use community based supply water and the quality of water is not good (Table 12).

Access of safe water is still a dream for many slum dwellers. There are limited water treatment practices which are applied at household level for safe drinking water. All of the respondents answered that they face different kind of problems in water collection during high temperature and heavy rain. A large percentage of respondents answered (90.9%) they face lack of pure drinking water during water logging condition at slum (Table 13).

Conclusion

The findings of the study indicate that slum poor's are effecting for climate change. Most of the respondents gave their opinion that today's climate is different from the past. The water logging condition is one of the main problems in their living slum and the main reasons for water logging are high rainfall, poor drainage system and defective waste disposal system. The slum dweller shelters affected by the both heavy and normal rain but in heavy rain shelters affected completely.

Slum name	Community based tube well (%)	Community based supply water (%)
Korail (Boubazar) (n=140)	82.9	88.6
Sattala IPH (n=172)	84.9	87.2
Nakhalpara (n=27)	81.5	81.5
South Begunbari (n=35)	74.3	94.3

Table 12: Water source of slums.

Slum name	Community based tube well (%)	Community based supply water (%)
Korail (Boubazar) (n=140)	82.9	88.6
Sattala IPH (n=172)	84.9	87.2
Nakhalpara (n=27)	81.5	81.5
South Begunbari (n=35)	74.3	94.3

Table 13: Problem faced in water collection.

The sanitary and drainage facilities found poor in the selected slum. The slum dwellers face problem with sewage and solid waste in water logging condition. During excessive rain the drainage and sanitation problems become extreme. Water collection becomes hampering during excessive rain and in high temperature they face lack of water problems. By examining various effects of climate change, the present study has given importance on the inter linkages amongst different livelihood strategies and climate change effects. The study also draws an attention to the vulnerability that affects slum dwellers to climate variability and climate-induced disasters. The study only covers four slum areas though there have about more than 4,000 slums in Dhaka. Further research is needed with more livelihood sectors in terms of effect of climate change in wider aspects and generation of more information. The results can be used as a benchmark study to be compared with future and more extensive studies.

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