

**AN ENQUIRY INTO THE CAUSES OF WATER LOGGING AND THE COPING STRATEGIES  
OF THE URBAN POOR: A CASE OF THE RAILWAY SLUM, KHULNA**

By

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A thesis submitted to the Department of Architecture in partial fulfillment of the  
requirements for the degree of Master in Disaster Management.

Postgraduate Programs in Disaster Management (PPDM)

Department of Architecture

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## **Declaration**

It is hereby declared that

1. The thesis submitted is written as an original work for completing the degree of masters at BRAC University.
2. The thesis paper does not contain material previously published or written and includes statements with citation.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.

I, hereby state that, I am the author of this dissertation. The paper has been written ethically with proper mention and citation where needed, without plagiarism. To ensure authenticity of my work, I have undertaken all the necessary methods and precautions required.

A handwritten signature in black ink that reads "Raisa". The signature is written in a cursive style with a horizontal line underneath the name.

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## Approval

The thesis entitled “An enquiry into the causes of water logging and coping strategies of the urban poor: a case of the railway slum, Khulna” submitted by Raisa Binte Salam (ID: 20268014) of Fall, 2020 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master in Disaster Management on June, 2024.

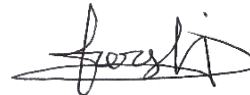
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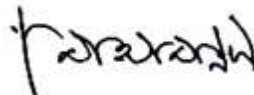
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## **Ethics Statement**

The entire work has been done with conscious ethical integrity in terms of legal standard, social, economic and ecological segment. The whole survey was done after getting the permissions of the residents of the railway slum area. Data collected through focus group discussion, questionnaire survey, photographic survey and observational survey has been carried out with permission from the respondents, making sure not to cause any inconvenience to the tenants during the whole process. Authority has been informed about the use of the information during key informant interview prior to data collection. The collected data has been analyzing properly without bias decision. All the participants of the survey have been kept anonymous. Any intellectual property used here has been mentioned with proper citation and credit.

## **Abstract**

Developing countries like Bangladesh frequently deal with various socio-economic challenges, especially urban poverty. Despite making an essential contribution to the national GDP, the urban poor population lacks proper housing, sanitation, safety, and security. Bangladesh's location and the shifting climate make it a hotbed for natural disasters. Furthermore, cyclonic storms, surges, sea level elevation, and saline encroachment exacerbate the housing predicament of urban impoverished communities, notably in coastal zones.

Being a city in the coastal zone, Khulna experiences the outsized impact of storm surges, cyclones, and coastal floods. These hazards cause a persistent waterlogging problem, especially in low-lying slum areas. The Railway slum area is one of the largest slums in Khulna, and it has been experiencing frequent and prolonged waterlogging problems. With their limited means and a trial-and-error process, the inhabitants of the Railway slum have learned and innovated to cope with the stagnant water. This research focused on two interrelated issues: the cause of waterlogging in the Railway slum and how the inhabitants cope with it. This case study-based research employs various methods to collect qualitative and quantitative data, including observation, photographic survey, key informant interview, household survey, and focused group discussion. Each method offers unique insights and perspectives that contribute to a comprehensive understanding of the subject under study. Triangulation was used to validate the findings. The results bring to light the causes of this prolonged waterlogging. The findings show the precautionary measures taken by the slum dwellers to reduce the impact of waterlogging conditions, as well as their coping strategies.

***Key words: coping strategies, coastal zone, stagnant water, precautionary measures, slum dwellers***

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# CHAPTER ONE

## Introduction

### 1.1 Background

Khulna is indeed a significant city in Bangladesh, known for its industrial and commercial activities. It covers 46 sq km. It was once a thriving industrial center, benefiting from its proximity to the Mongla seaport, located just 50 kilometers away. Situated on the banks of the Bhairab River, Khulna's topography slopes westward, in contrast to the regional slope, which is southward. The city's average land surface elevation is approximately 3.32 meters above Mean Sea Level (MSL) (Adhikari *et al.*, 2006). However, a significant part of low-lying Khulna lies below the Mean Sea Level. Khulna is known by a different mixture of lands, water, and natural resources, including the world's largest mangrove forests, renowned for their vast biodiversity of flora and fauna.

The economy of the city is mostly depending on trade and people from surrounding regions of southern Bangladesh has migrated here for better employment. The jute industry and shrimp farming are among the primary economic activities in the region. As a result, a larger number of trade laborers and industrial investors are found in Khulna. These large number of migrant laborers do not have any permanent residence. In most cases, they take shelter in the informal settlements like slums or squatters.

This study focuses on Khulna due to several factors, notably the high concentration of slums and the poor living conditions within them. These slums primarily emerged during the city's industrial expansion, and their current state is precarious. The total population of Khulna is 0.95 million (Worldpopulationreview.com 2023), with an annual growth rate of 4.13% (Alam *et al.*, 2013). Approximately 0.187 million people reside in the city's 520 slums (Islam and Uyeda, 2007). Most slum households are renters, paying lower rates than those in formal housing. Khulna's slum population accounts for 3.46% of Bangladesh's total.

## 1.2 Problem Statement

Khulna city, situated between three rivers -the Bhairab, Rupsha, and Mayur, and within the Ganges delta, faces annual challenges with waterlogging. The city's elevation is remarkably close to sea level, with some low-lying areas even dipping below the mean sea level. As a result, these areas are prone to regular tidal flooding and subsequent waterlogging. With an annual rainfall of 1710 mm, heavy monsoon rains frequently cause urban flooding, exacerbating the waterlogging issue. This problem is particularly acute in Khulna's slum areas, such as the densely populated Railway slum, where several zones remain waterlogged throughout the monsoon season, causing significant hardship for residents (source: <http://oldweb.lged.gov.bd>).

In the study area, most of the residents are impoverished, lacking skills or with low skills, and work for low wages in the informal sector. People with such limited means cannot afford adequate and resilient housing and arranging low-rent houses for the demographic groups, while keeping it economically lucrative makes the local land owners and political elites provide poorly built and insufficiently sized spaces. The overall indoor environment in these houses is not pleasant, healthy, or humane. In the slum area, there is insufficient space for air movement and sunlight penetration. The cleanliness of the house is also in bad shape. The environment of the slum area is so congested with enough lacking of livelihood resources. They use to manage their water supply from tube-wells which are not sufficient for all the dwellers. The lack of adequate sanitation in the slum is evident, with only one latrine with five chambers serving 45% of the housing. Most households dispose of waste indiscriminately, leading to widespread dirt and constant pollution in the environment. The polluted environment generates mosquitos in a large number and the slum dwellers suffer from it a lot. The entire area lacks proper drainage systems. Some individuals utilize the canal both as a drainage channel and for various purposes. However, this practice leads to waste accumulation and waterlogging in the slum area.

Following the first survey, the slum's residents informed us that during the monsoon season, excessive rainfall often leads to waterlogging in slum areas. This phenomenon typically persists for a maximum of two days. The narrow pathways within the slum become submerged, sometimes

reaching knee level, posing challenges to mobility. Prolonged waterlogging can even result in structural damage to the roads.

Additionally, the makeshift or semi-permanent dwellings in the slum, often constructed from rudimentary materials, are also adversely affected by the inundation.

This water stays for several hours, even sometimes for a day which hampers the furniture, cloths and sometimes damages the full houses of the dwellers. During the waterlogged situation, sometimes the dwellers can't go outside for work. As a result, during waterlogging condition sometimes they have to pass a day without food. Side by side during waterlogging situation the slum dwellers can't cook foods sometimes, when water stays in their kitchens. For this reason, they have to depend on dry foods only at that time. When the water stays in the roads of the slum the children of the slum can't go the school, which hampers their studies. The waterlogging zones spread bad smells all over the slum area and the waterlogging condition makes an unhealthy environment for the slum dwellers. Sometimes waterborne diseases occur in that environment.

The effects of waterlogging in Railway slum are devastating. The problems of waterlogging hamper social life, infrastructures and environment. On occasions, the waterlogging issue severely damages the dwellings of slum residents, necessitating costly and potentially unattainable rebuilding or repairs.

To minimize these adverse effects of waterlogging the main reasons of it have to be known. Insignificant research has been done before about waterlogging in this site but that can't give a clear concept about how the slum dwellers will cope with the situation. This study tries to find out what should be the coping strategies and this study also give a light on the main causes of it.

### **1.3 Objectives**

This study's overarching objective is to advance our understanding of the origins, effects, and immediate and long-term remedies of waterlogging. Here are some more case-specific goals:

- To identify the waterlogging causes and its hazardous impacts on slum dwellers of railway slum area
- To analyse the mitigation measures adopted by the slum dwellers to reduce the impact of waterlogging
- To document and evaluate the coping strategies of slum dwellers to survive the waterlogged condition.
- Formulating a few suggestions to improve the situation based on survey findings

## 1.4 The Study Area

### 1.4.1 Area map

The study area is situated in 21 no. ward of Khulna metropolitan area which has been marked with orange color in the following map:

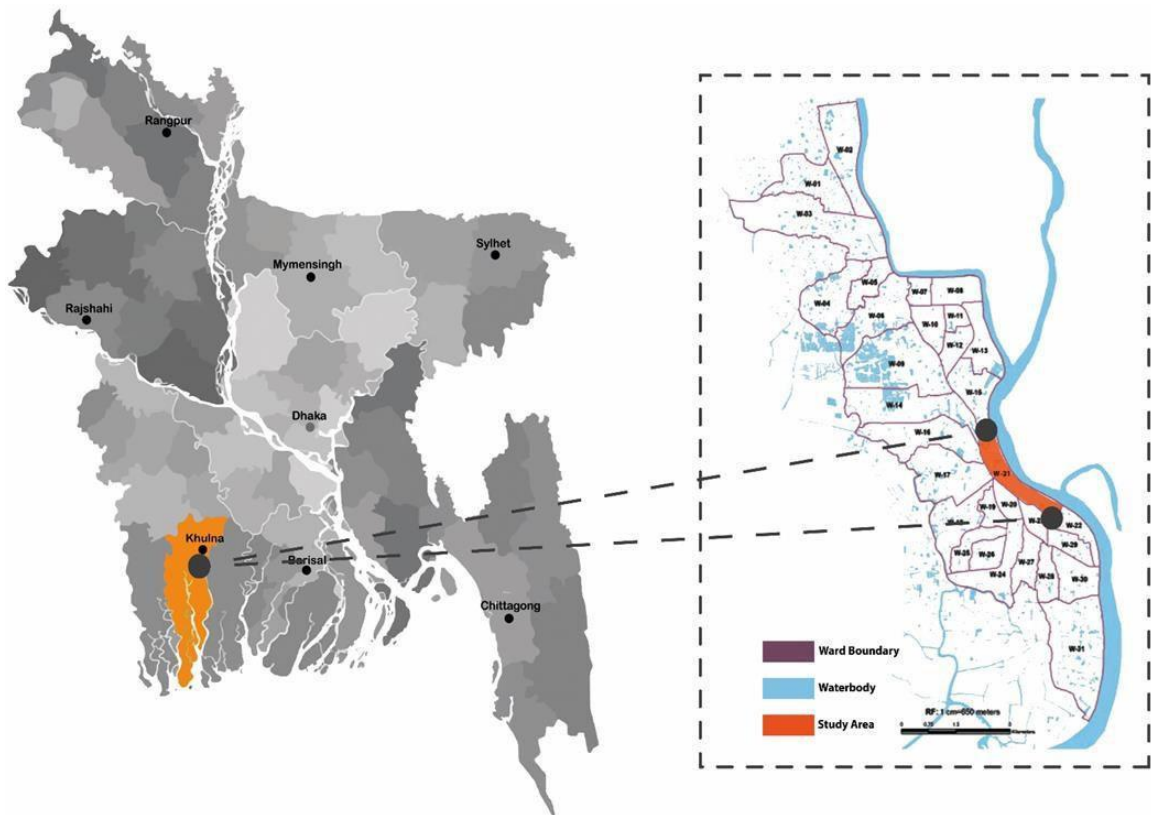


Figure 1: Khulna district and the Study area location

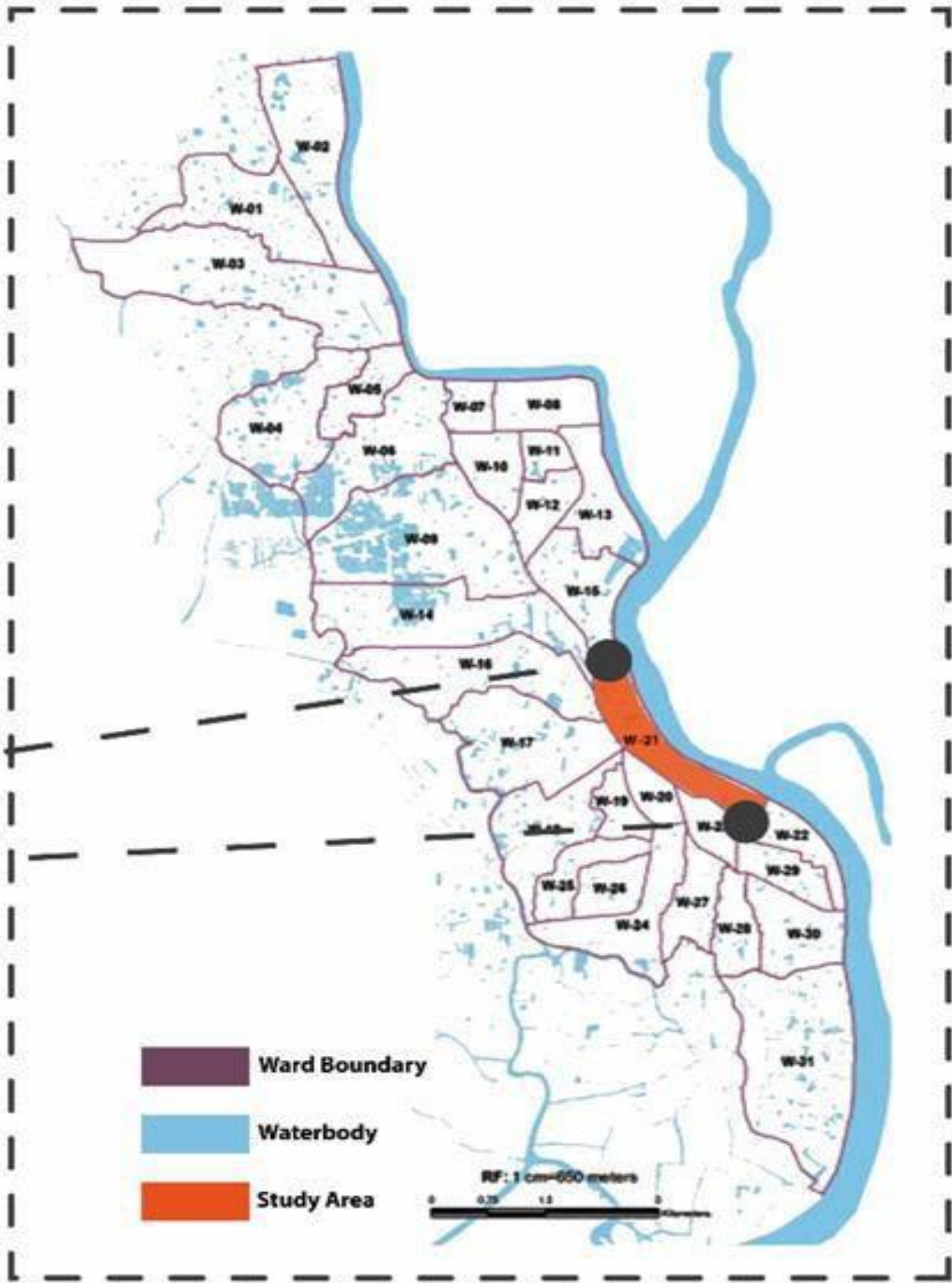
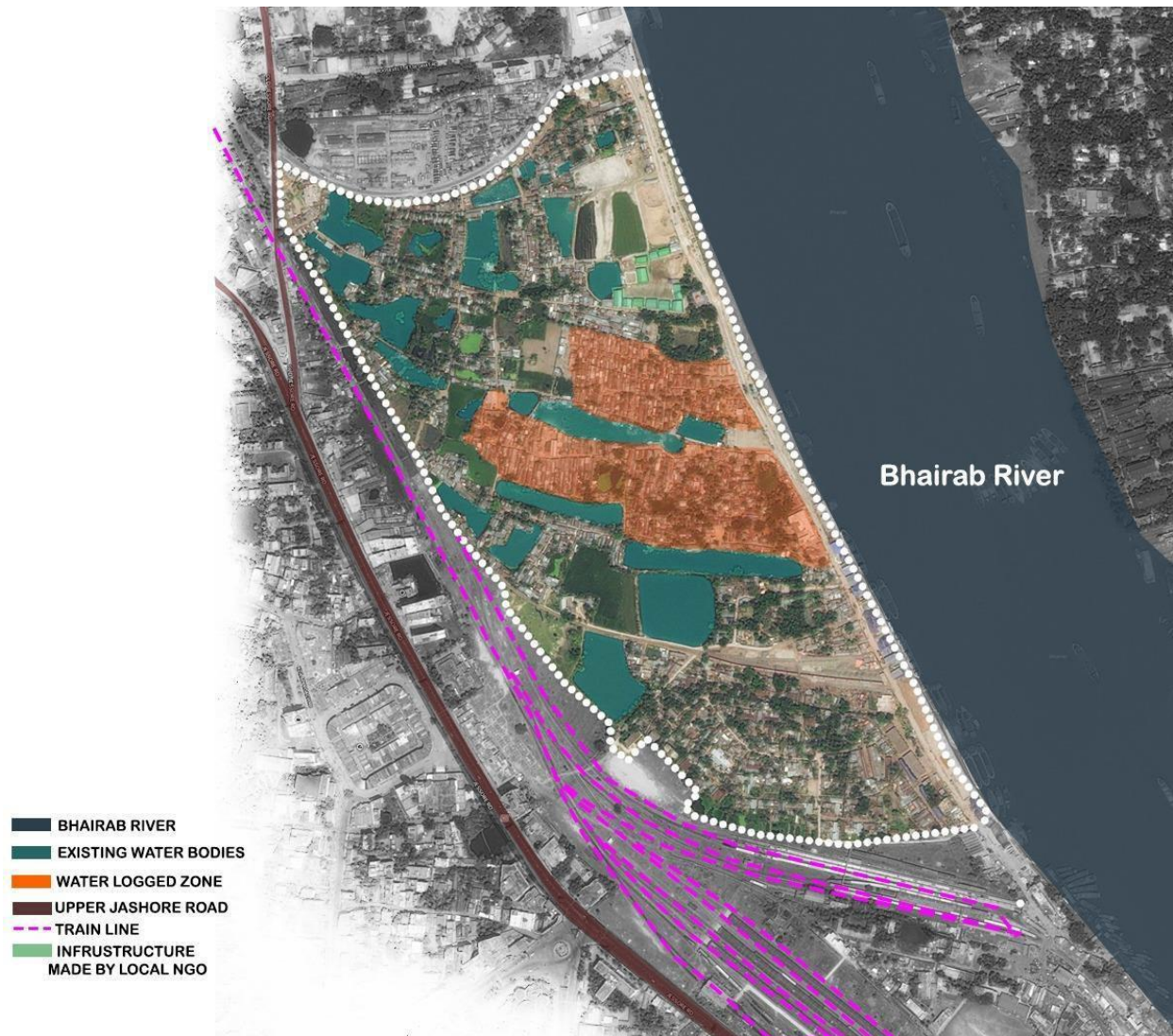


Figure 2: The Study area





**Figure 3:** Waterlogging zone and surroundings of Khulna railway slum area

### 1.4.2 Selection of study area and its rationale

The Railway slum area is one of the most densely populated slums of Khulna. Railway slum has been chosen as study area because during the whole monsoon period several zones of the Railway slum area remain as waterlogged zones causing major sufferings. Here insignificant research has been done on this site regarding waterlogging and its impact. Moreover, some valuable lessons can be learnt from this site which can contribute to our overall knowledge about how to deal with waterlogging.

### **1.4.3 Background of railway slum**

Among the slums in Khulna the railway is the biggest one. Bangladesh Railway Administration owns the slum's land, and the region is under Khulna City Corporation's administrative ward number 21. Before residents moved into this impoverished region in 2001 (Khulna City Corporation 2012), a well-known criminal bearing Ershad Shikder's name had gained control of the area. Later the authorities of Khulna City Corporation began keeping an eye on the region in 2003. Some NGOs like BRAC, CDC etc., and an international organization UNDP used to work there to help slum dwellers get a better living environment. Almost 4500 families are living in the railway slum area and KCC has divided the slum area into 6 blocks for managing the slum dwellers living space properly. As the slum area is informally situated over Governmental land so slum dwellers don't pay any home rent. Poor people of rural areas use to migrate in cities in search of income sources and they used to live informally in slum areas. So, the people who migrate to Khulna city for labor jobs or any other low incoming occupation choose mostly railway slum area to reside in because there they do need not to pay any rent which helps them to manage their family expenses well.

### **1.4.4 Demography of the dwellers of railway slum**

Most of the dwellers of the railway slum area are poor. Various kinds of professional people live in slum areas. Many of them are employed as day laborers, some are rickshaw pullers and some are small grocery shopkeepers. For their poor incoming condition, they struggle to manage their family expenses and many of them try to involve their children in various kinds of child labor activities. In the railway slum area, most inhabitants are illiterate, leading to low interest in their children's education. Consequently, many children in the Railway slum are unschooled, despite two nearby primary schools that few families utilize for elementary education. Due to educational lack many children in the slum area are implicated in various crimes and also get involved in drug addiction usually. As slum dwellers manage their family expenses with their few incomes, they can't manage better sanitation, water supply, housing, etc. in the slum area. Therefore, they are always in need of Governmental or Nongovernmental organizational assistance.

The socioeconomic condition of dwellers living in the slum area are shown in the table below:

Ownership	Occupation	Years of Living	Income range	House type
Building owner	Railway stuff (Rtd.) Or present	45-50	12000-15000	Pacca
Tenant	Driver, daily labor, night guard, rickshaw puller, small business owner, etc.	20-35	5000-12000	Semi-Pacca, kacha
Temporary Dwellers	Rickshaw puller, house keeper, beggar, small business owner	5-8	2500-5000	Temporary, kacha

Table 1: Socioeconomic condition of slum people (source: household survey)

Based on the table data, slum residents fall into three categories based on housing and income. Some, notably railway employees, live permanently in their own homes, averaging 45-50 years of residence. They earn 12,000 to 15,000 Taka monthly. Railway employees alone have been allowed to inhabit these permanent houses and can rent them out for extra income.

Secondly, some other people are living in the slum area who pay rent for the use of the semi-pacca or kacha buildings. Their income level is not so high. They are driver, daily laborers, night guards, rickshaw pullers, small businesses, etc. They are living here for 20-35 years maximum. On the other hand, there are some people who are living in the slum area temporarily. Most of them are rickshaw pullers, beggars, and housekeepers. Actually, they are very poor. With their insufficient income, they cannot rent houses with proper living conditions. Economic vulnerability prevents them from building pacca houses. Makeshift kaccha houses with a short life span are the only answers for them. These houses provide unhealthy and inadequate living conditions.

## CHAPTER TWO Literature Review

Waterlogging can be a result of natural factors as well as man-made activities. Waterlogging indeed poses numerous challenges to daily life in urban areas. It disrupts transportation, damages infrastructures, increases the risk of waterborne diseases and can even lead to property damage. (Atauzzaman *et al.*, 2019). The reasons of waterlogging have importance for financial development as well as for differentiate the arrangement of difficult situations of the waterlogged territory. (Hasan *et al.*, 2018)

However, urban waterlogging problems are closely related to human activities in most cases. Waterlogging occurs when the soil becomes saturated with water. When the water table rises to the point that the pores in the soil become saturated, the area is deemed to be waterlogged. (Awal *et al.*, 2014). Among several types of waterlogging urban populations commonly face seasonal waterlogging, perennial waterlogging, & sub-soil waterlogging. Waterlogging in metropolitan areas is frequently caused by poorly maintained drainage systems, clogged pipelines, and inadequate rainfall management (Ning *et al.*, 2017). High-intensity rainfall also causes floods, which is called rainfall-induced waterlogging. The absence of an adequate drainage system and improper management are the primary causes of runoff in the city (Mowla and Islam, 2013). In our country poverty is a common issue.

Urban poverty refers to economic and social challenges in industrialized cities, stemming from factors like rising living standards, increasing individualism, social fragmentation, and segmented labor markets, resulting in social division. In cities, poor people mostly live in slum areas. A slum is an overcrowded urban area characterized by substandard housing. These areas typically lack adequate infrastructure and are predominantly inhabited by socioeconomically disadvantaged individuals. (Cave, 2006). Many residents in these slums play a crucial role as daily laborers in the RMG sector and other industries, providing essential services for the nation. Due to the informal nature of these settlements, people typically live in unplanned houses, leading to a polluted environment as a result of insufficient infrastructure and maintenance.

Coping capacity is the ability of individuals, organizations, and systems to effectively deal with adverse conditions, risks, or disasters using their existing skills and resources. It involves the ability to respond to challenges and mitigate their impacts through the use of available capabilities. Slum dwellers often raise their houses to a certain height above the ground to protect them from waterlogging, and they construct bamboo walkways over waterlogged areas for passage.

A slum is an overcrowded area where the housing patterns are low standard. Here lifestyle is unhealthy, at the same time lives are unsafe (R.Harris, 2009). It can also be described as a locality with substandard buildings in a state of disrepair, an environment degraded by unsanitary conditions, and lacking basic amenities like electricity, clean water, drainage, schools, healthcare, and recreational areas. (A. Olotuah, 2012).

A slum is delineated by the absence of critical indicators, including availability of fresh water, proper sanitation, enough living space, proper housing pattern, a suitable location, and protection of life (Turkstra and Raithelhuber, 2004). Slums are classified as either notified or not notified. Notified slums are formally recognized by municipal, corporate, or local governments, whereas non-notified slums are densely inhabited regions with substandard housing and inadequate infrastructure, often containing at least 300 people or 60-70 homes (Arif, 2015). In 2018, it was known that in Bangladesh about 47.2 percent of the urban people were living in the slums. Under 71 percent of urban population was living in the slums of Bangladesh. This amount was decreased from 2005 (Statista Research Department, 2021). In Bangladesh, it is commonly believed that a large proportion of rural poor migrate to divisional cities for work and other reasons, leading to the proliferation of slums.

Coping techniques are behavioral and cognitive approaches used to manage crises, situations, and demands that are deemed upsetting (D. Carr, 2007) while another author explained that specific coping strategies are divided into coping subtypes. Basically, solving the problems, gathering information, basic emotional expressions, distractions, avoidance, wishful thinking, acceptance, need of social support are the examples of common subtypes (Huesmann et al., 2011). Any waterlogging condition is such a disastrous event that making people living with a strategy to cope with hazard-related stress. Different types of coping strategies were found from several studies,

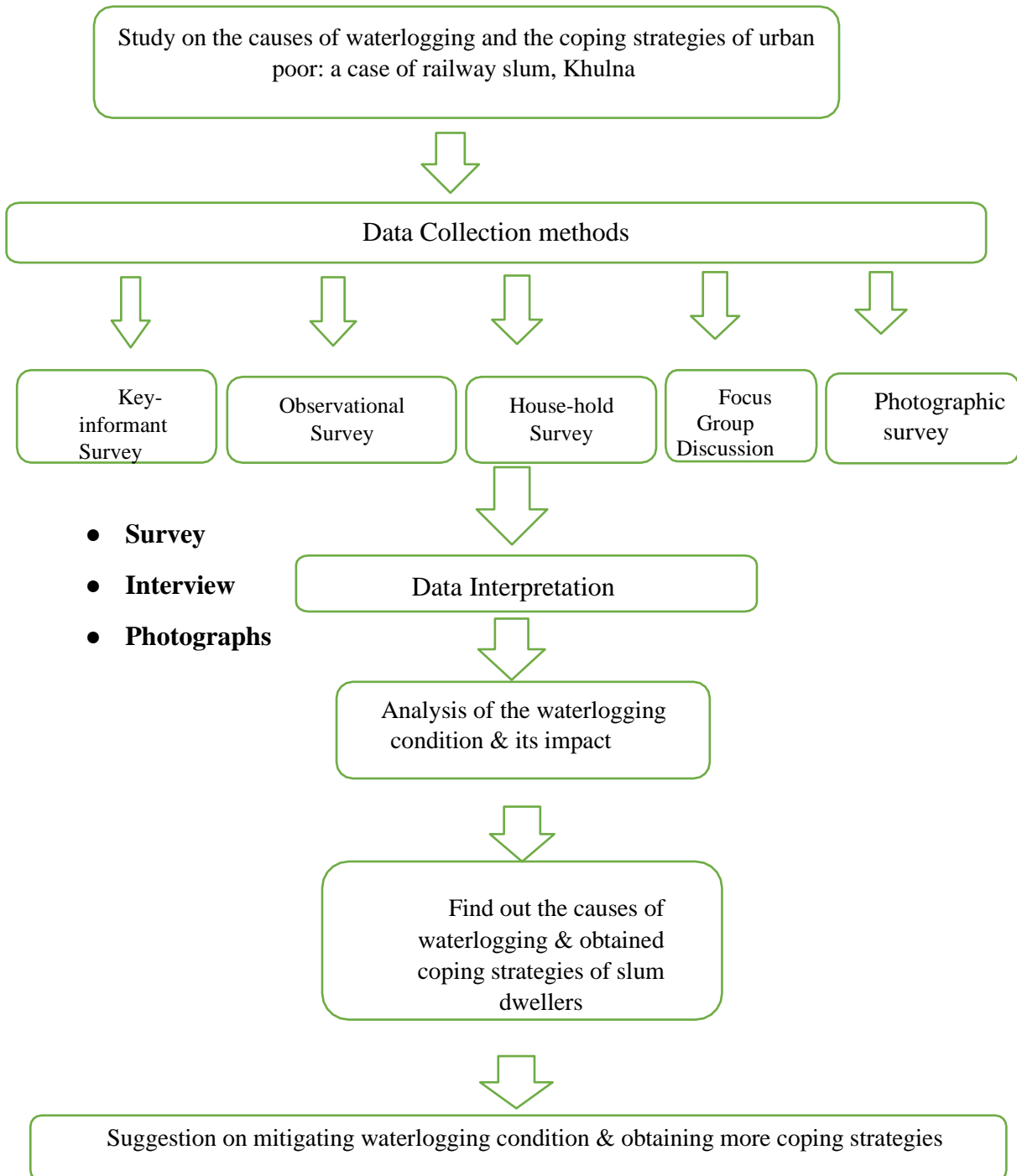
like structural changes, food adjustment, diversification of livelihoods, banking or savings, migration, sale of goods to manage the waterlogging condition (Md. Moniruzzaman et al., 2018). During any disastrous event, adaptation is also an important procedure to obtain. A study defined itself as Adaptation is the process of changing a system's behavior and attributes to make it more resilient to external shocks.

Another research describes adaptation as the process or ability of an individual or socio-ecological system to enhance their underlying genetic or behavioral features to better deal with change, which is frequently accomplished through social learning (Wang, J et al., 2014). Though adaptation and coping strategy have similarities in obtaining process it differs from each other because coping is a technical response within a short period of time against an impact which is already experienced (Pradhan et al., 2012).

Here coping strategy is oriented towards survival and prompted by a lack of alternatives while adaptation is oriented towards longer-term livelihood security and focused on finding opportunities (Angie, 2009). Adaptation strategies are “more proactive” because they are used for avoiding to turn out natural hazards into disasters. But coping strategy is not any less important because of the provision of essential medicines, food, water, primary treatment and water to help people cope with the hazard.

## CHAPTER THREE Methodology

**3.1 Research Design:** A research design has been prepared for this study, which is:



## **3.2 Data Collection**

This study heavily draws on a qualitative research protocol. The entire study has been carried out using a systematic, step-by-step procedure in order to achieve the goal of the investigation. The investigation was done by using primary and secondary data at the same time. The questionnaire of this study mainly covered two topics: the family status of the slum dwellers and waterlogging status which is set on the causes of waterlogging and the slum dwellers' coping strategies. A qualitative household interview was conducted with the questionnaire to know how slum dwellers act on facing waterlogging conditions. Purposive sampling has been used in this data collection process which has been described below:

### **3.2.1 Observational Survey:**

Observational survey was used to gather initial information on the slum dwellers' lifestyle. Household daily needs, time schedule, work and recreational habits, settlement pattern, etc. were observed and recorded.

### **3.2.2 Photographic Survey:**

Photographs of the slum area has been captured twice. At first the photographs have been taken during the waterlogged condition then again photographs have been taken during the absence of waterlogged condition. Also, the whole slum area has been captured from a nearby rooftop. These photographs helped in detecting waterlogging zones of the slum area.





**Figure 4:** Railway Slum Area, Khulna (study area part)

### **3.2.3 Key-informant interview:**

Railway slum is controlled by Khulna City Corporation and assisted by some international organization and NGOs like UNDP, BRAC, CDC etc. In this area, the key informants are ABIRUL JABBAR, in charge officer of KCC (Address: KCC Officer's quarter), NAZRUL ISLAM, NGO manager (Address: Karitas Regional office, Khulna), RANA SIKDER, community leader (Address: Railway Colony, Khulna), TAPAN and GAZI SUKUR ALI, night guard (Address: Railway Colony, Khulna), shopkeeper (AKBAR ALI, Address: Beside Railway Slum) and some business owners (Mr. Hafiz and Mr. Ibrahim). They are chosen as key informant because they are the important persons of this area and have knowledge about the community. Statistical and maintenance data of the slum area have been collected by interviewing the key informants. All the data from these key informants were collected through a questionnaire.

### 3.2.4 House-hold Survey:

It has been known from key-informant survey and observational survey that Block B of railway slum area is the most affected area by waterlogging events so block B has been chosen for conducting the survey. There are all around 140 houses in block B. Actually, this is an academic thesis and the time schedule of the thesis is not so long hence it becomes tough to survey all the houses of block B. so that purposive sampling method was used for this survey. block B has been divided into 3 zones and 10 houses from each zone has been selected to do purposive sampling. A questionnaire was used for collecting data from the selected houses. The questions from the questionnaire were asked to one or two persons from the ten houses of the selected zones randomly. The questions had two parts, one part was used to know the family life, social status, occupations of the dwellers. The other part was used to know about the water logging conditions (time, reasons, effects, duration of waterlogging).

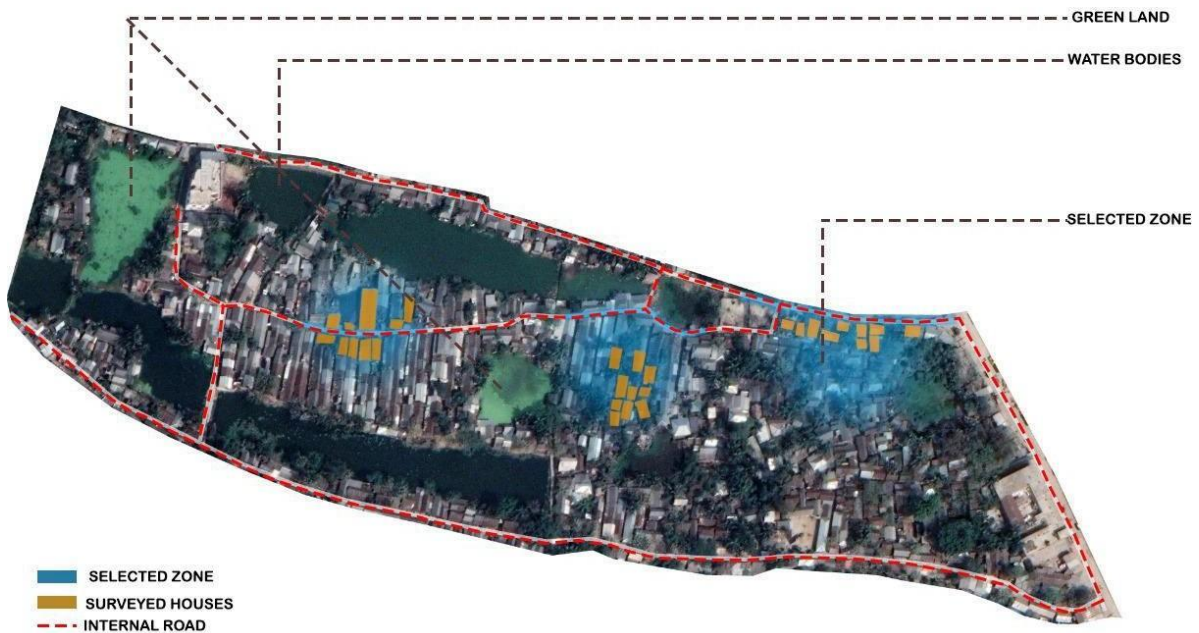


Figure 5: Selected household zone in block B for purposive sampling method.

### 3.2.5 Focus Group Discussion (FGD):

Due to unavoidable societal problems, two groups have been made to conduct the interview where one is made of 6 male members and another one is made of 6 female members. Societal condition of the slum area & management of the community during any waterlogging event have been

understood by focus group discussion. Both groups have been selected by taking single or couple of numbers of male slum dwellers & female slum dwellers from the adjacent area of block B and rail lines, from the adjacent area of block B near by the river bank and also from the adjacent houses near water-bodies inside block B. now the FGD group Sampling equation has given below:

Purposive sampling areas	Male slum dwellers	Female slum dwellers
1. Adjacent housing area along with the rail lines	3	2
2. Adjacent housing area along with the river bank	2	3
3. Adjacent housing area along with the waterbodies inside the block B	1	1

**Table 2:** FGD groups sampling

### 3.3 Triangulation

The collected data using various methods was compared with each other to validate the finding. Most of the findings are established by verification through triangulation. For example, some of the causes of waterlogging stated in the key informant interview were agreed upon in the focus group discussion. Similar issues were mentioned in the household survey as well. Observation and the photographic survey were also aligned with the interview findings. However, using various research methods has also generated some unique findings, which can give us further insight into the questions at hand.

### **3.4 Scope and Limitation of the study**

This study is important to find out the main reasons behind waterlogging in the railway slum area but there have been some limitations. As an academic exercise, the research has its financial shortcomings. Moreover, the limitation of survey time made it unrealistic to survey a larger sample size which would have provided a more representative picture of the ground reality. The survey had to be limited to households.

This study represents the first comprehensive investigation conducted in the railway slum region regarding waterlogging. Consequently, the findings are expected to provide valuable insights for policymakers and slum residents, offering guidance on effective strategies for managing and mitigating the impacts of waterlogging.



## CHAPTER FOUR Survey and Analysis

### 4.1 Family Structure & Socio-economic condition of slum dwellers:

Slum-dwellers are mostly poor in the railway slum area. Houses of the slum area are primarily of two types, most of the houses are katcha, and a few are semi-pacca. Each family has 4-5 members on an average, where mostly one male member works and earns for the family. The earning members of the families are involved in various professions like day laborer, rickshaw pullers, easy-bike drivers, and also some are shopkeepers. The range of monthly expenditure of these families are within 5000 to 10000 taka and for this, they have to undergo immense hardship. Average number of children of these families is two. Very few children of the slum area go to school & some children are involved in child labor activities.



Figure 6: Unplanned housing of railway slum area

## **4.2 The Survey**

Being a very large area, the Railway slum is divided into several blocks. Among these, block B is most waterlogging affected as per observation and pilot survey. Due to the time and resource limitation, the survey is focused in block B to ensure most relevant data and findings. The initial observation and pilot survey helped decide on the survey strategy and methods used.

**4.2.1 Observational Survey:** By this process, data was collected through observing. In this process slum dweller's lifestyle, their working pattern, time schedule, habits, housing pattern etc. were observed. These all were noticed at the time of walking through roads of block 'B' of the slum. At that time, it was observed that, the slum dwellers had low income and most of them were illiterate. Moreover, the unplanned housing pattern, the poor drainage system, unplanned work management, unplanned garbage heaps were observed. It was clearly noticed that the slum dwellers built their houses in an unplanned way which covered the natural drain lines. At the same time, it was noticed that the natural drains were also covered with solid waste and garbage. It was clearly known by the survey that water was logged because of the poor drainage system which was mostly covered with garbage. As a result, water couldn't pass throughout the narrow line, which was responsible for waterlogging.

**4.2.2 Photographic Survey:** Photographs were taken in two different times. Some photographs were taken at the time of walking throughout the roads of block 'B' of the slum area. Some pictures were taken from a large building beside the slum area. Whole surveyed area was visible from that surrounding multi-storied buildings. In these pictures the unplanned housing of railway slum area, the poor drainage system, unplanned garbage heap was clearly visible. In the pictures it was noticed that in rainy season the water couldn't pass through the drain lines. Because the slum dwellers through waste and garbage into the drainage.

The katcha and semi-pacca houses of the slum dwellers were clearly noticeable in the pictures which cover most of the natural drainage. So, this housing pattern is one of the main reasons of waterlogged situation in the slum area. Above all the miserable life of slum dwellers during the water logging period was clearly visible in the pictures, which was taken during the waterlogged condition in monsoon for heavy rainfall. Some pictures are given below:



**A:** Condition of roads during waterlogging



**B:** Poor drainage system of the slum



**C:** Full view of the Railway slum



**D:** Unplanned garbage heap

**Figure 7:** Collected Photos during Photographical Survey

From figure 7A, the devastating condition of the roads of the slum during waterlogging condition is observed. During waterlogging condition, the roads of the slum go under knee water which sometimes remains for whole day. At that situation it is quite impossible for the slum dwellers to go outside for their works. The houses of the dwellers are directly connected with the roads. So that the water must be flooded their houses surely which is very painful for them.

From figure 7B, the poor drainage system beside the houses of block B of the Railway slum is noticed. The unplanned housing pattern of the slum dwellers covered the natural drainage system. The drains are filled up with garbage and solid wastes which is clearly seen in the picture. Side by side it is clearly noticed from the picture that, the drainage line is too narrow to pass the extreme water flow. Moreover, the picture of figure B also showing the poor condition of the drain lines of block B.



Figure 7C represents the full view of the Railway slum. This picture has been taken during the absence of waterlogged condition. This picture is giving a clear idea of the whole Railway slum. This photograph is taken from a nearby rooftop of the Railway slum. The rail line, infrastructures, roads, green lands, water bodies as well as everything is clearly visible from figure 7C.

Figure 7D shows the condition of the green lands beside the houses of the slum. In this picture the waste materials are gathered in the field which can go to the nearby drain lines and can create blockage of them. From this picture it is clearly observed that there is a lacking of planned garbage heap in the slum area. As a result, the slum dwellers are throwing waste materials here and there in the slum.

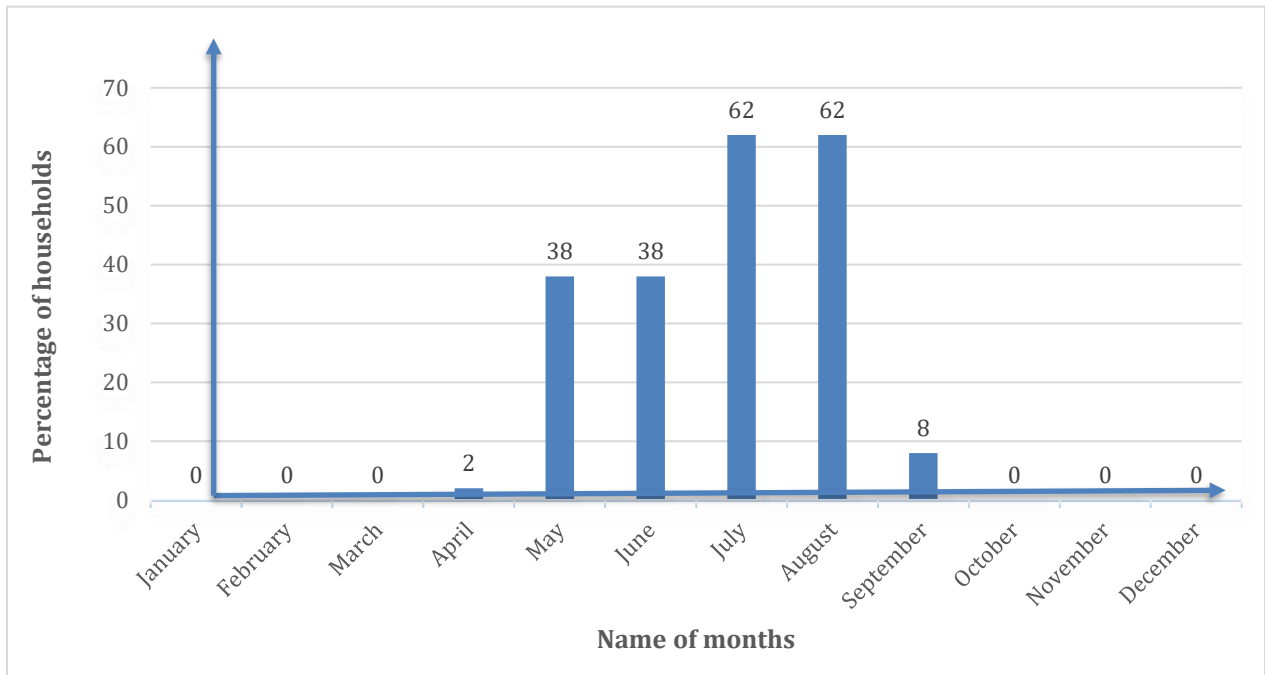
**4.2.3 Key informant interview:** In this area the key informants are ABIRUL JABBAR, who is the in-charge officer of KCC, NAZRUL ISLAM, the NGO manager, RANA SIKDER, who is a community leader, Mr. TAPAN and GAZI SUKUR ALI, the night guards, AKBAR ALI, a shopkeeper, Mr. Hafiz and Mr. Ibrahim, who are business owners. They are included as key informants because they are the important persons of this area and they have knowledge about the community and they have long experience in the slum area. Firstly, the statistical data were collected from the acting body of KCC and the NGO managers who are monitoring the slum area. It was confirmed by the key informants that block 'B' of the railway slum area is the most affected area by waterlogging events. From the statistical data of KCC, it was found that waterlogging occurs mainly in rainy season and it sustained for maximum two days. The other key informants (Shopkeeper, night guards) it was found that, the main causes for waterlogging in this area were heavy rainfall, poor drainage system, and unplanned settlement. The business owners and the NGO managers also agreed with this. The unplanned housing patterns covered the natural drainage which was confirmed by the NGO manager of BRAC.

**4.2.4 Household Survey:** There are 140 houses in block 'B'. Block 'B' has been divided in zones and 10 houses from each zone has been selected to do purposive sampling. One or two persons were interviewed from each house and the socio-economic condition, life style of the slum dwellers etc. were observed. Most of the slum dwellers are employed as day laborers, some are rickshaw pullers and some are small grocery shopkeepers. Some railway employees are living in



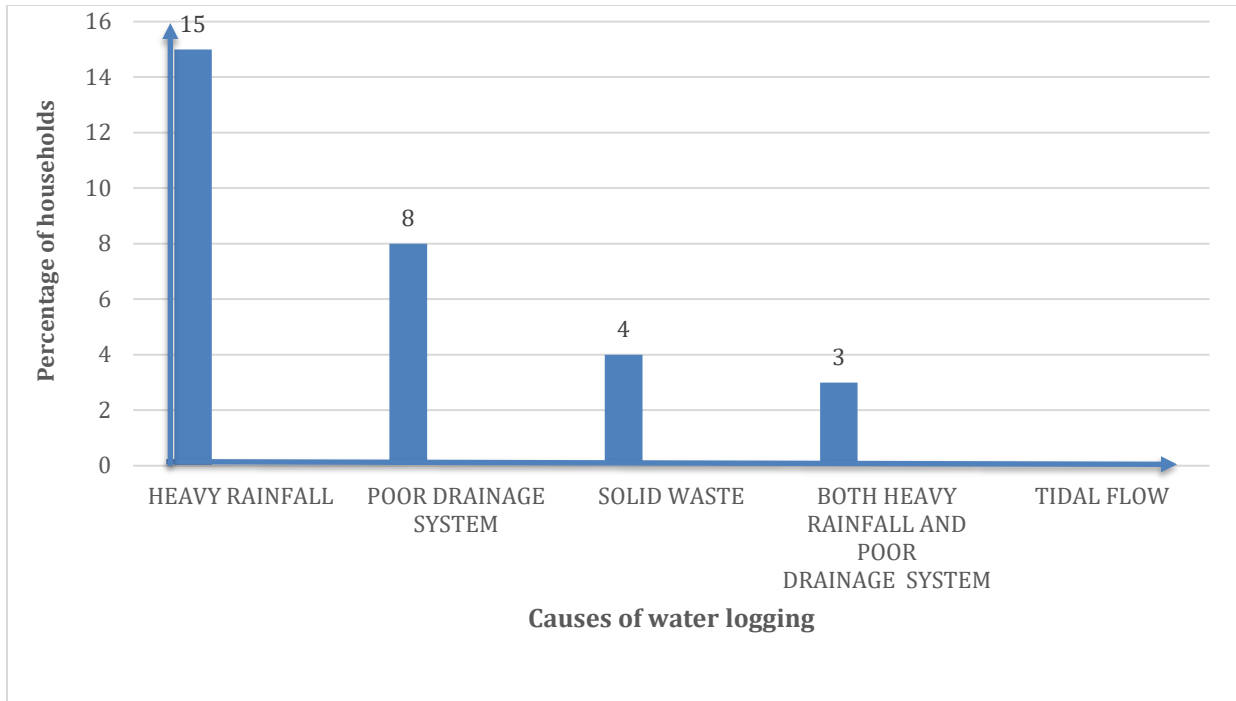
the slum area permanently. On the other hand, some people are living in the slum area who pay rent for using houses. Side by side, some other people are living here temporarily. Basically, they are very poor and they can't afford to rent a house for them. The questions were asked in total of 30 houses for completing this survey. During household survey, different answers of several questions are found. It indicates the capstone experiences of the slum dwellers about waterlogging conditions there. After asking about the duration of waterlogging approximately 62% slum dwellers answered that waterlogging occurs mostly in July/august & approximately 38% slum dwellers answered that waterlogging occurs in May/June.

Among all the surveyed persons, an ignorable number of people took the name of other seasons like September and April. (Figure 8)



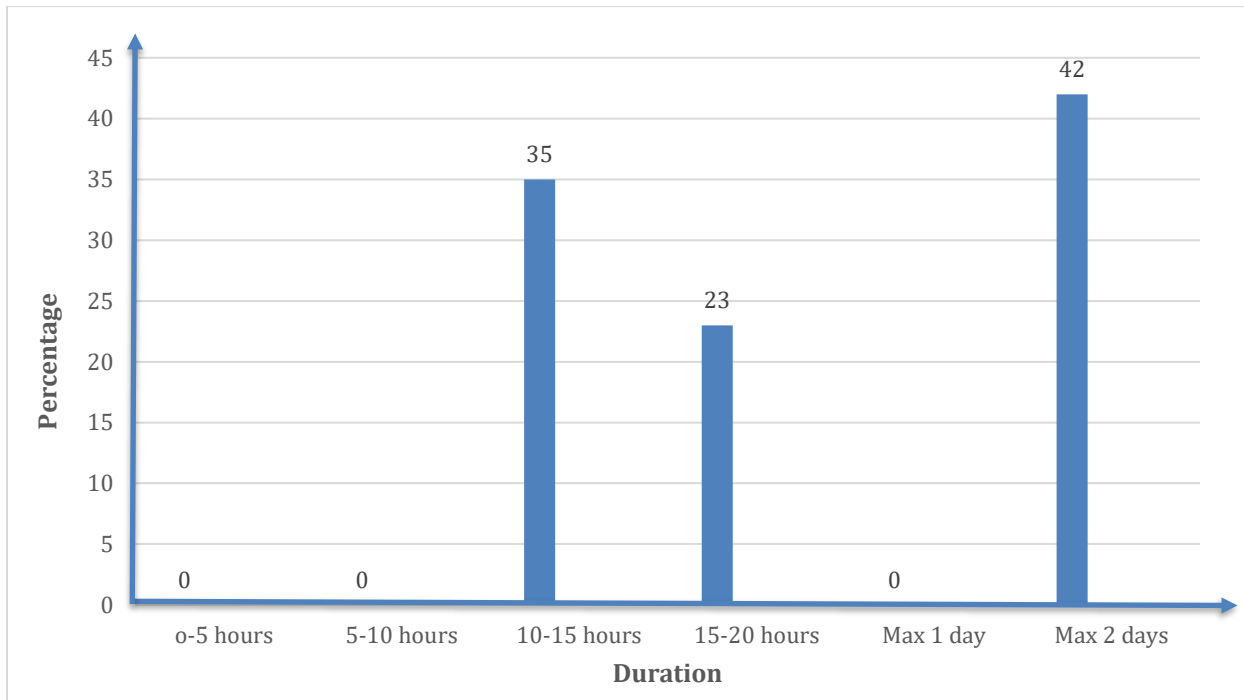
**Figure 8:** Period of water logging

During the survey main reason behind the waterlogging was known from the slum dwellers. Heavy rainfall was cited as the main cause of waterlogging by 15% of slum dwellers, while approximately 8% attributed it to poor drainage systems. Additionally, 4% of slum dwellers identified solid waste and garbage as contributing factors. However, only 3% of dwellers claimed both heavy rainfall and poor drainage system as the main reasons behind waterlogging. No one marked tidal flow as a cause behind the waterlogging situation at the survey time. (Figure 9)



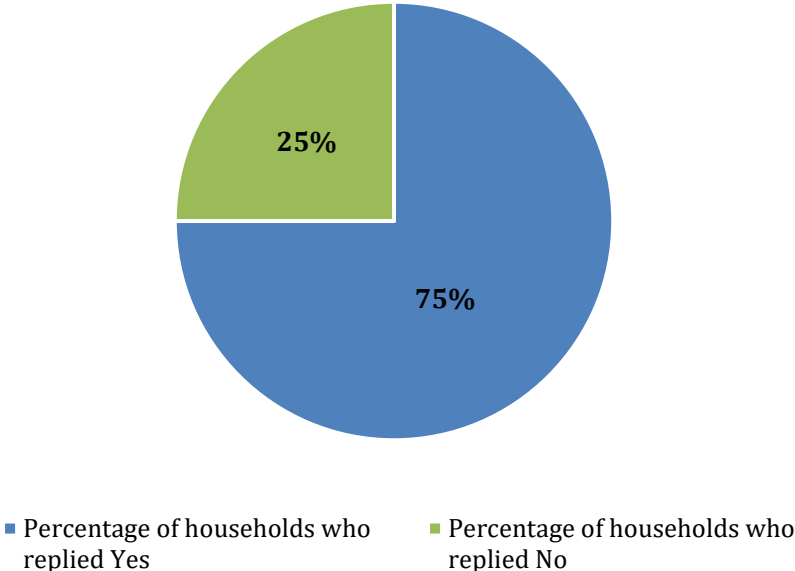
**Figure 9:** Causes of water logging

It was known by approximately 35% slum dwellers that the waterlogging condition remains for 10-15 hours and from approximate 23% slum dwellers that waterlogging condition remains for 15- 20 hours. Above all, the waterlogging condition remains for 2 days maximum as agreed by 42% dwellers. (Figure 10)



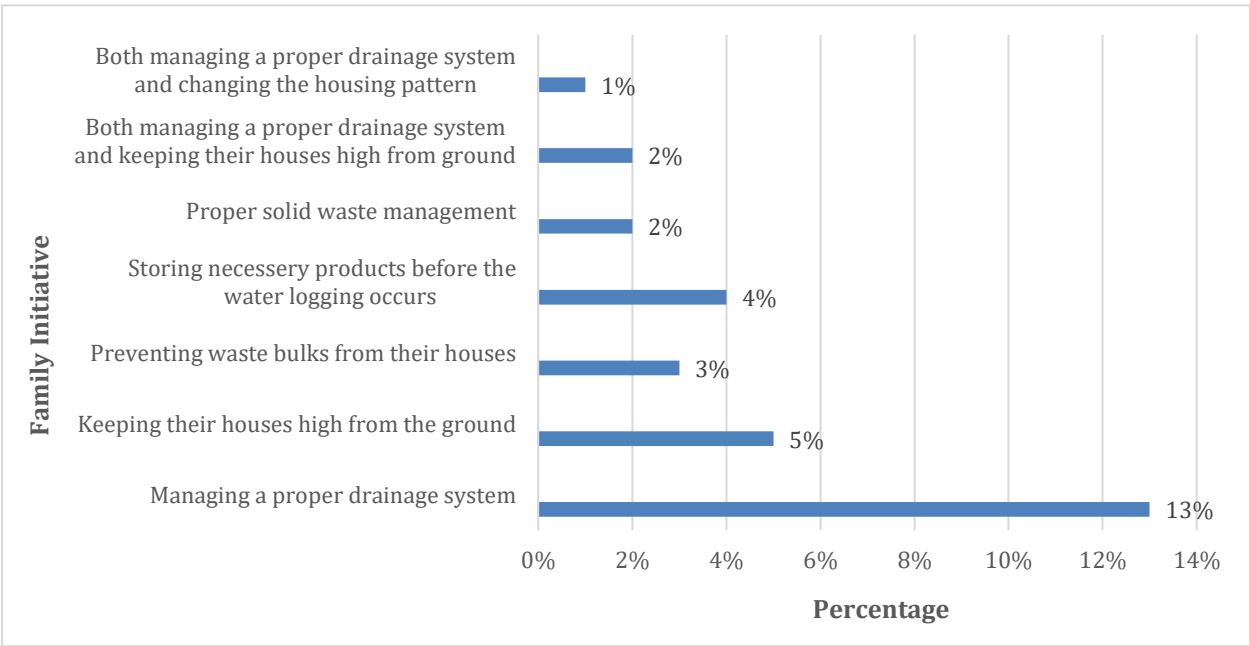
**Figure 10:** Duration of water logging

After asking if the waterlogging condition do harms to their residence or not, approximately 75% slum dwellers answered yes and approximately 25% slum dwellers answered no. (Figure 11)



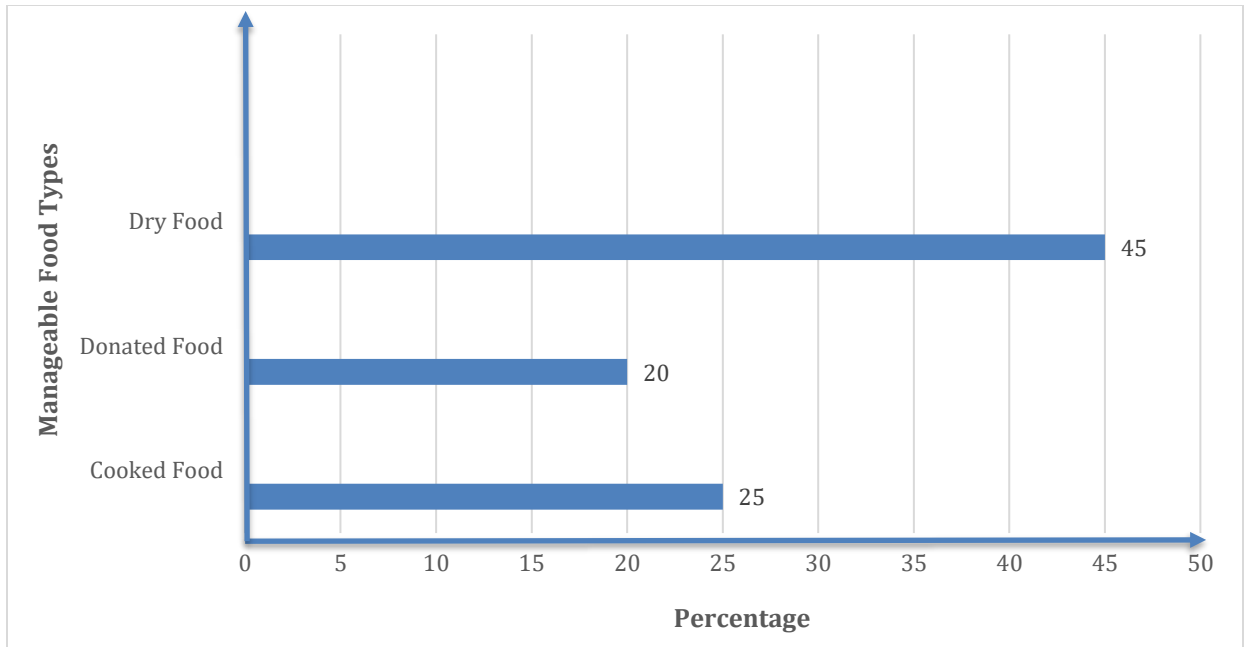
**Figure 11:** Harm of residence due to water logging crisis

Many data were found about waterlogging’s impact during the household survey, approximately 13% slum dwellers said that “managing a proper drainage system” would be their initiative step whereas approximately 5% slum dwellers said that “keeping their houses high from the ground” would be better initiative to reduce the waterlogging’s impact. Here 3% of slum dwellers answered that preventing waste bulks from their houses as their initiative and also 4% of slum dwellers answered that storing necessary products before the waterlogging occurs as their initiative. Side by side 2% people replied that solid waste management is a great action to prevent the waterlogged condition. But both managing a proper drainage system and keeping houses high from the ground were answered by 2% dwellers. Lastly only 1% dwellers replied both managing a proper drainage system and changing housing patterns in the slum area could be the useful measures. (Figure 12)



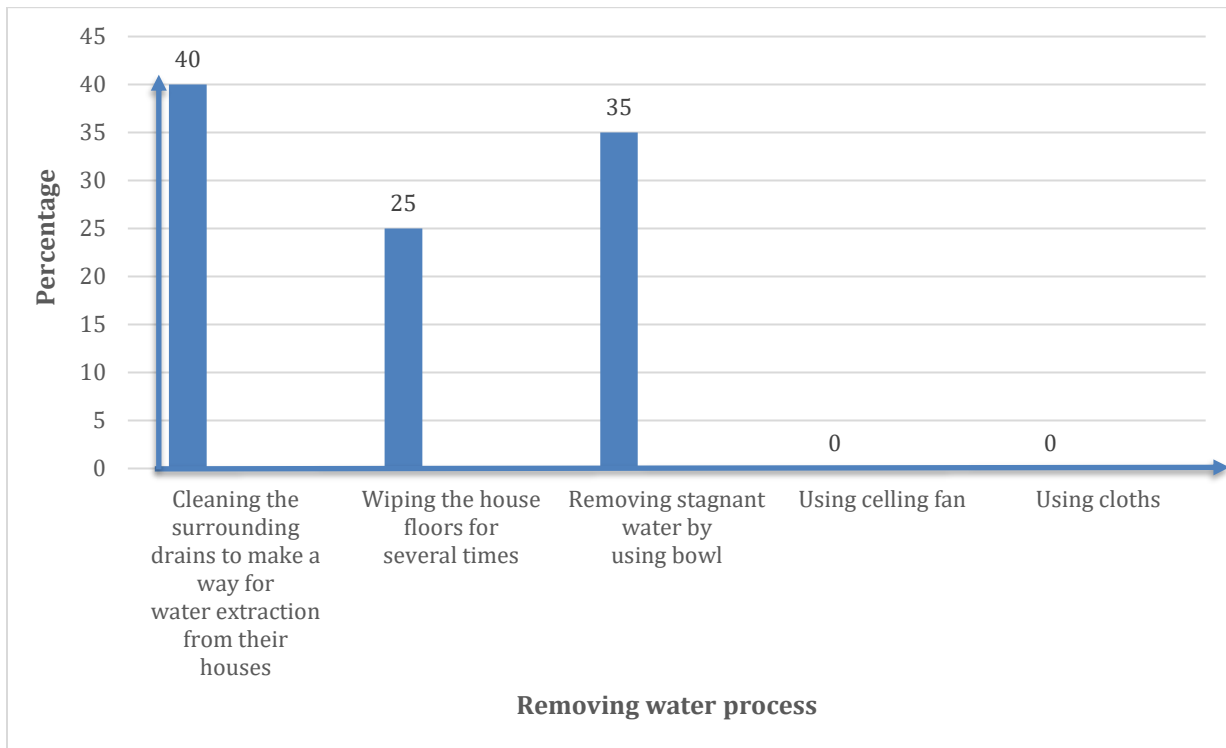
**Figure 12:** Family initiative to reduce the waterlogging’s impact

After asking the slum dwellers about which kind of food is manageable during the waterlogging period, approximately 25% of slum dwellers answered that they can manage “cooked food”, 20% of slum dwellers answered that they receive “donated food” & approximately 45% of slum dwellers answered that they manage “dry food” during the waterlogging period. (Figure 13)



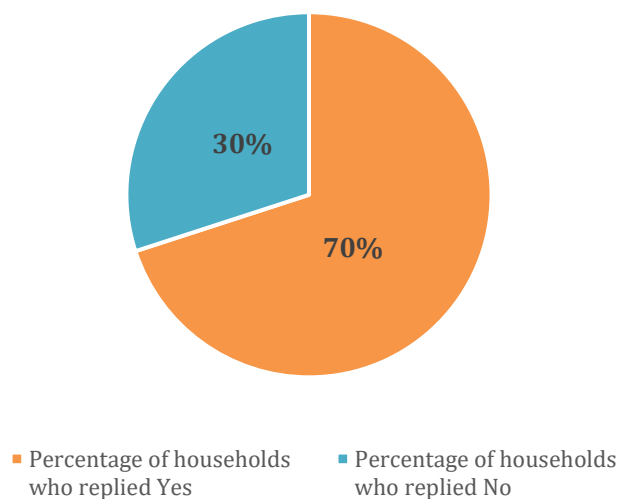
**Figure 13:** Slum dwellers' manageable food during waterlogging period

It was also asked to the slum dwellers that how they manage the water extraction from their houses, approximately 40% of slum dwellers answered that cleaning the surrounding drains of their houses to make a way for water extraction, 25% of slum dwellers answered that wiping their houses for several times to extract the fixate water from their houses & approximately 35% of slum dwellers answered that irrigating the fixate water from their houses by using bowl. (Figure 14)



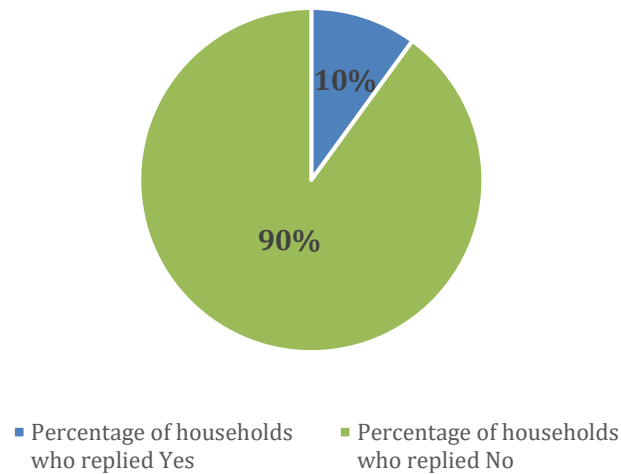
**Figure 14:** Removal of water during water logging period

It was asked to the slum dwellers that, do they receive any governmental help or donation during the waterlogging or not, approximately 70% slum dwellers answered yes and approximately 30% slum dwellers answered (figure 15)



**Figure 15:** Governmental help or donation during waterlogging period

Again, it was known from the slum dwellers during household survey that very few of the slum dwellers are assisted by the NGOs during the waterlogging condition which is only 10%. Because NGOs help only the known slum dwellers. (Figure 16)



**Figure 16:** Non-Governmental (NGO) help during waterlogging period

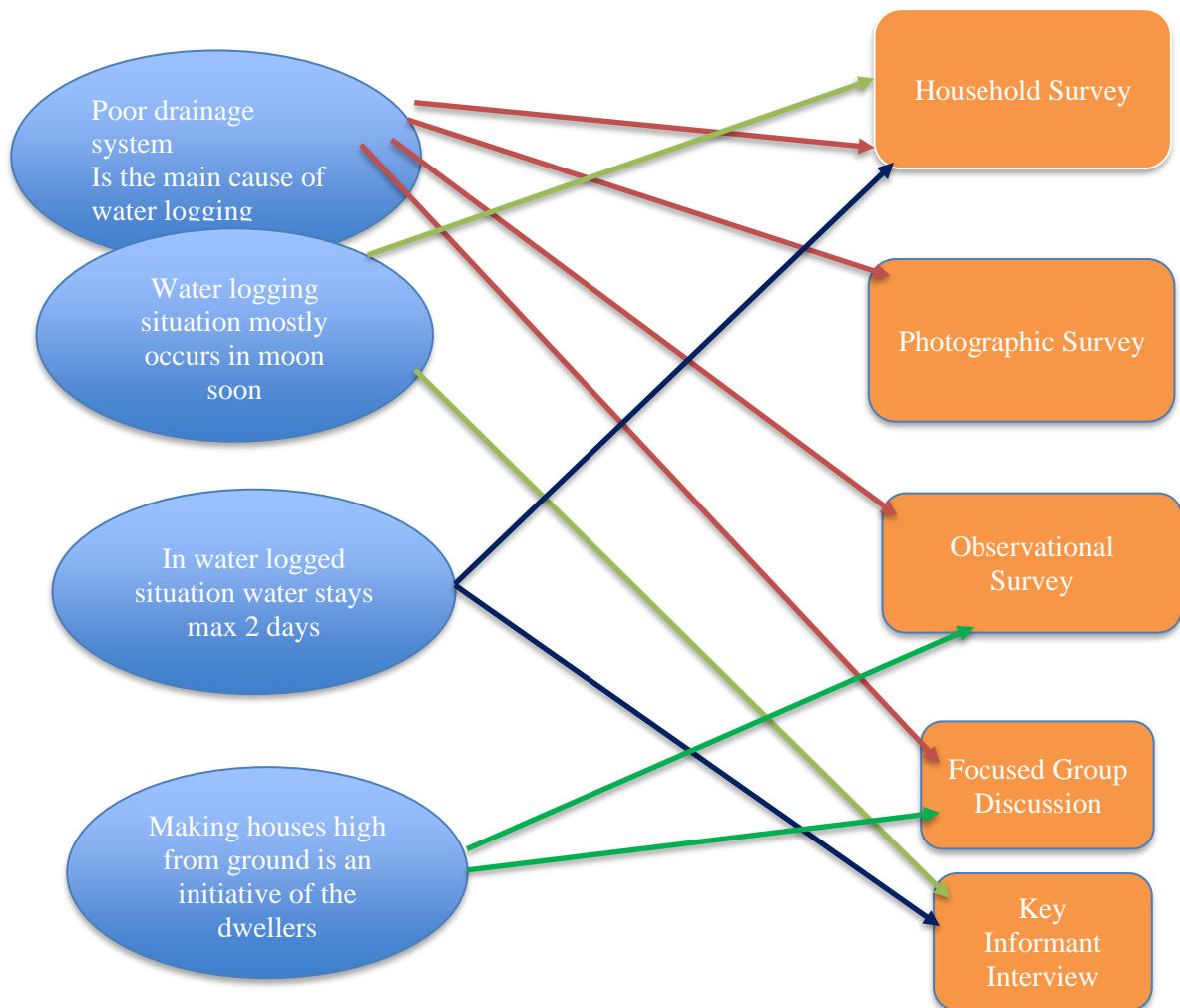
**4.2.5 Focus Group Discussion:** For these two groups were formed, where one comprised of 6 male members while the other one was of 6 female members from the slum community. The following questions were discussed with both the groups:

1. What is the main reason behind waterlogging in the slum area?
2. What is the initiative of the family to reduce the waterlogging's impact?

The group discussions revealed that poor drainage system, unplanned solid wastes management & heavy rainfall are the causes behind the waterlogging situation in block 'B' of the slum. But both the groups selected poor drainage system as the major cause behind it. It was answered by both the groups that, they try to remove the water from their houses by using bowls & they immediately clean the blocked narrow drain lines to remove the storm water rapidly. It was confirmed by both the groups that saving money is a main strategy to cope with the waterlogging condition.

### 4.3 Triangulation

From the observation survey it was clearly noticed that the house of the slum was unplanned and it was also found that the poor drainage system was responsible for waterlogging, which was similar to the photographic survey. At the same time, from the Household survey it was found that poor drainage system is the main reason behind the waterlogging condition. Which is similar to the findings of the two Focus Group Discussions and Key Informant Interviews. From the Key informant interview it was found that waterlogging situation mostly occurs in the rainy Season, which is similar to the findings from Household Survey. The outcomes of each survey are similar and inter related. So the Triangulation is so important and beneficial because it enhances the validity by approaching the same topic with different tools.



**Figure 17:** Summary of the research findings by Triangulation



## **4.4 Analysis and synthesis**

### **4.4.1 Existing waterlogging scenario**

Waterlogging is a frequent problem in both Khulna city and the railway slum area during the rainy season. Even the impacts of this waterlogging problem are increasing day by day. The pace at which water penetrates Khulna City is decreasing daily, which puts tremendous strain on storm water runoff. Inflow becomes significantly higher than outflow during periods of moderate to heavy rainfall, which fails the city's drainage system's capacity and leads to waterlogging issues in the city. Basically, Khulna city has many low-lying areas. With an annual rainfall of 1710 mm, heavy monsoon rains frequently cause urban flooding, which cause waterlogging. Heavy rainfall occurs in July and August. At this time because of low drainage density the Railway slum area is affected by moderate to extreme rainfall. According to KCC, the 15, 16, 17, 21, 29, 30 and 31 no. wards go under knee water after a medium to heavy rainfall. As the study area is situated in ward no. 21 and it is a lower land like other mentioned wards, it faces the flash flood due to heavy rainfall.

Railway slum area is situated beside the Bhairab River. A canal is connected between the slum area's drainage system & the river which is unfortunately covered by solid waste and that's why it blocks the water flow of the drainage system to the river what creates the waterlogging condition in the slum area. During rainy season, the railway slum area faces the waterlogging condition mostly. Due to heavy rainfall, the waterlogged condition remains for several house even sometimes for a day in the railway slum area. The waterlogging condition hampers the slum dwellers daily life and also damages their houses.



**Figure 18:** Waterlogged zones of block B of railway slum area and miserable life of slum dwellers

## 4.4.2 Causes of waterlogging

### Geographical reason behind waterlogging

- Khulna city is situated in between 3 rivers. Basically, the land surface of Khulna city is lower than the ground of the river. As a result, storm water can't move down to rivers easily after heavy rainfall and creates waterlogged condition in lower areas of the city.
- Gradual deposit of silt is raising the riverbed and reducing the discharge capacity. This is causing the areas of Khulna city adjacent to the rivers face Tidal flood. This is also reducing rainwater drainage capacity and speed of the system. The railway slum area is situated beside Bhairab River and it faces the waterlogging condition for both heavy rainfall and saline water intrusion due to tidal flow.
- 80% respondents identified excessive rainfall as the main reason for waterlogging in the Railway slum area.

## Unplanned settlements

- Railway slum area is one of the largest informal settlements in Khulna. Here, slum dwellers built their houses in a congested way which are unplanned. Most of the houses are semi- pacca and some are katcha. This unplanned housing decreased the roads and covered the existing sewerage line in the slum area.

## Poor solid waste management

- Slum dwellers are used to littering non degradable wastages in the existing water bodies and drainage ways of slum area. As a result, 90% of water bodies and drainage become blocked by solid waste which counteract the water supply system of the slum area. Such inefficient and unsustainable waste management leads to lasting waterlogging.

## Encroachment of natural drainage system



**Figure 19:** Drain blockage and unplanned garbage heap at block B of railway slum area

- As the slum dwellers have built their houses in an unplanned way, it has covered the natural drain lines too. Natural drains are also clogged due to the indiscriminate disposal of solid waste and garbage. In last few years, almost 30% of the natural drainage system areas has been decreased in the railway slum area which is also a major reason behind waterlogging conditions in the slum area.



## Unplanned and inadequate drainage system

- In Khulna, most of the storm water and wastewater is drained out by using artificial drainage. Most of the slum areas of Khulna are not connected to the planned drainage network of KCC. So, it is not different in railway slum area. In 2007, Khulna City Corporation took step toward developing the slum area for the first time and they proposed to develop the drainage system of the slum area and built it in 2012. The drainage system is 3.5 km long & 3.5 m in height from the road edge. Later on, the slum area has been enlarged more and it has been separated into six blocks by KCC authority where some blocks couldn't be connected with remaining drainage line in the slum area.

The surveyed area B block is also unconnected with the main drainage network. Though the slum dwellers of block B had made a normal drainage line of 2-meter-long throughout the block later but unfortunately it couldn't be connected with the main drainage line because of unplanned housing and the out passes of the drainage line has been connected with nearby water bodies in B block. This unplanned drainage line is too narrow to pass the extreme flow of water quickly to any water body. So, after any heavy rainfall, the storm water can't pass away quickly by this unplanned drainage line and floods out the B block.



**Figure 20:** Poor Drainage system around the houses of Block B of railway slum area

### **Operational performance and maintenance of drainage systems:**

- In railway slum area, the canal serves as the primary drainage channel for surface runoff. However, solid waste and encroachments obstruct the drainage lines, diminishing their capacity and resulting in water inundation within the slum area.
- Many surveyed slum dwellers confirmed that poor drainage operation, maintenance of the drainage are the main causes behind waterlogged situation. The KCC Municipal authority blames the lack of a comprehensive maintenance plan, insufficient equipment, budget constraints, staffing shortages, and inadequate monitoring for the issue. These factors collectively contribute to the inadequate maintenance of the drainage system, exacerbating waterlogging issues in the area.

### **Coping strategies of slum dwellers in waterlogging condition**

The various coping strategies adopted by the slum dwellers were meant to protect lives and properties (D. Carr, 2007). These strategies are divided into three phases: reactive, preventative, and recovery. Reactive solutions are quick reactions to waterlogging consequences, whereas recovery techniques aim to restore degraded qualities. Preventive techniques are intended to avert future waterlogging occurrences (Huesmann *et al.*, 2011).

- i. In railway slum areas waterlogging mostly happens during the rainy season and 42% of slum dwellers informed that any waterlogging period remains for a maximum 2 days. For this short period, Temporary relocation following a crisis is frequently avoided since it risks losing access to assets, social ties, and livelihood networks. In the case of waterlogging, all dwellings are submerged. As a preventative step, people use bowls to remove stagnant water from their houses and clean neighboring drain lines to assist rainwater drainage.
- ii. Again 45% slum dwellers claimed that as a preventive strategy they keep dry food in home during rainy season in case of managing food in waterlogging condition.
- iii. Sometimes waterlogging condition cause damage to the house infrastructure.

## **5.1 The Key Findings**

The railway slum area is a natural low-lying area. It is always advised to avoid settlements in such areas. However, in the economic reality of the urban poor, and the scarcity of affordable housing in the proximity of the areas that can offer employment opportunities has been making such unsuitable areas valid for informal housing options in many cities of Bangladesh, and Khulna is no exception.

The study looked into the multifaceted nature of waterlogging in the railway slum of Khulna. Secondary sources, observation, and key informant interviews delineated the waterlogging impact scenario in the study area. The research objectives were to identify waterlogging causes, to analyze mitigation measures and coping strategies adopted by the dwellers, and to formulate some suggestions to improve the situation. Various qualitative methods were used like observation, household interviews, focus group discussions, key informant interviews, etc. The results were analyzed and triangulated in the previous chapter and a set of validated findings were presented.

The waterlogging causes found in the research underscored the complexity of waterlogging, a phenomenon intricately woven with both natural elements and human activities. The study area's waterlogging stems from its natural topography, unplanned settlement patterns, and poor solid waste management. The absence of natural drainage systems compounds the situation. Unplanned and poor drainage systems compound the issue. The operational performance and upkeep of drainage network are also key factors. The coping strategies found to be in frequent use can be divided into preventive, reactive and recovery strategies. Among others, removing water by pots, relocating valuables, cleaning nearby drainage paths, temporary sandbag barriers to reduce water penetration, etc. are pointed out by the dwellers.

## **5.2 Suggestions to mitigate waterlogging**

To prevent drain clog, the municipality's drains should be frequently cleaned and maintained. Water should drain out successfully at the required speed and volume if strong waste management can be in place. The unplanned development of houses is also a key reason behind the waterlogging situation in this area. Due to unregulated urban expansion, the drainage system is experiencing unauthorized encroachment, filling, diversion, and blockage, disrupting the normal water flow. This obstruction increases the susceptibility to waterlogging, particularly during the monsoon season. It is essential for drainage planning to account for existing housing structures and to implement measures to prevent future encroachments on natural drainage routes. Furthermore, removing structures that obstruct drainage paths may be necessary to ensure the unimpeded flow of storm water. Waterlogging leads to significant social, physical, economic, and environmental costs, both directly and indirectly.

Absolutely, sustainable drainage system is vital for managing rainfall and water runoff effectively, reducing flooding risk. Efficient drainage also ensures the effective operation of utility services. Collaboration among relevant authorities is essential for an effective drainage system to address waterlogging in slums. Slum residents should adopt standard coping strategies to reduce the immediate waterlogging effects, aiming to mitigate the hazard's immediate effects. Understanding the cyclical nature of waterlogging, slum dwellers can adopt preventive strategies. The coping strategies adopted by slum dwellers, such as raising the floors of their houses and installing barriers across doors with drain line for water flow, are proactive measures aimed at reducing the impact of water inundation.

They should also exercise caution in ensuring compliance with building construction regulations, as this plays a crucial role in preserving green spaces for effective water discharge. They should obtain humanitarian strategy like immediately implicating societal helps on the issue of waterlogging extend beyond living conditions to broader issues of public health, education, and economic stability. Awareness programs should be intensified to educate slum dwellers about waterlogging mitigation. Knowledge dissemination can empower the community to adopt environmentally conscious habits as well. Some specific suggestions are as follows:

- i. The natural drains of this area are covered by unplanned housing & filled up with solid wastes or garbage. For these reasons 70% natural drain of this area has been decreased. So proper maintenance of the drainage system of this area on regular basis by KCC can solve this problem.
- ii. A proper Solid waste management system should be introduced in this area by KCC.
- iii. The artificial drainage system of this area is not connected with the main planned drainage network. As such, KCC should take proper steps for reconnecting the artificial drainage system with the main planned drainage system. Slum residents in this area blame inadequate drainage maintenance for waterlogging, emphasizing the need for regular system upkeep by the authorities.
- iv. The KCC Municipal authority blames insufficient planning, equipment, budget, staffing, monitoring programs, and manpower for inadequate maintenance. These challenges cannot be addressed solely by KCC. Therefore, collaboration among various agencies, including KCC, UNDP, BRAC, and KWSA, is essential to ensure the sustainability of maintenance and repair efforts for drainage, sewerage, and roads
- v. NGOs & KCC authority should arrange meetings to enrich the slum dwellers awareness on mitigating water logging events & should encourage the dwellers to obtain the better coping strategies to reduce the impact.
- vi. To ensure the effectiveness of this approach, continuous monitoring and evaluation mechanisms were implemented. Regular updates from meteorological agencies and feedback from community stakeholders informed adaptive adjustments to the forecast-based action plan. So, the key components of using forecast-based action as a risk management strategy specifically tailored for addressing waterlogging issues in the railway slum area.



### **5.3 Suggestions to enhance coping capacity**

Here Slum dwellers should obtain some better coping strategies to reduce the impact of waterlogging condition. They are:

- i. As a pre-waterlogging preventive strategy slum dwellers may heighten the floor of their houses to save it from water inundation and also should make barriers in front of the doors with creating outlets from houses which can flow the water easily.
- ii. Savings are viewed as a principal coping mechanism for the majority of households. It is imperative to educate and incentivize slum dwellers to consistently save with savings groups or NGOs. This practice enables them to access loans from their savings in response to waterlogging events.
- iii. As a community-based initiative, slum dwellers may also work on cleaning drainage lines to save their area from any waterlogging events.
- iv. In the railway slum area, NGOs and Khulna city corporation authority should arrange meetings to enrich the slum dwellers awareness on mitigating waterlogging events and should encourage the dwellers to obtain the better coping strategies to reduce the impact of waterlogging condition.

### **5.4 The contribution of the study**

The study illuminates the intricate web of factors contributing to waterlogging in the railway slum of Khulna and underscores the resilience and resourcefulness of the urban poor communities in navigating these challenges. Identified coping strategies can provide insights for community-driven interventions and policy measures aimed at mitigating the impact of waterlogging on vulnerable urban populations. As the city grapples with the growing severity of waterlogging, addressing the root causes and empowering communities with adaptive strategies stands as a critical imperative for sustainable urban development. An academic exercise without funding has limitations in terms of time and resources. Limited secondary work in the study area also increased the difficulty. However, the research findings will serve as a solid foundation for more in depth studies on the topic of waterlogging, especially in the railway slum of Khulna.

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## Appendix A

### Questionnaire

#### Household Survey

##### A. Family Status:

1. Name of the study area:
2. Name of the household spokesperson:
3. Number of family members:
4. Number of earning members:
5. Earning person's Profession:

1) Day laborer	2) Rickshaw puller	3) Shopkeeper	4) Others
If others, specify:			

6. Monthly expenditure of family (Tk):

1) <5000	2) 5000-10000	3) 11000-15000	4) >15000
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7. Number of children in the family:
8. Do the children work? Yes No
9. Do the children go to school? YesNo
10. Do you own this house? Yes No
11. Housing Condition:

1) Katcha	2) Semi-pacca	3) Pacca
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**B. Waterlogging Status:**

1. What is the main reason behind waterlogging in the slum area?

1) Heavy rainfall	2) Poor drainage system	3) Tidal flow
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2. In which months does waterlogging occur mostly?

1) January/February	2) March/April	3) May/June
4) July/ August	5) September/October	6) November/December

3. Duration of waterlogging at a time:

1) 5-10 hours	2) 10-15 hours	3) 15-24 hours
4) >24 hours		

- If the waterlogging remains more than a day:

1) 2 days	2) 5 days	3) 7 days	4) >7 days
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4. When the water floods which areas of the slum become mostly affected?

1) A block	2) B block	3) C block
4) D block	5) E block	6) F block

5. Can the earning person go outside of the home to attend the job when the waterlogging occurs?

Yes    No

6. If he/she can't go to outside for their job due to waterlogging conditions, how does he/she manage their livelihood?

1) Selling assets	2) Receiving fund from donation
3) Taking loan from NGOs	4) Expensing money from savings
5) Others	If others, Specify:

7. Can the children go to school when waterlogging occurs?

Yes No

8. If the rainwater floods the slum area in a minimum range how slum dwellers manage the water extraction from their houses?

1) Wiping the house for several times	2) Keeping Ceiling fan on for drying the floor rapidly
3) Brooming the floor for several times	4) Others

9. What kind of food is manageable for the slum dwellers during a long waterlogging period?

1) Cooked food	2) Dry food	3) reserved food	4) Others
If others, Specify:			

10. Due to polluted floodwater, what kind of disease family members mostly suffer from?

1) Diarrhea	2) Skin disease	3) Cold fever
4) Others		

11. If the rainwater floods the slum area in a high range how slum dwellers manage the water extraction from their houses?

1) Cleaning the surrounding drains to make a way for water extraction from their houses	2) Irrigating fixate water from their houses by using bowl
3) Using bucket to eliminate the water from their houses	4) Others
If others, specify:	



12. Does the waterlogging condition harm their residence?

Yes No

13. Do the slum dwellers take any action for protecting their houses before any waterlogging occurs?

Yes No

14. Which protection do the slum dwellers obtain for their houses before any waterlogging condition occurs?

1) Heightening the floor	2) Using a wooden barricade in front of the door	3) Using polythene over the roof.
4) Others		
If others, specify:		

15. What is the initiative of the family to reduce the waterlogging's impact?

1) Keeping their houses high from the ground	2) Managing a proper drainage system beside of the house
3) Others	If others, specify:

16. Do the slum dwellers receive any Governmental Donation or help during the waterlogging crisis?

Yes No

17. Which Governmental body actually helps during the waterlogging condition?

1) KCC authority	2) Railway authority	3) Local Commissioner
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18. Do the NGOs assist the slum dwellers during the waterlogging condition?

Yes      No

19. When do the NGOs help the slum dwellers by providing loans or donation?

1) During any short-time waterlogging period	2) During any long time, waterlogging period	3) During any post waterlogging period
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20. What kind of role does Government play for reducing waterlogging conditions?

1) Constructing dam on the riverside	2) Keeping wastage away from the slum area
3) Aware people to build their houses keeping a standard height from the ground	4) Constructing a proper drainage system in the slum area
5) Others	If others, specify:

21. How the NGOs assist the slum dwellers when the waterlogging remains for a long time?

1) Cleaning the drains	2) Removing wastages from slum area	3) Helping slum dwellers to eliminate the fixate water from their houses
4) Others		
If others, specify:		

**(Thank you for your co-operation)**

Participant's Signature

**Appendix B**  
**Questionnaire**  
**Key Informant Survey**

**Respondents Information**

Name:

Gender:

Age:

Educational Level of the respondents:

Position of the respondent in the organization:

**Water logging status**

1)What is the reason behind long-time waterlogged condition in the slum area?

Ans:

2)When waterlogging occurs how long in average it remains in the slum area?

1) 5-10 hours	2) 10-15 hours	3) 15-24 hours
4) >24 hours	5) 2 Days	6) 3 Days

3) Do the slum dwellers take any step to protect their assets when any waterlogging event occurs?

Yes No

4) Which kind of step slum dwellers take to protect their houses before any waterlogging condition occurs?

1) Heightening the floor	2) Using a wooden barricade in front of the door	3) Using polythene over the roof.
4) others	5) If others, specify	

5) Do the slum dwellers receive any Governmental Donation or help during the waterlogging crisis?

Yes No

1) Which Governmental body actually helps during the waterlogging condition?

1) KCC authority	2) Railway authority	3) Local Commissioner
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2) What kind of role can Khulna City Corporation play for reducing waterlogging conditions?

1) Constructing dam on the riverside	2) Keeping wastage away from the slum area
3) Aware people to build their houses keeping a standard height from the ground	4) Constructing a proper drainage system in the slum area
5) Others	If others, specify:

3) Do the NGOs assist the slum dwellers during the waterlogging condition?

Yes    No

4) How do the NGOs assist the slum dwellers when the waterlogging remains for a long time?

1) Cleaning the drains	2) Removing wastage from slum area	3) Helping slum dwellers to eliminate the fixate water from them houses
4) Others		
If others, specify:		

**(Thank you for your co-operation)**

Participant's Signature

**Appendix C**  
**Questionnaire**  
**FGD survey**

**Respondents Information**

Number of participants

Ans:

Group composition (gender, age, educational background, marital status)

Ans:

List of respondents (full name)

Ans:

**Water logging status**

1. What is the main reason behind waterlogging in the slum area?

1) Heavy rainfall	2) Lower land	3) Tidal flow
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2. What is the initiative of the family to reduce the waterlogging's impact?

1) Keeping their houses high from the ground	2) Managing a proper drainage system beside of their houses
3) Preventing waste bulks from their houses	4) Storing necessary products before the waterlogging occurs
5) Others	If others, specify:

**(Thank you for your co-operation)**

Participant's Signature