

**CAUSE OF REPETITIVE FIRE DISASTER IN INFORMAL
SETTLEMENTS AND THE IMPORTANCE OF COMMUNITY
BASED DISASTER RISK MITIGATION**

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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.

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Declaration

It is hereby declared that

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2. The thesis paper do not contain materials previously published or written and includes statements with citation.
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Approval

The thesis titled “Cause of repetitive fire disaster in informal settlements and the importance of community-based disaster risk mitigation” submitted by Mehnaz Ahmed Adiba (ID: 18268006) of Fall, 2018 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master in Disaster Management on 15th December, 2023.


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Ethics Statement

The entire study has been conducted with conscious ethical integrity in terms of legal standard, social, economic and ecological segment. The field survey was conducted with permission from the land owner and consent from the residents of Laal Fakir Majar slum. Data collected through focus group discussion, questionnaire survey, photographs and mapping has been carried out with permission from the respondents and the landlord, making sure not to cause any inconvenience to the tenants during the process. Designated authorities have been informed about the use of the information during key informant interview prior to data collection. The data collected has been morally and ethically analyzed through content analysis method without altercation or bias decision. The participants of the surveys have been kept anonymous. Any intellectual property used has been mentioned with proper citation and credit.

Abstract

The growth of informal settlements has increased massively in developing countries in the last few decades. The main pull factor from rural to urban cities is the high possibility of job opportunities for the migrating poor. This has resulted in the formation of substandard housing as a means of housing the low-income urban poor. The living conditions of the slum dwellers are extremely hazardous. Due to the unviability of basic facilities, slum dwellers are forced to use illegal connections, which is the major cause of disaster in slums. Fire disaster is the most common and devastating hazard in the shanties. Although it is a concerning matter due to its repetitive occurrence, little to no action has been taken by the respective authorities. Thus, community-based fire mitigation is the only mode of survival for the slum dwellers. The research focuses on the cause of repetitive fire disasters in informal settlements and how community-based disaster risk mitigation plays a vital role in addressing the issue. The survey site, Laal Fakir Majar slum is a double structured slum, situated in Kalabagan, Dhaka, the capital city of Bangladesh. It is formed within a pocket space that is in the residential zone of the city. This makes the site an ideal study area to understand the context of slums and their correlation with urban development. The research conducted includes both quantitative and qualitative approaches. The questionnaire survey includes 127 respondents, followed by a focus group discussion, which includes 12 respondents, to gather information based on the real scenario. A key informant interview was conducted with the respective authority bodies to understand the policy formulated by the government and the actions taken by the local NGOs. The perception of the targeted group revealed the vulnerability of the slum dwellers to fire disasters. Policies in the national guidelines regarding disaster mitigation in informal settlements are yet to be implemented which creates a scope for the corrupted influentials to extort the vulnerability of the slum dwellers. Lack of help from the local authorities has led to the use of local knowledge as the only mode of survival during disasters. The importance of community-based disaster risk mitigation has been recognised globally, as it has proven to be the most effective in preventing disasters due to its bottom-up approach. Even though the role of community-based disaster risk mitigation has been recognised, it has yet to be widely implemented.

Key words: Informal settlements, Fire disaster, Community participation, Risk mitigation

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List of Acronyms

BFSCDA	Bangladesh Fire Service and Civil Defence
BNBC	Bangladesh National Building Code
CAP	Community Action Planning
CBDMit	Community-based disaster mitigation
CBDRM	Community-based disaster risk management
CBDRR	Community-based disaster risk reduction
CBO	Community-based organisations
CBPDRA	Community-Based Participatory Disaster Risk Assessment
CBPRA	Community-Based Participatory Risk Assessment
CRED	Centre for Research on the Epidemiology of Disasters
CUP	Coalition for the Urban Poor
DAP	Detailed Area Plan
DRM	Disaster Risk Management
DRR	Disaster risk reduction
FGD	Focus Group Discussion
GoB	Government of Bangladesh
HFHB	Habitat For Humanity Bangladesh
KII	Key Informant Interview
NGO	Non-Governmental Organization
NHA	The National Housing Authority
RAJUK	Rajdhani Unnayan Kartipakkha
UDD	Urban Development Directorate
UDP	Urban Development Programme
UN	United Nations
UNGA	The United Nations General Assembly
UN-Habitat	United Nations Human Settlements Program
UNISDR	United Nations International Strategy for Disaster Reduction
UPPR	Urban Partnerships for Poverty Reduction Project

CHAPTER ONE

Introduction

1.1 Background

UNISDR, 2009, stated that “A disaster is a serious disruption of the functioning of a community or society causing widespread human, material, economic, or environmental losses that exceed the capacity of the effected community to cope using its own resources” (Hossain et al., 2021). A fire disaster is a concerning matter for the growth of urban infrastructure. Due to the rapid increase in population, disasters, whether natural or man-made, create major disputes over urban livelihoods. Fire disasters are one of the most challenging components because they cause huge losses of property and disrupt urban development (Gernay et al., 2016). In Bangladesh, from 2014 to 2016, there have been 16213, 17488, and 16858 fire disaster cases, respectively, of which 2397, 1977, and 2953 took place solely in Dhaka (Islam & Hossain, 2018).

Out of all the human-induced disasters, fire disasters have occurred the most, causing massive losses of property and lives over the years. Asia and Africa are the most affected by fire disasters compared to other continents. The highest number of fire disasters occurred in Asia; this is due to the huge number of populations living in slums, where fire disasters usually occur more frequently (Edobot, 2015). The impact of fire is most devastating on the urban poor, as they lack the necessary knowledge and tools to prevent such hazards, which cause severe damage (Westwell, 2011). On average, fire causes around 300,000 deaths per year, which is the fourth largest cause of death globally (Masoumi et al., 2019). In 2007, the loss of monetary value due to the fire disaster was 5 million USD, and that too only for Dhaka city, according to the official records of the BFSCDA, which has increased at an alarming rate for the next few years (Islam & Adri, 2008). Africa, leading in the number of slums, faces major losses due to fire disasters each year. There has been a notable increase in the number of people at risk of disasters globally by 70 to 80 million (Edobot, 2015). Regardless of its severity, there has been very minor global advancement in preparedness (Kihila, 2017).

Fire disasters in informal settlements are a global threat, as a large number of fire incidents occur in slums throughout the world. 95% out of 300,000 or more deaths are reported to be the result of fire-related burns that occur mostly in low- and middle-income countries (Westwell, 2011). The formation of informal settlements, or slums, is due to the rapid growth of population in unplanned urban cities, which is related to poverty and a low standard of living (Edobot, 2015). This rapid growth of informal settlement raises vulnerability and the risk of fire hazards (Gachago, 2013). As per UN-Habitat, more than 30 percent of the world’s population lives in slums. Fire disaster is a common scenario in Asia as it leads to a large number of slums where fire hazards usually occur (Hossain et al, 2021). These informal settlements are often structured by the dwellers themselves and lack proper planning or required open spaces (Promy & Muntasir, 2019). The materials used are cheap, easily available, and mostly recycled. Bamboo, timber, corrugated iron sheets, and plastic sheets are used as building materials that are highly flammable. This is risky, especially during the hot dry season (March to May in Bangladesh),

as this increases the chance of fire ignition that spreads more rapidly. Apart from unintentional fire hazards, slums are often the target of eviction, which results in an intentional fire disaster that is caused by a dispute between local goons (Ahmed, 2014). Due to the unplanned growth of slums, the environment is congested without proper road access, which spreads fire more rapidly. This creates a challenge for firefighters to respond on time. The mean duration of fire in slums is 68 minutes on average, which is higher compared to other sectors (Stott & Nadiruzzaman, 2014).

Community-based fire mitigation and response during the early stages of an outbreak is crucial, as the dwellers are the first and only to address the situation (Nyayo, 2015). Fire services in Cape Town encourage informal settlement communities to be aware of the immediate response during a fire disaster and to inform officials promptly (Westwell, 2011). As claimed by Kamengere (in 2012), community-based fire response and mitigation in informal settlements can be in the form of voluntary social workers, NGOs, grassroots organisations, or community-based participation. Volunteers participating in community-based fire response include youths and locals who are familiar with the area, as they are the first to respond during a fire disaster. Local people and their knowledge are the primary essential resource in fire mitigation. Community-based response is crucial when authorities' mechanisms lack the ability to provide a quick response, as stated by Mbugua (2015). Due to insufficient training program, a lack of proper fire mitigating equipment, and no proper structural layout, community-based resilience faces challenges (Nyayo, 2015).

Substandard housing in slums is vulnerable to fire disasters due to repetitive loss of life and property (Chaturvedi, 2016). Overcrowded, poor infrastructure made of combustible material with no proper evacuation plan causes rapid spread of fire, resulting in a delay in fire mitigation. The duration of fire in slums is higher compared to other sectors; on average, it lasts 68 minutes in slums and 28 minutes in non-slum residential areas ((Stott & Nadiruzzaman, 2014). Lack of fire disaster awareness, along with little to no effective preventative measures, causes severe casualties. Slum dwellers living in substandard housing are deprived of basic facilities, which leads to the use of illegal gas and electricity lines, which are often the source of fire disasters (Islam & Hossain, 2018).

This study will help to understand the vulnerability of substandard housing and the need for community-based responses to create resilience in order to mitigate repetitive fire disasters. A case study at Laal Fakir Major slum, situated in Kalabagan, has been surveyed to better understand the severity of the fire disaster in informal settlements in Dhaka. The site is situated in a residential zone that is surrounded by high-rise buildings, making it more vulnerable to a fire disaster. A thorough field survey has been carried out, including both quantitative and qualitative methods to collect primary data, along with focus group discussion and a questionnaire survey, in order to get detailed information on community-based response regarding fire mitigation.

1.2 Rational of the research

This research aims to understand the cause of repetitive fire disasters, the vulnerability of substandard housing in informal settlements in Dhaka, and how community-based fire response and mitigation can be adapted to minimize hazards.

1.3 Significance of the research

It is important to understand the core problems that cause the vulnerability of slum dwellers to disasters. This research focuses on the major cause of repetitive fire disaster in informal settlements and the methods that can play a vital role in disaster mitigation. The necessity of implementation of community-based disaster risk mitigation has been emphasized as this method has been the most effective in addressing the ongoing crisis. The selected site has been thoroughly investigated to figure out the root cause of the problem. The collected data has been analyzed in details to understand the real scenario.

1.4 Statement of the problem

A fire disaster, whether natural or man-made, is a global concern. Rapid urbanization has resulted in an increasing number of informal settlements. These substandard housings are mostly made of combustible materials. The settlements are built without any proper evacuation route, which results in devastating losses during a fire outbreak. The use of illegal gas and electrical connections, along with little to no fire disaster awareness, are the causes of repetitive fire disasters in informal settlements. Although many cases of intentional fire disasters in slums have been reported in order to force eviction.

1.5 Research aim

This research aims to understand the cause of repetitive fire disasters in informal settlements and how they can be mitigated via community-based disaster risk mitigation.

1.6 Research question and objective

This paper aims to identify the causes of the fire disaster and which procedures should be carried out in order to mitigate the disaster. To carry out the research, the paper focuses on a few questions and the objectives of the study.

- What are the causes of repetitive fire disasters in slums?
 1. To understand the causes of frequent fire disasters in slums.
 2. To understand the vulnerability of slum dwellers to fire disaster.
- How does community-based disaster risk reduction response play a vital role in fire mitigation in slums?
 1. To understand the devastating consequences of fire disasters in slums.
 2. To understand the need for community-based participation for fire mitigation in slums.

1.7 Research methodology

This research includes both quantitative and qualitative approaches to understanding the cause of repetitive fire disasters in slums and how they can be prevented through community-based fire response.

CHAPTER TWO

Literature Review

This research study, based on the cause of repetitive fire disasters in informal settlements, focuses on community-based response as a possible mitigation approach. The literature review of the study emphasizes on two main factors (cause of repetitive fire disasters in informal settlements and community-based disaster risk mitigation) in justification of the cause and mitigation process: the formation of informal settlements in urban contexts and community-based response in fire mitigation.

2.1 Informal settlements in urban context

Research on informal settlement is crucial to understanding the cause of repetitive fire disasters in slums, the key theme of this research paper, and the importance and need for community-based response in the mitigation of fire disasters in substandard housing.

2.1.1 Fire hazard

According to UNGA, in 2016, “a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation” (UNDDR & Dadvar, 2020).

Definition of slums	
UN Habitat (2008)	Slum is and area with: <ul style="list-style-type: none">• Poor infrastructure of housing• Overcrowded environment with lack of space for individual• Fear of eviction• Lack of basic facilities
UN Habitat (2013)	According to UN definition of substandard housing in slums: a household that lacks in availability of proper basic facilities

Table 01: Varying definitions adopted by the UN Habitat program over time (Laing, 2014)

Fire hazards are the most common and devastating hazards in slum communities. Due to lack of proper planning and the absence of utility management, fire hazards are difficult to mitigate, which causes severe loss of life and property. Fire in slums occurs for various reasons. Electric short circuits, gas burners, lack of awareness, and arson are a few of the common causes of fire disasters in slums (Islam & Hossain, 2018). Fire spreads faster in substandard housing due to the presence of flammable materials and narrow pathways. Fire trucks often cannot get access to the site due to its unplanned formation and lack of an evacuation route. This increases the response time, which causes severe casualties (Ahmed, 2014).

2.1.2 Formation of informal settlements/ slums globally

‘Informal settlements have always been a persistent feature of urbanization’ (Rosenfeld, 2012). Migration from rural to urban areas has been occurring globally. Africa, Latin America, and Asia have all been experiencing mass migration at a massive rate. Latin America's urbanization growth rate in the last 50 years has been beyond 80%. In Asia, 50% of the people live in urban

areas, whereas a few of the significant cities, including Dhaka, Kolkata, Mumbai, and Bangkok, consist of over 50 million people, of whom one third live in urban slums. This growing number of people migrating from rural to urban cities creates an immense amount of pressure on the specific targeted regions, which eventually results in an increase in slum formation in order to provide shelter to the migrants. Thus, these informally formed slums lack proper infrastructure and fail to provide basic necessities such as gas, electricity, and water, along with other required amenities (Panday, 2020).

Dhaka, the capital city of Bangladesh, is one of the fastest-growing metropolitan cities. The city has been going through rapid urbanization for the last 25 years, where the rise in population is about 6.9 percent and 50 percent of the population is urban poor. In 2005, Dhaka had around 5,000 slums inhabited by an estimated 3.4 million people. In 2010, the population increased to 17.6 million people, of whom 60 percent were living in slums. Private land owners started renting their lands as a large number of people would fit within a confined space, which would provide the landlords with much higher rental returns. As a result, 77% of slums were formed on private properties in 2006. This rapid growth of slums increased the land value and created unplanned development in Dhaka city (Sinthia, 2013).

Similarly, many Nigerian urban cities have developed in an unplanned manner due to the rapid growth of slums. As a result, these slums are formed with illegal structures without proper road access, water availability, or sanitation (Baloye & Palamuleni, 2017). One-third of the global slum population resides in India. In 2011, according to the Census of India, about 66 percent of towns in India consisted of slums (Chaturvedi, 2016). Since 1940, Mumbai, a fast-developing city in India, has been facing problems sheltering its growing population. About 30 percent of the city's population is classified as urban poor. As per the 2001 Census of India, Mumbai held 1959 slums that sheltered 6.25 million slum dwellers. Slums have formed in an unplanned manner on empty pocket spaces within the city, mostly on private properties (Kaur & Soni, 2014). Morelia, a moderately sized city situated in the west-central state of Michoacan, Mexico, started to grow in population in the 1970s, from 44,304 to 161,040 people due to blooming urban development. A local report in Morelia stated that about 80 percent of the city's irregular settlement is situated in risk-prone areas. The selection of vulnerable areas by migrating people globally has been categorized into two categories. One reason suggests that the migrating people, being the urban poor, have no other alternative than settling in empty, vulnerable spaces, as it is cheaper and their only option. Another reason suggests that migrants, by choice, select such risky, vulnerable, disaster-prone areas because they are affordable and provide a certain number of urban facilities. The area is mostly close to the job sectors and also has accessible city facilities for better livelihood. However, both reasons are related to each other due to an increase in urban land value (Güiza et al., 2017).

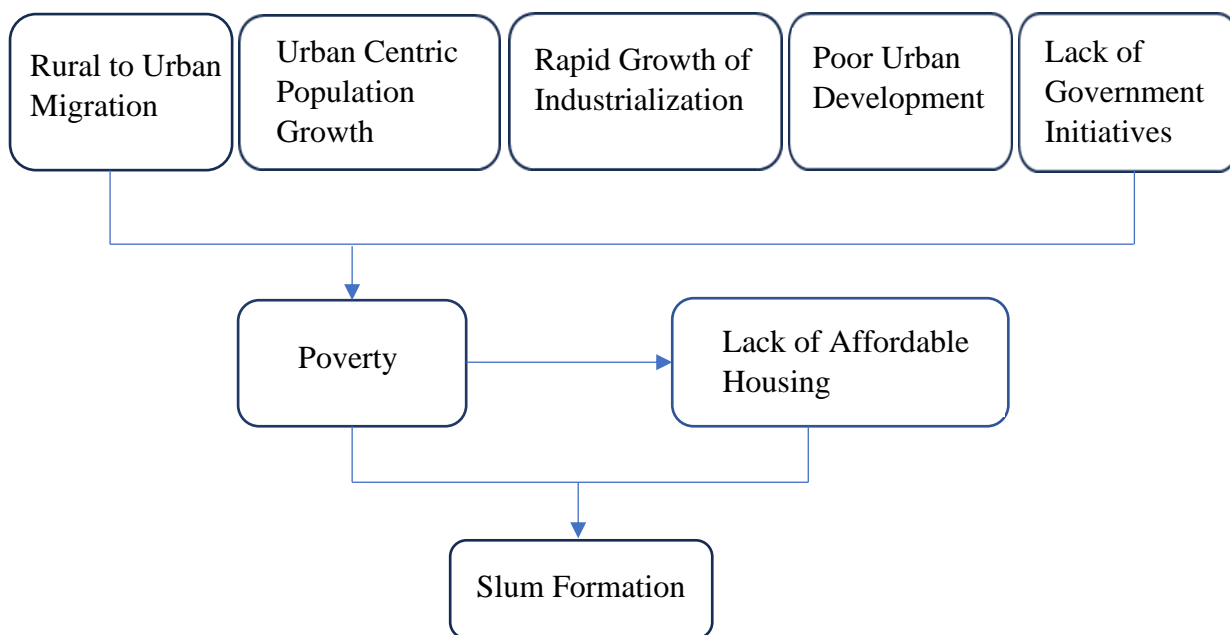


Fig 01: Process of formation of slums (Panday, 2020).

The pull to urban cities is also a result of natural calamities in rural regions, where people migrate in search of a stable habitat. Harsh climatic change and high demand for land due to the rapid growth of the population are also reasons behind the reduced cultivation of land. A reduction in agricultural work scope has pulled rural migrants to urban job opportunities (Panday, 2020). Migrating from rural to urban areas mostly includes young adults, as their scope of work and life expectancy are higher (Lall et al., 2006). The migrants, mostly known as ‘urban poor’, have been surviving in the urban context mostly while working for the informal sectors. Researchers and academicians predict that, within the next few decades, almost 90 percent of the jobs in urban cities will come from the informal sector. For example, informal sectors provide 72 percent of employment in Sub-Saharan Africa (Panday, 2020). Most young adults migrate from rural to urban areas as the need for cheap labour due to urbanization is immense (Lall et al., 2006). Once they secure employment, they build a makeshift shelter in an empty space that is closest to their job. This process eventually forms slums (Panday, 2020).

2.1.3 Substandard housing in urban context

As stated by UN Habitat in 2007, "Wherever poor people live in large numbers in what is considered substandard housing, these areas have been labeled slums". Substandard housing is meant to describe a habitation where dwellers do not have access to basic necessities such as clean water, sanitation, sewage, and drainage systems; health facilities; risk of fire hazards; lack of proper ventilation; maintenance; and accommodations that do not meet building and construction codes. Housing has been considered a part of Goal 11 in the Sustainable Development Goals (SDG) on Sustainable Cities and Communities. However, substandard housing includes much more complicated issues that require the participation of various parties. United Nations Habitat stated that terms like ‘adequate housing give an idea of the situation that housing is a complex issue that cannot be solved solely but rather by advancement from various components. Rapid urbanization, being one of the vital causes of substandard housing

formation, is most prominent in developing regions such as Asia, Africa, and Latin America. The study on SDG 11 on Sustainable Cities and Communities by UN Habitat in 2018 estimated that the global need for sufficient and affordable housing will reach approximately 3 billion people. Developed countries have worked on substandard housing for centuries, but the struggle for developing countries is yet to be resolved (Rainga & Khan, 2020).

Overwhelming growth in population challenges the ability of the government and local authorities to provide accommodation to the migrating urban poor which eventually generates formation of substandard housings. Slums are built with poor infrastructure and fails to provide basic necessities to its inhabitants. Substandard housing is usually built with discarded recycled materials that are mostly collected or purchased at a cheap rate as building materials are beyond the affordability of the slum dwellers. These makeshift shelters lack proper maintenance and are not adequate to provide shelter during harsh climatic conditions. Unplanned poverty-stricken environments fail to provide security, evacuation routes, sanitation, water supply, electricity supply, drainage, sewerage, and garbage disposal. As a result, the slum dwellers are vulnerable to diseases and fire hazards. In some cases, the poor condition of existing building structures, along with a lack of awareness among the slum dwellers, triggers hazards (Harris et al., 2012).

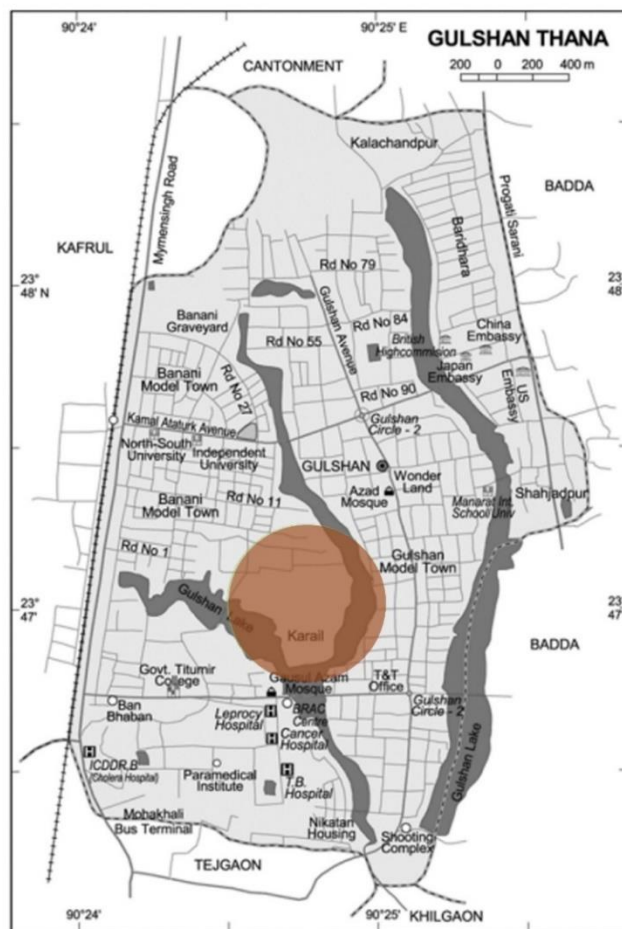


Fig 02: The map of Gulshan Thana and location of Korail slum (Sinthia, 2020)

Dhaka, the capital city of Bangladesh, consists of a high density of population, of which the majority are rural-urban migrants. In 2010, the population of Dhaka was estimated to be 17.6 million, out of which 60 percent were slum dwellers. Korail, one of the largest slums in Dhaka, is situated in the poshest area of the city, formed in parts of Banani and Gulshan. Inhabitants mostly work as maids, drivers, caretakers, garment workers, retail shop helpers, salespersons, or vendors in the neighbouring area (Sinthia, 2020). The slum was formed in 1980 on solid land and rapidly expanded to a massive informal settlement covering approximately 80 acres or more, sheltering around 120,000 urban poor in an estimated 15000 substandard housing units. Due to land scarcity and the rapid growth of population, the slum started to grow, moving from high land to low-lying and water-edge areas, which are riskier and more hazard-prone. This enormous informal settlement consists of different variations of substandard housing depending on the category of the area. On average, each room in substandard housing is accommodated by a family of five members living in a confined space of 100 to 150 square feet. The rooms are built in close proximity, and the roofs of the enclosed structures shade the common space. Kitchens and toilets are shared. The structures are formed based on the rural format, which is altered according to their urban socio-economic needs (Iqbal & Shankar, 2014). Substandard housing materials consist of recycled materials, tin and plastic sheets, bamboo, brick, and concrete in partial areas (Sinthia, 2020). Several NGOs have worked to develop better infrastructure for sanitation, drainage, and water supply within the slum, but it is limited and excludes the riskier areas of the settlement (Iqbal & Shankar, 2014).

2.1.4 Repetitive fire disaster in slums

The global number of people at risk of disaster has continued to grow by 70 to 80 million. Among which, the fire disaster is most prominent (Edobot, 2015). The urban poor are extremely vulnerable to both natural and man-made disasters due to their poorly built structures and poverty-stricken livelihoods, which make them unable to recover from such hazards. Lack of basic services within the slum community not only impacts the slum dwellers but also the environment as they live within or in close proximity to the fast-developing urban city. As a result, contamination, pollution, fire breaks, and environmental degradation extend beyond the slum community and have effects on a local, regional, and national scale. While slum dwellers contribute to the growth of a country's economy, the negative aspects hamper development as well (Mahabir et al., 2016). Unplanned substandard housing, with no effective preventative measures taken into consideration to prevent hazards, is the cause of repetitive fire disasters. While there are many factors that play a key role in causing the outbreak of fire disasters in slums, electrical short circuits, gas pipe leakage, unplanned zoning and placement of kitchen areas, use of flammable materials to build structures, and no evacuation route are the primary causes of the rapid spread of fire that increases the risk of disaster. The vulnerable urban poor are victims of such disasters, as loss of shelter, property, and life is a regular occurrence due to such hazards (Chaturvedi, 2016). According to UN-HABITAT (2008), informal settlements are formed due to the crucial needs of the urban poor. As the nature of the slums is informal, this creates the possibility of generating crimes as the slum dwellers are in a state of vulnerability. Thus, the slum dwellers are exploited by the influentials as they have no other option but to survive and avail themselves of basic urban facilities (Gachago, 2013).

2.1.4.1 Risk prone supply of basic facilities in slum

Slum dwellers have been deprived of basic facilities such as electricity, gas, and water supply for decades. It is a common phenomenon in almost every slum. This is mainly due to their inability to provide valid documents and a permanent residential address, which are prerequisites to applying for basic social services. Due to constant fear of eviction, financial restraint, and a lack of knowledge, the slum dwellers are unable to fight for their rights. Thus, the vulnerable slum dwellers fall victim to local goons known as 'maastans, who are politically influential. Due to slum dwellers lack of ability to get access to basic facilities, the local maastans corrupt the system with the help of their political power and provide services at a much higher rate than the original charge set by the government. As a result, the supplies provided in the slums are not done by professionals or supervised later on, which increases the risk of hazards. Slum dwellers pay a hefty amount as they are charged for electricity as per the use of appliances rather than unit consumption. The vulnerability of the urban poor is being exploited by the local maastans, corrupt local politicians, and authorities (Lipu et al., 2013).

The unstable illegal electrical lines are exposed, and the joints are not sealed properly. These exposed wires are distributed haphazardly throughout the slum community, which eventually increases the risk of fire hazards. A minor short circuit or an electrical spark causes a fire disaster that spreads rapidly within the slum as the materials used to form the substandard housing are flammable. Unplanned growth of structures with narrow passageways without any evacuation route puts the entire community at high risk of a fire disaster. Gas supply is also a major concern for the urban poor, as this too is provided illegally without proper setup or maintenance. Gas lines are often distributed via GI pipes, plastic pipes, and even hose pipes. These pipes are exposed and mostly connected as overhead cables or placed on the ground, where they are repeatedly stepped on by the passersby of the narrow passageway. Due to limited space and an overcrowded environment, slum dwellers dry their clothes on burners, which are often a source of fire ignition. The slum dwellers live in constant fear of fire hazards as the pipes and wires used to provide electricity and gas within the slum community are of low quality and often have leaks and tears (Mollah & Hasan, 2019). Slum dwellers, being migrants from rural areas, often prefer their known mode of living over urban methods. Lack of gas supply, along with their preference for traditional cooking methods with clay burners and dry wood instead of gas stoves, increases their risk of hazard (Lipu et al., 2013). The gas supply provided is limited, which makes it difficult for the slum dwellers to cook as the kitchen is shared. Clay burners also have their challenges. It is difficult to collect firewood during the wet season. The smoke from the clay burners creates air pollution and causes suffocation in the crowded environment (Ali et al., 2016).



Fig 03: Exposed electrical wire and gas pipe in slum (Author, 2022)

2.1.4.1.1 Illegal electricity supply

The informal settlements are mostly deprived of basic services, one of which is electricity. This raises the risk of generating illegal methods of electricity distribution amongst the slum areas, which are often the root cause of fire disasters. Poverty is one of the major reasons behind the lack of electrical facilities. Due to the continuous increase in price for electrical service, the slum dwellers are forced to use alternative illegal methods, such as extracting electricity from the electrical posts by using wires, which is unsupervised and unmonitored. Lack of infrastructure and government policies are also the reasons behind slum dwellers deprivation of basic facilities (International Energy Agency, 2019). Dhaka, the capital city of Bangladesh, is divided into North and South city corporations, where 1639 slums exist under the North city corporation, consisting of 499,011 slum dwellers, and the South city corporation consists of 1755 slums inhabited by 147,056 slum dwellers. This overwhelming number of informal settlements is often vulnerable to fire disasters due to illegal electrical connections. It is a common occurrence as the wires used to distribute electricity among the slum community are of poor quality and the connections are not operated by professionals. Thus, faulty electrical work with exposed joints that spreads throughout the informal settlements is often the root cause of massive fire outbreaks as these shelters are densely packed. According to Fire Service authority, "the illegal electrical connections are taken from the electrical posts set by the power authorities on the road, mostly for street lighting purposes. As the connections are made with poor-quality wires without any professional supervision and later are not monitored as well due to a lack of awareness among the slum dwellers, they often cause fire outbreaks that leave a huge number of urban poor homeless. Many fires safety drill program have been initiated by trained volunteers to raise awareness within the community, but little to no change has been observed." (Anik, 2020).

Year	Number of fire incidents in Dhaka
2020	30
2019	31
2018	33
2017	32
2016	27
2015	47

Table 02: Fire in Dhaka Slums by Fire Service and Civil Defense (Anik, 2020)

A fire outbreak in Kalaynpur slum in Dhaka, Bangladesh, was caused by a faulty electrical connection that resulted in the death of a young man. Upon investigation, the fire service authorities found an electrical short circuit to be the root cause of the fire disaster. There are multiple syndicates that are operated by the local politically influenced goons who distribute these faulty illegal electrical connections throughout the slum communities with the help of corrupted authorities in charge. According to fire service officials, about 39 percent of fire disasters that occur in slums are caused by short circuits from faulty electrical wires. The poor-quality electrical wires are distributed haphazardly with multiple exposed joints that are often supported by bamboo, making the informal settlements extremely vulnerable to fire disasters, especially during the rainy season (Mollah & Saad, 2021).

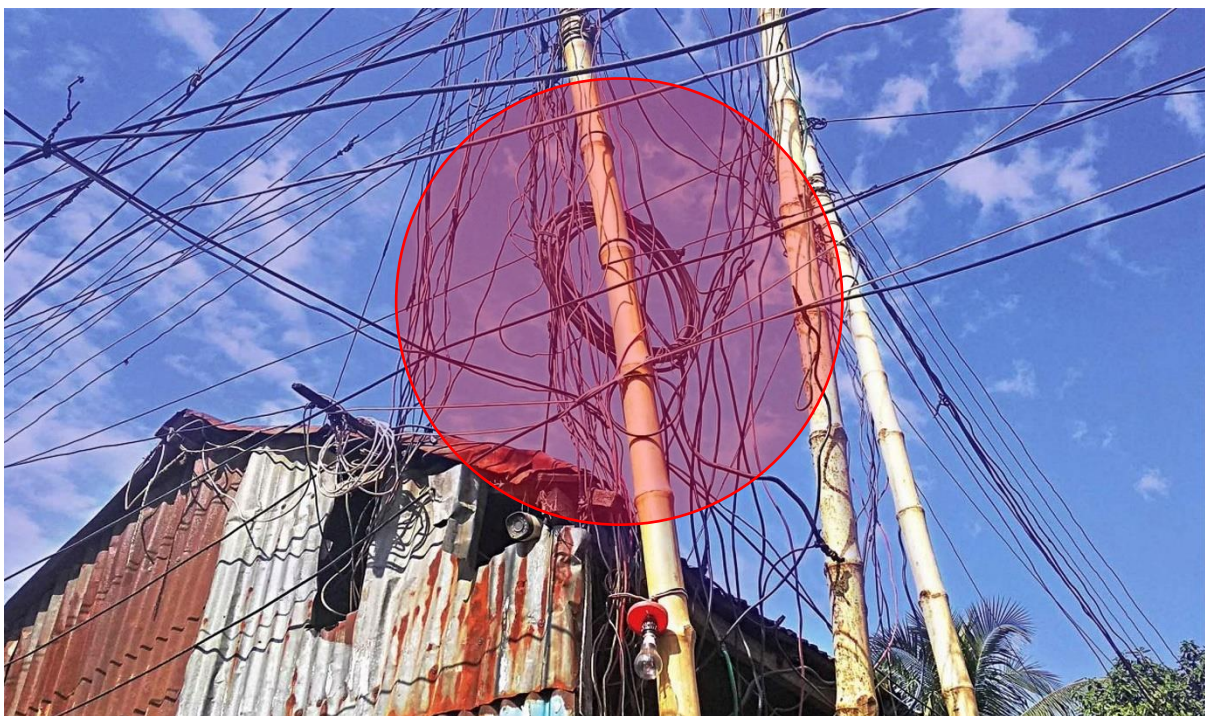


Fig 04: Illegal faulty electrical wire connection at Korail slum, Dhaka, Bangladesh (Mollah & Saad, 2021)

2.1.4.1.2 Illegal gas supply

Along with illegal electricity supply, illegal gas supply is also a massive threat to causing fire disasters in slums. Several cases have been reported in slums formed in Dhaka, the capital of Bangladesh, where fire disasters have occurred repeatedly due to faulty distribution of basic facilities, which are unsupervised and illegally supplied throughout the informal settlements. This has generated numerous fire disasters where it was a challenge for the fire service authorities to respond on time due to densely packed, substandard housing. The use of low-quality pipes for gas distribution, where the pipes are often exposed and have leaks, caused massive explosions during any small spark of fire. According to Fire Service and Civil Defence authority, the ruptured gas pipes are the cause of turning a small fire disaster into a massive outbreak that spreads rapidly throughout the slum community, eventually resulting in greater loss. Councilor of Dhaka North City Corporation, stated that ‘illegal gas supply is often distributed by the local politically influenced people who get the connections through corrupt officials in charge’. The pipes used for the illegal supply of gas in the slums are GI pipes, plastic pipes, and hose pipes. The distribution is done haphazardly and often connected overhead in a hanging position, which increases the risk of fire hazards (Mollah & Hasan, 2019)

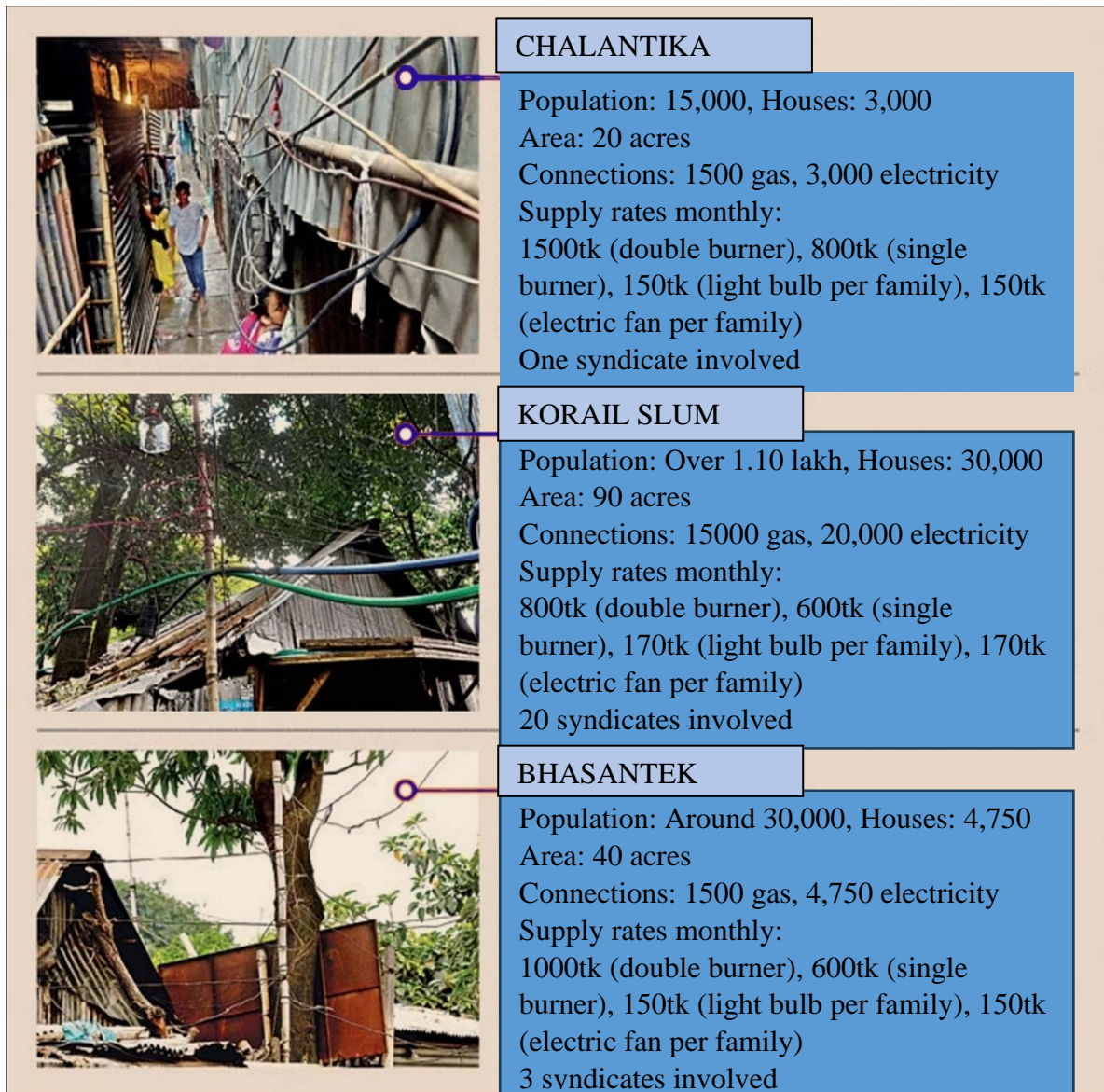


Fig 05: Charges for illegal gas and electricity supply in three major slums in Dhaka, Bangladesh (Mollah & Hasan, 2019)

2.1.4.1.3 Kitchen placement and cooking stoves

Kitchens in informal settlements are considered a risk factor for generating fire disasters. Due to the presence of flammable materials and the use of kerosene stoves for cooking purposes, they are often the source of fire hazards (Noashin et al., 2020). Due to the unplanned nature of slum formation, kitchens are often placed in open areas that also act as passageways. The narrow alley is often used to store kerosene, gas cylinders, and other flammable materials that increase the risk of fire disaster, mainly due to unattended cooking and a lack of awareness. This cramped-up space also works as a social gathering space and a children's play area. Thus, a small spark of fire spreads rapidly, causing severe casualties (Mbiggo & Ssemwogerere, 2018). Slum dwellers are compelled to use alternative methods for cooking as a result of a lack of basic facilities. Various types of cooking stoves that are used in the slums include gas stoves, kerosene stoves, wood-burning stoves, and electric heaters. In wood burning stoves if the

ignited particles are not extinguished after cooking, they can cause a fire hazard due to the presence of flammable materials, and a crowded space will cause the fire to spread rapidly. The expiration date of the LPG gas used for cooking is often not monitored, and refilling often takes time. Kerosine containers are kept near the burner and, if not monitored, can cause casualties as the kitchen area is often used as a common space where people gather and children play (Retd & Chaturvedi, 2016). Charcoal stoves are also used where other resources are unavailable. The smoke from the charcoal creates a suffocating environment in the already crowded space, causing health hazards (Global Hearthworks Foundation, n.d.).



Fig 06: Gas stove in slum (Author, 2022)

2.1.4.1.4 Arson

As slums are mostly built on bare government lands, the slum dwellers are in constant fear of eviction due to political disputes and syndicates by the local politically influenced leaders. The intentional cause of fire disasters in slums has been a major concern within the slum communities, as many believe that arson is caused to make the urban poor evict the occupied land forcefully. Two major slums in Dhaka, Korail and Sattola slums, were subjected to a fire disaster within a short span of time, which made the slum dwellers suspect that the cause of the fire was arson. Community-based organisations (CBOs), civil society members, and a few political members suspect that the allegations might be true due to future proposed projects by the government on those lands. According to executive director of the Coalition for the Urban Poor (CUP), the forced eviction is also caused by hired goons in order to move the slum dwellers to the rehabilitation Bhashantek project, which is built by the government to provide rehabilitation to the slum dwellers. Authority also claimed that the arson was also caused to minimize the number of slum dwellers so that corrupted political leaders could benefit from

the project. On December 4th, 2016, a fire disaster occurred in Korail that burned down five hundred substandard housing units, which were shelters for around one thousand families. The opposition party during that time accused the ruling government of causing arson in order to force the slum dwellers to evict the land, as it was the second time in nine months that the claimed slum was subjected to a massive fire disaster. A community-based organisation leader stated to a local news media outlet, that every slum leader is connected to a political party. The slum dwellers are victims of extortion as they have no power and are being taken advantage of by the slum leaders. The Korail slum has faced several fire disasters, and more frequently since 2012. Local authorities denied any motive for arson by stating that any such conspiracy would have caused fire to spark at several different points of the slum during a fire disaster (Mahmud, 2016).

2.2 Community-based response

During any disaster, the affected community is the first to respond. Thus, vulnerability is determined by the ability of the community in terms of preparedness, response, and mitigation in the course of any disaster. Hyogo Framework 2005-2015 and UN 2005 define "the conditions determined by physical, social, economic, and environmental factors or processes that increase the susceptibility of a community to the impact of hazards" (Mallick et al., 2011). The developing countries have a gap between disaster management and urban planning, which mostly affects the urban poor. The rapid growth of population within developing countries has exposed the urban poor to hazards due to a lack of infrastructure, funds, and planning. The World Bank's disaster management facility has stated the need for disaster mitigation practises as a solution to hazard prevention, but their implementation is vastly absent (Yu et al., 2016). The impact of disasters varies for each country as it depends upon the community's adaptation, resilience, preparedness, and mitigation capabilities. It is observed that while the developed countries face economic losses during a disaster, the developing countries face human casualties. According to the World Bank in 2005, developing countries are mostly disaster-prone, which affects the poor and hinders development and the economy. The disaster management professionals agree on the need for local community-based disaster risk reduction in order to create resilience, adaptability, and vulnerability. The community-based disaster risk reduction (CBDRR) method enables the local people to create awareness and promote the use of available resources for disaster mitigation, which helps them be prepared for any further disaster (Gupta & Barman, 2021).

2.2.1 Drivers, strengths and weaknesses of CBDRM

Community-based disaster risk mitigation enables the community to strengthen its capability by reducing vulnerability through a series of practical approaches that also help to create community bonds. These multiple practical participatory approaches are carried out by selected groups within the community, which helps to generate socio-ecological stability (Berkes & Ross, 2013). CBDRM process has its driver, strength and weakness modules based on selected literature, such as:

Drivers:

Ahmed et al., 2015	<ul style="list-style-type: none">• A key element of CBDRM is volunteerism as it focuses on the involvement of the community along with government and non-government organizations.
Niekerk et al., 2017	<ul style="list-style-type: none">• Community-based participatory disaster risk assessment (CBPDRA) enables the community to identify their risks and generate risk-reduction plan according to their need and ability, which follows a bottom-up approach.• Local knowledge helps to address hazard and minimize disaster. This enables to develop community capacity.

Azad et al., 2020	<ul style="list-style-type: none"> • A community in cooperation generates a collective community which eventually creates a common platform to address risk factors and mitigate disaster. • Community working as a whole to create awareness by having mutual understanding helps to be cooperative before, during and after a disaster.
Islam, 2013	<ul style="list-style-type: none"> • The community develops resilience by taking lessons from past experiences and by keeping an adaptive mindset.
Victoria, 2003	<ul style="list-style-type: none"> • Strategies generated to provide early warning signals helps to create preparedness amongst the community. • Communication amongst the community members create efficient networking that enhance social bonds.
Gupta & Barman, 2021	<ul style="list-style-type: none"> • Social accord ensures a collaborative approach from the community members.

Strength:

Ahmed et al., 2015	<ul style="list-style-type: none"> • Volunteers work to provide early warning signals as well as for recovery and preparedness.
Niekerk et al., 2017	<ul style="list-style-type: none"> • Community members along with stakeholders work together to formulate an inclusive participatory disaster risk assessment (PDRA) report in the form of active participation. • Native knowledge helps to build community capacity by utilizing the local understanding to denote risk factors and their mitigation processes.
Azad et al., 2020	<ul style="list-style-type: none"> • An inclusive community effort helps to derive a well-informed assessment data that is a vital part of the CBDM (community-based disaster management) process. • Unity amongst community members helps to address crisis situation more efficiently and effectively.
Islam, 2013	<ul style="list-style-type: none"> • Available resources and strategies are enhanced to strengthen coping mechanisms to build a more resilient community.
Victoria, 2003	<ul style="list-style-type: none"> • Setting up early warning signals helps to develop preparedness which later enables a community to better address the disaster and minimize loss. • A well-informed community is generated through efficient communication process that helps them to understand their capacity and risk factors which

	eventually aids in decision making during crucial situations.
Gupta & Barman, 2021	<ul style="list-style-type: none"> • A community in harmony aids in efficient decision making in a short span of time that helps to reduce response time which is a crucial factor in disaster mitigation.

Weakness:

Ahmed et al., 2015	<ul style="list-style-type: none"> • Volunteers often lack proper training which reduces their ability to handle crisis situation more competently. Absence of proper equipment during emergency situation also minimizes the efficiency of the volunteers.
Niekerk et al., 2017	<ul style="list-style-type: none"> • Often community members are neglected and undermined by the officials which hamper the process. • At times the process is at a local level which often is not suitable to mitigate large scale disasters. • Limitations to spread awareness and individualistic mindset cause drawback in generating efficient capacity building strategies through communication.
Azad et al., 2020	<ul style="list-style-type: none"> • Interruption from higher officials may hinder the assessment report as it often eliminates the vulnerable group. • Unavailability of basic requirements may cause disturbance in forming social bonds. • Community progress as a unity often face obstacles due to negligence of authorities in charge.
Islam, 2013	<ul style="list-style-type: none"> • Lack of innovative ideas to generate resilience amongst the community members create limitations to developing preparedness and mitigation methods.
Victoria, 2003	<ul style="list-style-type: none"> • Due to lack of training and knowledge, many do not understand the early warning signals and fail to act promptly. • Limitations to spread awareness and individualistic mindset cause drawback in generating efficient capacity building strategies through communication.

2.2.2 Community-based disaster risk management (CBDRM)

The Centre for Research on the Epidemiology of Disasters (CRED) 2014 reports that, on average, 373 countries are affected by disasters annually that result in the human deaths of approximately 100,000 people. The Asian continent, being the most affected by disasters, has a 62 percent decadal average, whereas in 2013, the casualty rate was 88 percent due to a variety of disasters. Disaster management researchers have expressed the need for community-based disaster risk management (CBDRM), as during any disaster, the effected communities are the first to face the impact. It is important to understand the vulnerability of the community and its ability to prevent major casualties in order to create policies that would help minimize the hazard. Thus, the involvement of the community plays a major role in increasing the effectiveness of the policies as it helps to understand the specific requirements of each community and also to create awareness (Gupta & Barman, 2021). The Sendai Framework for Disaster Risk Reduction 2015–2030 emphasizes the need for the involvement of people from all groups of society as disasters have an overall impact on the community. It requires unbiased participation in order to create inclusive accessibility to ensure disaster mitigation and also to focus on the community that is most vulnerable during a disaster, which is mostly the poor (Timothy et al., 2017). The standard Disaster Risk Reduction (DRR) policy had a top-down approach, which was not as successful as the disaster mitigation process. The absence of involvement by the affected community proved crucial during the mitigation strategy. CBDRM was established to fill this gap, which includes a combined strategy of both top-down and bottom-up approaches to enhance the vulnerable community's resilience in disaster risk reduction. The implementation of CBDRM methods in all Disaster Risk Management (DRM) program in recent years proves their effectiveness in building a more resilient community as they include the affected group of people, who play a vital role in the process (Gupta & Barman, 2021).

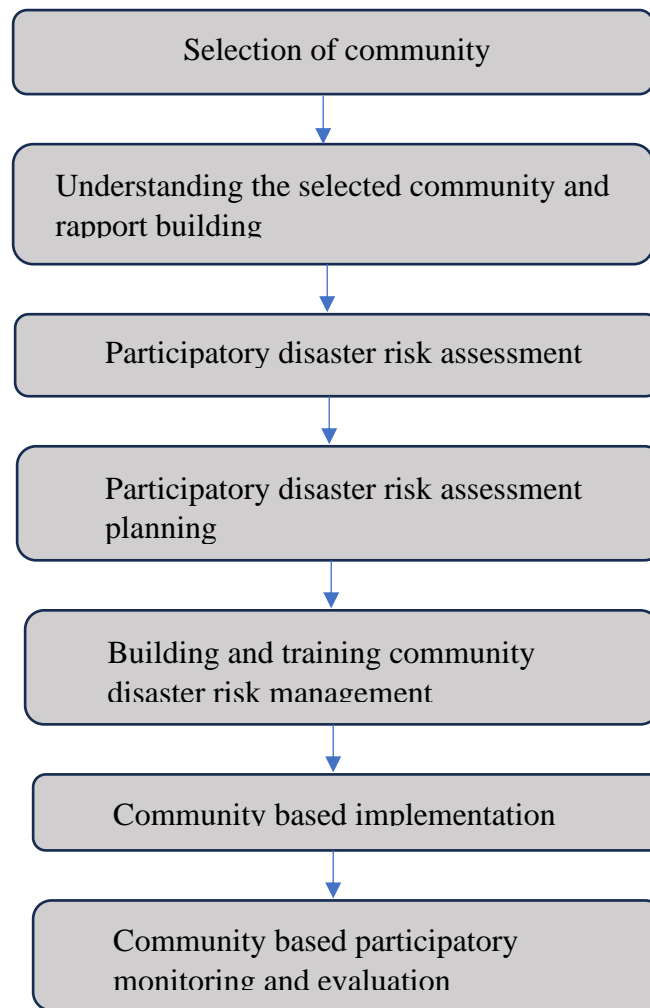


Fig 07: CBDRM Approach (Gupta & Barman, 2021).

2.2.3 Implementation of community-based fire risk management

The United Nations Office for Disaster Risk Reduction (UNISDR) identifies urban fire as a global issue and defines it as an "extensive risk". UNISDR states that "repeated or persistent hazard conditions of low or moderate intensity, often of a highly localized nature, can lead to debilitating cumulative disaster impacts". Annually, fire hazards cause over 300,000 deaths globally. Over 95 percent of these incidents occur in low- and middle-income countries. Informal settlements are one of the prime risk factors for fire disasters, which are rapidly forming in developing countries. The causes of fire disasters in informal settlements are often unknown due to a lack of capacity and resources for data collection. As a result, fire hazards are being neglected in policymaking, which is further generating more vulnerable communities (Twigg et al., 2017). Any minor or major disaster occurring internationally or locally affects the vulnerable community, which is the first to face the impact and respond. This required a change from the traditional DRR top-down approach to the community-based disaster mitigation (CBDMit) bottom-up approach. The CBDMit approach focus on the sectors where conventional DRR policy failed to provide an efficient solution. This involved the engagement of vulnerable community members in decision-making along with local authorities,

professionals, and policymakers. CBDRM is established based on each individual community's needs and focuses on capacity building with resources that are available, which results in enhancing community resilience (Victoria, 2003). Community-based risk assessment plays a crucial role in CBDRM, especially in informal settlements where data collection is difficult. A holistic approach can resolve the gap and help to understand the overall risk factors that make a community vulnerable to hazards (Twiggy et al., 2017).

Dhaka, the capital city of Bangladesh, is a fast-growing metropolitan city that has an alarming number of informal settlements. The formation of slums is rapidly increasing each year. But Dhaka has had slums ever since 1971, the year of Bangladesh's independence. One of the oldest informal settlements existing in Dhaka till now is the Talab camp. It was formed to avoid ethnic conflicts and mostly provided shelter to those who were refugees from India. This minor ethnic community is vulnerable to many hazards, including fire and many others. Initially, the participants were trained on the Resilience Framework, which was not efficient and failed to focus on the root problem. Thus, a community development plan was generated. Habitat For Humanity Bangladesh (HFHB) later formed the Community-Based Participatory Risk Assessment (CBPRA) toolkit to understand the type and magnitude of vulnerability specific to its community. The Community Action Planning (CAP) toolkit was used to initialize the primary activity of the project. On the final training project, community leaders were involved. The group assisted in the need assessment of the community, which was undertaken by the Urban Partnerships for Poverty Reduction Project (UPPR). The training program helped to understand the situation on a wider international level and at the minor root community level. This provided an inclusive training program to build a more resilient community with their 'hands-on' approach (Ahmed, 2016).

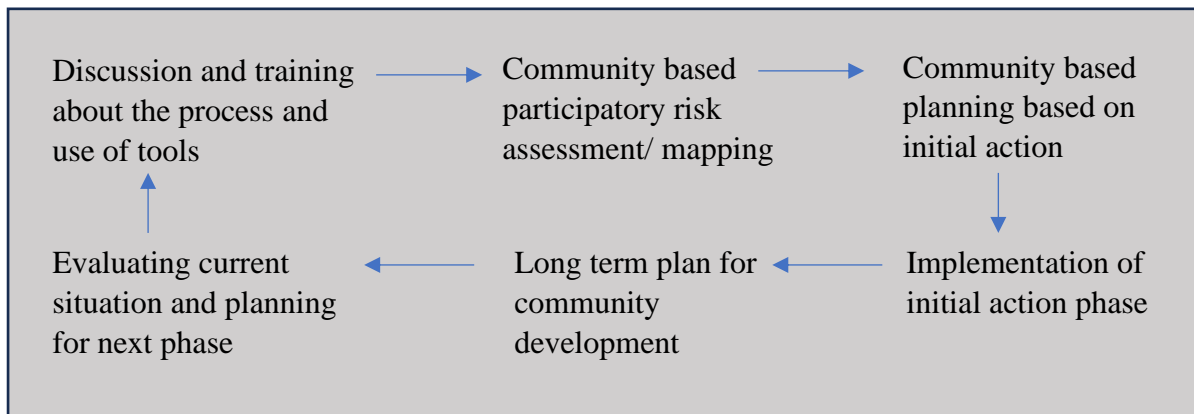


Fig 08: Project Activity Sequence Flowchart (Ahmed, 2016).

Category of actors	Roles
Women	<ul style="list-style-type: none"> • To give fire alarm signals vocally • To provide containers that can be used to carry water • To provide water to the youth volunteers from source • To evacuate children and vulnerable members of the community • To provide first aid help to the injured • To retrieve properties from damaged buildings • To do a headcount around the village to check if everyone has been rescued
Youth	<ul style="list-style-type: none"> • To stop fire from spreading by demolishing structures to create a breakage and to form path to distribute water • To provide water to other youths on site • To retrieve property • To disconnect electricity supply • To carry out safe evacuation and rescue operation
Older men	<ul style="list-style-type: none"> • To organize youth of the community to put out fire • To assist the youth in fire mitigation • To remove objects from burning building • To ensure safety of retrieved objects
Village leaders	<ul style="list-style-type: none"> • To spread the news of fire and call for help from local authorities • To assist and organize fire mitigation and response actions • To form a route for fire vehicle entrance

Table 03: Roles of actors in fire response (Ngau & Boit, 2020).

CHAPTER THREE

Methodology

According to Yin (2014), case study plays a vital role in research study as a research method (Hollweck, T, 2016). Laal Fakir Majar slum, situated in Kalabagan, Dhaka, Bangladesh, has been chosen as a case study area as it sets a prime example regarding the vulnerability of unplanned informal settlements to fire disasters. The site's being surrounded by neighbouring high-rise buildings and having a double-story structure with already existing poor infrastructure and little to no evacuation route sets a key example of urban slum vulnerability to fire hazards.



Fig 09: Laal Fakir Majar slum formed within a pocket space surrounded by high rise buildings without any proper evacuation route (Site survey & Google earth, 2022)



Fig 10: Double storied structure of informal settlement in Laal Fakir Majar slum (Site survey,2022)

3.1 Research methods

The research study includes both qualitative and quantitative data for analysis. The content analysis of the research has been conducted through a questionnaire-based survey, a focus group discussion (FGD), a key informant interview (KII), a case study, and a site survey.

3.2 Unit of observation

The unit of observation aids in the unit analysis of the research. The questionnaire survey includes slum dwellers who are living within the slum community. The focus group includes slum dwellers who have been living in the study area and are adults. The unit of analysis includes designated authorities who are in charge of the research study. This includes government officials, NGOs, and social volunteers.

3.3 Data collection tools

The research includes data collection from both primary and secondary sources. The key primary sources are site surveys, observations, questionnaire surveys, focus group discussions (FGD), and key informant interviews (KII). The target audience for FGD has been selected based on the vulnerability of the inhabitants, who have experienced fire disasters while living in substandard housing. Respective authorities have been selected for the KII of the research. The secondary sources have been collected from news portals, published papers, articles, journals, thesis papers, and reports for the literature review of the study, which facilitates the paper and helps to gain better knowledge of the research study.

3.3.1 Primary Data Collection

The primary data collection includes a site survey, a questionnaire survey, a focus group discussion (FGD), and a key informant interview (KII). The process of collecting data with the help of these tools has been described below.

3.3.1.1 Site survey

The Laal Fakir Majar slum, situated in Dhaka, Bangladesh, has been selected as the study area for the research. The site selection was based on its vulnerability and risk-prone structure within the densely packed high-rise residential neighbourhood, which was considered an ideal site to understand the dynamic of informal settlements that grew within Dhaka city.

A planned method has been set before the site visit to ensure proper observation of the key points. A few basic facts about the site have been gathered by the author from the approachable residents of the slum before his visit. This helped to point out problematic areas and how the data can be collected efficiently. The site permitted access to multiple number of surveys throughout the research along with cooperative response from both the tenants and the landlord for FGD and questionnaire survey. Thus, the site chosen was ideal for the research study.

3.3.1.1.1 Detailed Plan Preparation (of the site)

The detailed plan of the site has been prepared through a series of steps:

- Site survey

- Photographs
- Videos
- On-site site mapping with the help of digital tape
- Surrounding road mapping through Google Earth

The necessary tools required for data collection and to keep records were gathered before the site visit. This includes digital measuring tape, a camera, a recorder, and a preset questionnaire that might aid the research later.

3.3.1.1.2 Preparing the layout plan

The site has been measured thoroughly with the help of digital tape during multiple site visits. The measurements gathered have been used to plan out the entire slum community in detail on AutoCAD software. The detailed plan denotes existing structures and road accesses. The plan helps to understand the dimensions of the site and its structures, including the function of the structures. This has been done to guide and denote the risk-prone zones, which later helped to focus on the vulnerable points during further site visits. The risk-prone zones have been identified and documented as photographs as well for validation of the research. The questionnaire set beforehand was used to interview targeted respondents, which has been recorded. Several videos have been captured on the spot that enrich the research.

3.3.1.2 Questionnaire survey

The questionnaire survey was conducted on 127 respondents who live in the Laal Fakir Major slum. The number of respondents were selected through sampling method. The survey was carried out to understand the perception and knowledge of slum dwellers about fire disaster and the importance of community-based fire mitigation in slum communities. The questionnaire was set to gather information in relation to the cause of fire disaster and community-based mitigation methods followed by the respondents. A preset questionnaire was derived based on data collected from literature review to. The questionnaire survey was validated by FGD and KII methods.

1. Did you experience fire disaster?
2. Are you aware about fire disaster?
3. What was the severity of your loss to fire disaster? <ul style="list-style-type: none"> • Minor loss of property/ belongings • Major loss of property/ belongings • Health injury
4. What was the major cause of fire disaster that you experienced or witnessed? <ul style="list-style-type: none"> • Electrical short circuit • Gas pipe leakage/ poor placement of kitchen • Lack of awareness
5. Which is more vulnerable to fire disaster: Ground floor or first floor?
6. Did you participate in fire mitigation?
7. Did you participate or witness any fire safety drill as a part of CBDRM?

3.3.1.3 Focus Group Discussion (FGD)

A focus group discussion was carried out to understand the perceptions of the people living in Laal Fakir Majar slum. 12 slum dwellers were interviewed, and the respondents selected were adults. Participants from each lane were interviewed to collect thorough data on the entire slum community in order to generate an in-depth understanding of their living situation and their perception of risk-prone living conditions. People living in the slum were the target group, which includes both male and female respondents. The FGD was carried out during the day, when most of the participants were available. The questionnaire was generated to gather information based on the perception of the slum dwellers on fire hazards, their knowledge about precaution, how they act as a community to mitigate fire disasters, and the impact of fire disasters on their livelihoods. The interview with the respondents was recorded as audio data and transcribed for data analysis. The questionnaire was formed to facilitate the methodology of the research based on the objective of the study.

1. Understanding the cause of repetitive fire disaster
<ul style="list-style-type: none">• Are you aware about fire disaster?• Have you experienced fire disaster?• Why do you think repetitive fire disaster occurs in slums?
2. Knowledge about fire mitigation and precaution
<ul style="list-style-type: none">• What precaution do you take to prevent fire disaster?• What do you do to mitigate fire disaster?
3. Act of community-based fire mitigation
<ul style="list-style-type: none">• How does your community act to prevent fire disaster?• How does your community act during a fire disaster?• Do you have any community-based practices for fire mitigation?
4. Effect of fire disaster on the livelihood of the slum dwellers
<ul style="list-style-type: none">• Have you faced physical injury due to fire disaster?• Have you faced financial loss due to fire disaster?• Have you faced eviction due to fire disaster?

3.3.1.4 Key Informant interview (KII)

The qualitative research of the study includes key informant interviews (KII) to gather in-depth knowledge and an overview of the authorities in charge. The process is intended to understand the role of the authorities and whether they are aware of the issues concerning the slum

dwellers. The KII was formed to get detailed information regarding the existing proposals as well as actions that have been taken to address the problem (if any). The questionnaire was setup to get a thorough understanding based on the roles played by the authorities regarding slum formation and their vulnerable living conditions, which are highly prone to fire hazards. KII includes authorities from:

- The National Housing Authority (NHA)
- Urban Development Directorate (UDD)
- Rajdhani Unnayan Kartipakkha (RAJUK)
- Urban Development Programme (UDP) (umbrella organisation of NGO BRAC)
- Bangladesh Fire Service and Civil Defence Head Quarter
- Ward commissioner of ward 17 (Kalabagan), of Laal Fakir Major slum area

KII was selected based on their involvement with the research study in order to gather collective information that will help to understand the roles of governing bodies as well as NGOs. The interviews by the authorities were recorded as audio data and transcribed to analyze the data. The questionnaire was formed to gather in-depth knowledge for the research based on authorities' perspectives.

1. Understanding the formation of urban slums
<ul style="list-style-type: none"> • What causes the formation of urban slums? • Is there any control of the authority over the existing urban slums? • Are there any existing or future proposals for the formation of urban slums?
2. Knowledge about repetitive fire disaster in urban slums
<ul style="list-style-type: none"> • What are the causes of repetitive fire disaster? • Is there any lacking in the system that causes repetitive fire disaster? • What is the biggest challenge in addressing the problem?
3. Action taken for fire precaution and mitigation
<ul style="list-style-type: none"> • How does your organization act to prevent fire disaster? • How does your organization act during a fire disaster? • Do you have any authority-based practices or programs for fire mitigation?
4. Necessary steps needed to prevent repetitive fire disaster
<ul style="list-style-type: none"> • Do you think community-based fire response plays a vital role during a fire disaster? • What are the vital roles that authorities can play?

3.3.2 Secondary Data Collection

The secondary sources have been collected from news portals, published papers, articles, journals, thesis papers, and reports. The data collected from the mentioned sources has been used to generate the literature review of the study that validates the research.

3.4 Document review

The process of document review was carried out before the site visit. This was done to gather knowledge on the research topic beforehand, which helped to analyze the existing situation and focus on the key points. A total of four documents have been reviewed: two national documents and two international documents. The two national documents are the Bangladesh National Building Code (BNBC) and the Detailed Area Plan (DAP). Both documents include a thorough national guideline for development and construction, which helped to understand the current situation before the site visit and also facilitated finding further recommendations after the research. The two international documents are the National Planning and Building Authority of Kenya and the National Building Code of Nigeria. These two documents have been selected due to the similar pattern and growth of slums in the urban areas of the cities. The documents helped to understand the global scenario of informal settlements and how it has been addressed in the respective countries. This also provides new perspectives that further enrich the research.

3.5 Data analysis

The content analysis method was used to analyze the qualitative data obtained from FGD, KII, site surveys, and document reviews. Yin (2009) suggested utilization of classification, systemization, organizing and reassembling qualitative data to inscribe the initial statement of the research (Chowdhoree, 2018). Data collected has been organized and clearly interpreted following a structured procedure. This established rationale of the study and unit analysis which further distinguished the concept, category and framework of the analysis. The collected data provided a detailed overview of the authorities along with responses from the target audience selected at the site survey. The data collected aided the research in better analyzing the context and severity of the situation. Site survey was carried out to gather information based on observation, mapping, photographs, video graphs and interviews by the slum dwellers. Data collected from the site survey enhanced the understanding of the practical situation and provided the basis to compare with the standard guideline, which is further discussed in the findings of the research.

3.6 Research framework

The data collected from the above-mentioned tools has aided the research framework. The research includes data collection from both primary and secondary sources. The key primary sources are document reviews, FGD, KII, and site surveys. The target audience has been selected based on vulnerability and the number of inhabitants who have experienced fire disasters while living in substandard housing. Secondary sources have been collected from news portals, published papers, articles, and journals published by NGOs or respective authorities, which aided the literature review of the research. Laal Fakir Majar slums, situated in Kalabagan, Dhaka, Bangladesh, have been chosen as a case study area as they set a prime

example regarding the vulnerability of unplanned informal settlements to fire disasters. The site's being surrounded by neighbouring high-rise buildings and having a double-story structure with already existing poor infrastructure and little to no evacuation route sets a key example of urban slum vulnerability to fire hazards. Audio data collected during interviews has been transcribed. The results of the data collected have been discussed in the findings.

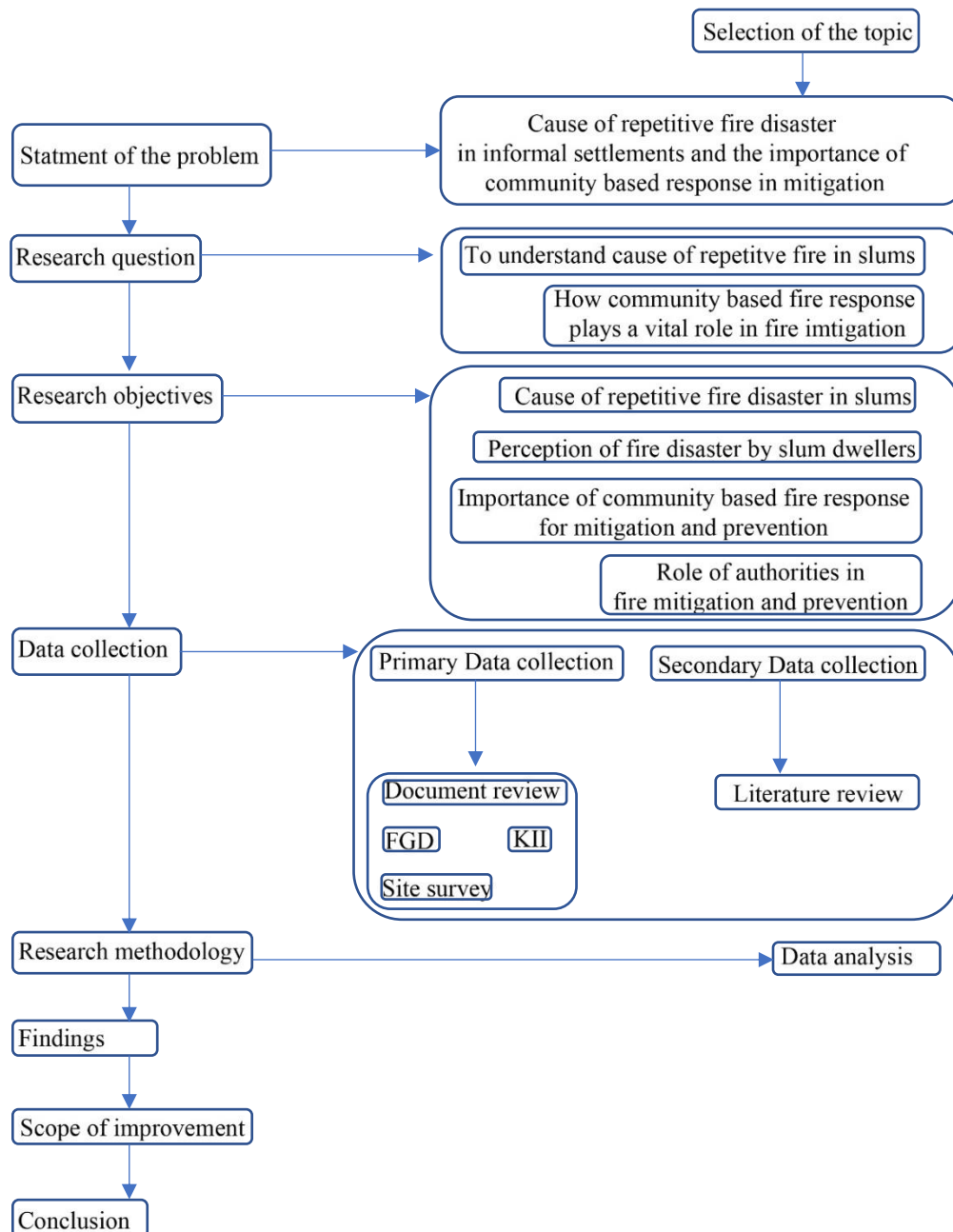


Fig 11: Research framework

CHAPTER FOUR

Document Review

The documents that have been reviewed before the site survey have been mentioned below:

- *Bangladesh National Building Code (BNBC)* (Housing and building research institute, 2015)
- *Detailed area plan (DAP)* (Rajdhani Unnayan Kartripakkha [RAJUK] et al., 2016)
- *National Planning and Building Authority of Kenya* (Bureau of Standards, 2009)
- *National Building Code of Nigeria* (Federal Republic of Nigeria, 2006)

Information that aids research from the mentioned documents has been listed below. This helps to generate perspective on both the national and global stage at the moment.

4.1 Bangladesh National Building Code (BNBC) (Housing and building research institute, 2015)

According to the Bangladesh National Building Code (BNBC), there are basic guidelines that need to be followed during any form of development or construction within the city.

Land use

Any city, union, or municipality development should be conducted under a structured and detailed planning area that considers land use patterns, transportation, and environmental factors that are permitted by the planning authorities and government. Land use patterns are categorized into different zones: residential, commercial, industrial, green park, storage, agricultural, reserved, etc., including mixed-use land. Any development on the land should follow the approved land use pattern by the planning authority and be indicated on the approved master plan. The planning authority determines permitted, restricted, and conditionally permitted residency.

Area limitations based on FAR (floor area ratio)

The required fire separation distance is based on building type, occupancy, and setback, which will further determine the FAR in order to prevent fire hazards. FAR will be determined by the designated authority. FAR is set by the area or city development authority under certain guidelines as per BNBC.

Fire Protection and NFPA (National Fire Protection Association) Standard guidelines

Fire protection and prevention guidelines as per BNBC code, applicable for residential or occupancy areas:

1) General provisions (Part 1 Code of Fire Protection on BNBC guideline)

General requirements for fire safety:

Basic requirements to ensure fire safety and preventative measures in a building.

- Height and area limitations: Floor area ratio, height and area limitations should be controlled by the occupancy group classification based on BNBC guideline (specified in Part 3 of the guide).
- Open space or fire separation requirement: Open space and fire separation of individual buildings at back and façade should follow BNBC guideline (specified in Part 3 of the guide).
- Access facilities for fire service: Accessibility of fire service vehicles and mechanism should follow BNBC guideline (specified in Part 3 of the guide).

Fire drill:

Fire drills should be arranged based on fire safety guideline to train occupants about first-aid firefighting, relocation and evacuation during emergency.

Fire tests and fire resistance rating:

Fire testing rating of individual building components should be conducted based on standard materials testing procedure according to each specific codes.

2) Precautionary requirements (Part 2 Code of Fire Protection on BNBC guideline)

Fire zones:

Fire zones of the city to be identified based on risk of fire hazard in the areas to ensure safety precautions for its occupants depending on the degree of hazard.

Smoke and heat vents:

Indoor ventilation should be ensured by means of opening to allow natural ventilation or in case of enclosed space by mechanical ventilation to prevent accumulation of smoke during fire emergency situation.

Fire lifts:

Fire lifts should be installed maintaining the guidelines as per code and have minimum occupancy of 8 persons. Lift lobby should be accessible to at least one fire stair for means of exit. Smoke detectors should be installed at a distance of 3m from every entry door of fire lift. Number of fire lifts will be based on total occupant load, floor area and compartment. It should be fully automated from the ground level and should be able to reach to the top floor (nonstop) within 1 minute.

3) Means of egress (Part 3 Code of Fire Protection on BNBC guideline)

General features:

- All materials used for construction should follow BNBC code.
- Structural stability of a building should be as per BNBC code.

- During an emergency, importance of life safety needs to be given to occupants, firefighters and rescuers. Thus, evacuation and reentry should be as per BNBC code.
- Availability and maintenance of firefighting equipment should be as per BNBC code to ensure minimum loss of property during fire emergency.
- Exits of a building should be clearly visible.
- The owner or the lessee of the building should be accountable to ensure fire safety protocols as per BNBC code.

Stairways:

- Dimensions of risers, threads (should be identical) and widths of stairs should be as per BNBC code.
- Handrails and guards should continue to the full length of the stairs.
- A visual enclosure should be established in a stairway that is being used by more than 10 occupants in a building higher than 3 storey.
- All exit stairways should be constructed using fire resistant materials.
- No stairway should be constructed around lift shafts unless both are built in a smoke proof space.
- Exterior stairways can only be used as a fire stair if it lands directly to the ground and is separated from the main structure or have fire resistant features that also ensure no accumulation of smoke.

Smoke proof enclosure:

- Highrise building exit stairways should have smoke prevention methods.
- Smoke proof enclosures and stairways should have retention capacity at least till 4 hours and should have no openings other than to fire doors.
- Smoke proof enclosures should have automated doors that enclose upon fire detection.
- The vestibule of a building should have adequate ventilation and should follow dimensions as per BNBC code.
- Mechanical ventilation should be established in case of windowless enclosed stairway or vestibule.

Exit of a building:

- The exit of a building acts as an evacuation system during fire emergency.
- The exit should be approachable from any part of the building and should not have any obstacles during evacuation or reentry of firefighters.

- Exits for emergency should not be used for any other means to maintain precautions and should be clearly indicated.
- The evacuation route should lead to an open safe space for the occupants.
- Exits should be clearly mentioned and illuminated signs to be installed where needed.

4) *Equipment and inbuilt facilities standards (Part 4 Code of Fire Protection on BNBC guideline)*

Fire classification:

Fire class has been categorized based on the type of fire.

Fire class A: Fire induced from common flammable materials such as wood, clothes, plastic, paper etc.

Fire class B: Fire induced from flammable liquids and gases such as gasoline, propane and solvents.

Fire class C: Fire induced from electrical devices such as computer, fax machine etc.

Fire class D: Fire induced from combustible metals such as magnesium, lithium, aluminum etc.

Fire class K: Fire induced from cooking elements such as oils, fats etc.

Fire extinguishing element will depend upon the type of fire.

Fire detection:

Fire detection can be done in the following ways:

- Human surveillance
- Automatic smoke/ heat detection
- Video surveillance

Fire alarm system:

Activation of alarms should be in sequence that is compatible with the design scenario to enable efficient evacuation and relocation of the occupants. Authorized person should be alerted through a password or pass phase during fire to avoid panic situation. A systemic evacuation protocol should be maintained with zoning and specific alarm system in each zone.

Requirements for fire detection and extinguishing system (Part 5 Code of Fire Protection on BNBC guideline)

Installation and arrangement of fire detection and firefighting equipment fixed centrally, localized or portable should be performance based.

Residential

Occupancy A1 and A2: Single family dwelling and two families dwelling:

- Fire detection and firefighting arrangements are not required for low rise buildings.

- High rise buildings with floor area more than 500 square meters should have manual alarm system with available fire extinguishing equipment in fire lift lobby and in fire escape stairs.
- High rise buildings with floor area more than 500 square meters should have manual alarm system and dry or wet riser hydrant system.

Occupancy A3: Flats and apartments:

- Fire detection and firefighting arrangements are not required up to 20meter height.
- Dwelling units of flats do not require any protection. High rise apartments should have manual alarm system and fixed hydrant system in the landings of fire stairs or in the lift lobby.

NFPA (National Fire Protection Association) Standard guidelines:

According to BNBC guideline, NFPA standard guidelines should be followed for:

- Hazardous, garage, utility and miscellaneous occupancy to ensure life and fire safety.
- Graphics of exit signs and floor numbers should follow NFPA 170 code to ensure clear visibility during means of evacuation.
- NFPA 22 code should be followed for the direct main water connection supply to ensure efficient firefight strategies during emergency situation.
- NFPA 25 code should be followed after hydrant system installation to verify the capacity that fulfills the minimum flow and time.
- NFPA 20 code should be followed for fire pump installation procedure and fittings to ensure the net pressure of 272 kPa or more as per firefighting demand requirements.
- For occupancy hazard, NFPA 10 code should be followed for the minimum number of fire extinguishers for different class of fire. The occupant, owner or designated person in charge is liable to recharge, maintain and inspect the equipment.
- For moderate hazard industries, NFPA 101 code (edition 15) should be followed for the exit access doors.
- For garages, NFPA 101 code (edition 15) should be followed for areas used only for parking purposes.
- NFPA 204 code should be followed for different shape roofs. Total vent area per curtain area should be maintained to meet design objective that ensure efficient ventilation as per code. Smoke and heat venting system as well as mechanical exhaust system should be inspected and maintained as per this code.

4.2 Detailed Area Plan (DAP) (Rajdhani Unnayan Kartripakkha [RAJUK] et al., 2016)

DAP had two major focuses: to maintain control over the development within the RAJUK area through land use zoning and to formulate a framework for future development of infrastructure and services. DAP prepared a land use zoning plan, including an infrastructure development plan. The land use zoning plan specified where future land uses will be located, which is part of the development control plan. Any developer intending to build a structure or make use of

any land needs to get land use clearance from RAJUK to ensure it is maintaining DAP regulations.

Informal Settlements

Most of the slums in Dhaka are monitored and controlled by the political influentials. Unavailability of affordable housing is a primary reason behind growth of slums as at current market price of housing, over 78% of the lower middle-income group and 70.73% of the middle-income group families cannot afford housing within the city. Thus, it is impossible for the lower income group to afford a decent accommodation within the city.

Policy-HN/4.1 (Provide Affordable Housing to the Low and Middle-Income Groups by public sector):

Mostly city's higher and higher-middle income groups have previously benefited from housing projects of RAJUK and NHA, whereas, only a minimal percentage of the city's low-income group got benefited. In order to create a non-biased benefit policy to address the housing crisis, the objective of DAP for the next 20 years is to provide affordable housing to the poor through agencies such as, M/O Land, RAJUK, NHA, Ministry of Finance and Bangladesh Bank by implementing the following tools:

- Build low rent high-rise buildings (10-20 storied) for the low-income group near their major working hubs.
- Land near eastern periphery adjacent to airport could be selected for low-income housing.
- Projects that create scope to rent public housings for Government and Private employees.
- Rents should be at an affordable rate.
- Policy to ensure long term rental facilities.
- Enable funds for research on affordable housing for the poor.
- Provide special rental benefits to low paid government employees.
- RAJUK to implement low-income housing projects in DAP.
- NHA and RAJUK to initiate housing projects near industrial zones to provide accommodation to the urban poor.
- Effective and efficient tools need to be improvised to ensure:
 - 5) The housing projects are indeed being benefited by the target group.
 - 6) The projects are being affordable to the target group.

Policy-HN/4.2 (Improve Conditions in Slums):

To improve the quality of living condition of the slum dwellers, improvement of slums is necessary. Under the provision of Rent Control Act, a contract with the slum owners could be conducted to stop the exploitation of the urban poor by limiting the raise of rent for a particular period of time. RAJUK, NHA, City Corporations and Pourashavas to take policy decisions on improvement projects of slums. Conducted by RAJUK, NHA and Urban Local Governments through a bottom-up approach that includes the slum community members by implementing the following tools:

- RAJUK, NHA, City Corporations and Pourashavas can collaborate with private slum owners on slum improvement projects.
- By obtaining funds through donor, government or agency's own source.
- A contract with slum owners to not raise rent for next five years.
- By enforcing legal laws under House Rent Control Act 1991 to authorize the control of house rent in favor of the slum dwellers.
- Rent control allocations should be broadcasted to aware both house owners and tenants.

Fire Disaster

Fire disaster has been a prominent threat for Dhaka city, mostly due to poor construction methods and for not following Fire Protect Act, 2003 guidelines. High percentage of fire disaster in Dhaka has occurred mostly in manufacturing industries, informal settlements and old parts of the city compared to the planned residential zones, commercial and outskirts areas.

Policy-UDM/1.1 (Preparation of Comprehensive Risk Sensitive Land Use Plan):

Risk zones can be mapped throughout the city, which can be overlapped with land use map to predict probable risk factors to take precaution. RAJUK, Local Government Agencies, and Directorate of Disaster Management can later construct infrastructures based on the risk factors to minimize vulnerabilities of the inhabitants. The risk sensitive land use plan can be carried out through following tools:

- Formulating land use pattern based on the disaster risk impact assessment by taking account of the risk sensitivity of the area.
- Planning adequate open areas such as parks and playgrounds which can later work as a platform to provide shelter during disasters like earthquake and fire incidences.
- Identifying hazardous areas to build capacity and resilience.
- Low land areas to be identified to form schemes that will preserve the environment and benefit during flooding.
- Land use zoning policies to be implemented and guidelines to be followed strictly.
- Including slum dwellers to formulate methods to build capacity and minimize environmental issues.
- BNBC guidelines to be strictly followed during any construction.
- Micro zonation mapping to be issued based on soil profile to minimize hazard.

Policy-UDM/1.2 (Preparation of Multi Hazard Risk Mapping for Dhaka Metropolitan Region):

Identifying areas suitable for development and habitation through multi hazard risk mapping. RAJUK, Directorate of Disaster Management and Local Government Agencies to identify the risk zones through projects by implementing the tools below:

- Agencies in charge to urgently develop projects to formulate multi hazard risk zoning maps for the entire Dhaka metropolitan region.
- Risk zone map to include factors such as evacuation route, nearby temporary shelter and facilities (hospitals, schools and others).

- Development projects should be initiated based on multi hazard risk assessment that helps to formulate urban risk profile in order to identify safer locations for construction.
- Development in hazard prone areas should be identified and monitored.
- An updated land use zoning map should be created in details to identify levels of vulnerabilities for each specific zone.

Policy-UDM/3.4 (Monitor and Forecast Demand for Fire Fighting and Evacuation Facilities):

Fire Service, Civil Defense and RAJUK to monitor and evaluate the need of firefighting and evacuation routes to ensure the safety of the urban dwellers. BNBC guidelines, Fire Prevention and Extinguishing Act 2003 to be followed. The process includes implementation of the tools mentioned below:

- Formulating updated data on fire and population to estimate the need of fire services depending on present and future requirements.
- Ensure maximum fire protection in the city at the lowest possible cost based on present and future need.
- Mandatory presence of fire evacuation plan in commercial, institutional and high-rise buildings.
- Sprinklers to be installed in high-rise building for fire protection.
- Monitoring and evaluating firefighting demands and needs should be in cooperated in both Fire Prevention and Extinguishing Act 2003 and in BNBC guidelines.
- RAJUK to collaborate with Fire service department to enhance firefighting capacity from 16 storied building to provide firefighting services to tall high-rise buildings.
- Fire stations to be established at the corner plots within a distance with minimum two entries on main roads.
- River/ khal/ lake/ pond needs to be preserved which can work as a source of water during emergency fire disaster situations.
- Apart from conservation zones, fire stations to be permitted in all land use zones.
- Flammable chemical factory or shops are prohibited in residential areas.

4.3 National Planning and Building Authority of Kenya (Bureau of Standards, 2009)

Basic design and construction requirements:

Any building or structure element should be constructed following the proper structural design to ensure strength, stability, durability, and serviceability. Buildings constructed following the authorized structural design should be able to prevent any damage from accidental overloading and not hamper the structure of the building. Materials used to construct should follow the code and standards approved by the Kenya Bureau of Standards. Walls should be fire-resistant and non-combustible. The roof of the building should be able to resist any possible force and should be durable and waterproof. Should have a proper water drainage system to prevent damping. The ceiling should be constructed at a standard clear height from the floor. Timber roofs and designs should follow the standard and code approved by the Kenya Standards. It should be treated to prevent infestation. The main staircase of any building that exceeds one storey should

have a clear height of at least 2 m, a minimum width of 900mm (in the case of residential buildings), follow the standard guidelines, and not have more than 16 steps without a proper landing. The staircase should have access to a street or an open space, and if the stairs continue to the roof as a means of fire escape, it should provide a door. Every building should have a proper means of escape in case of an emergency. Any building that exceeds one story should have a proper and adequate number of staircases and have access for firemen to all floors during a fire disaster. Any habitable room occupied by an inhabitant should have proper means of ventilation and lighting. Buildings should have a proper sewage and water drainage system that follows the guidelines and regulations set by the authority.

4.4 National Building Code of Nigeria (Federal Republic of Nigeria, 2006)

Residential buildings fall under Group H in the National Building Code of Nigeria. This classified group includes buildings that provide sleeping accommodation to the dwellers and might include or exclude dining facilities (excluding institutional buildings). This group has four different categories:

Group H-1

This includes buildings that provide temporary sleeping accommodations to the occupants, such as hotels, motels, boarding houses, or similar categories of buildings.

Group H-2

Buildings that are occupied by multiple families with more than two dwelling units and also multiple single-family dwelling units, boarding houses, or any similar building that provides shelter and sleeping facilities to the dwellers fall under this category. This also includes dormitories that accommodate more than five people for more than four years. (*Except: fire protection system, section 12.2, and fire-resistant construction building, section 12.3*)

Group H-3

This includes child care facilities that accommodate five or fewer children of any age. Also, buildings suitable for one- or two-family dwelling units that do not consist of more than five lodgers or boarders per family for multiple single-family dwelling units, *fire protection systems (section 12.2) and fire-resistant construction buildings (section 12.3)* need to be followed.

Group H-4

This includes detached one- or two-family dwellings that are not more than three stories in height, which also includes the accessory structures of these buildings.

Fire Protection Systems (section 12.2)

A fire protection system should be maintained and taken care of by the owner, tenant, or lessee of the building or structure to ensure the safety of the occupants. Fire protection devices should not be disconnected or handled unsupervised without the permission of the fire department. As the fire service department is responsible for inspection and maintenance of fire protection devices, respected authorities in the building should cooperate during the procedure. A proper plan should be submitted to the department with adequate details that help identify hazards and

evaluate the efficiency of the system. The details should include the materials used, placement, and exposure to the hazard.

Fire-Resistive Construction (Section 12.3)

This section constitutes the regulations regarding materials used and methods of construction as per the fire resistance rating and flame resistance of respective buildings and their occupancy compared to potential fire hazards. This includes the structure of the building along with the location, function, and other fire-resistive elements of the building, ensuring the prevention of the spread of fire to and from adjoining structures. This varies for each type of building, and based on the type of structure, a fire prevention method should be applied.

Vulnerability of Slum dwellers to Fire Disaster

Vulnerability of slum dwellers to fire disaster have many contributing factors. To identify the root cause of the problem and to understand the real scenario, the following site has been studied. The site was selected due to easy accessibility for multiple surveys, communicative respondents, permitted entry by the landlords and its vulnerability.

5.1 Site Information

The site, Laal Fakir Majar slum, is situated in Kalabagan, Dhaka, the capital city of Bangladesh. The slum has been formed within a pocket space surrounded by high-rise buildings on a private land on a residential zone, making it an ideal study area to understand how the informal settlements are formed in developing urban cities. During the field survey, it was found that the slum covers approximately 8677 square feet and accommodates 1400 to 1500 people. This slum is almost invisible from the outside, with no direct access to the main road. The slum being double structured with poor infrastructure and no planned evacuation route, provides a real scenario of the existing slums in Dhaka.

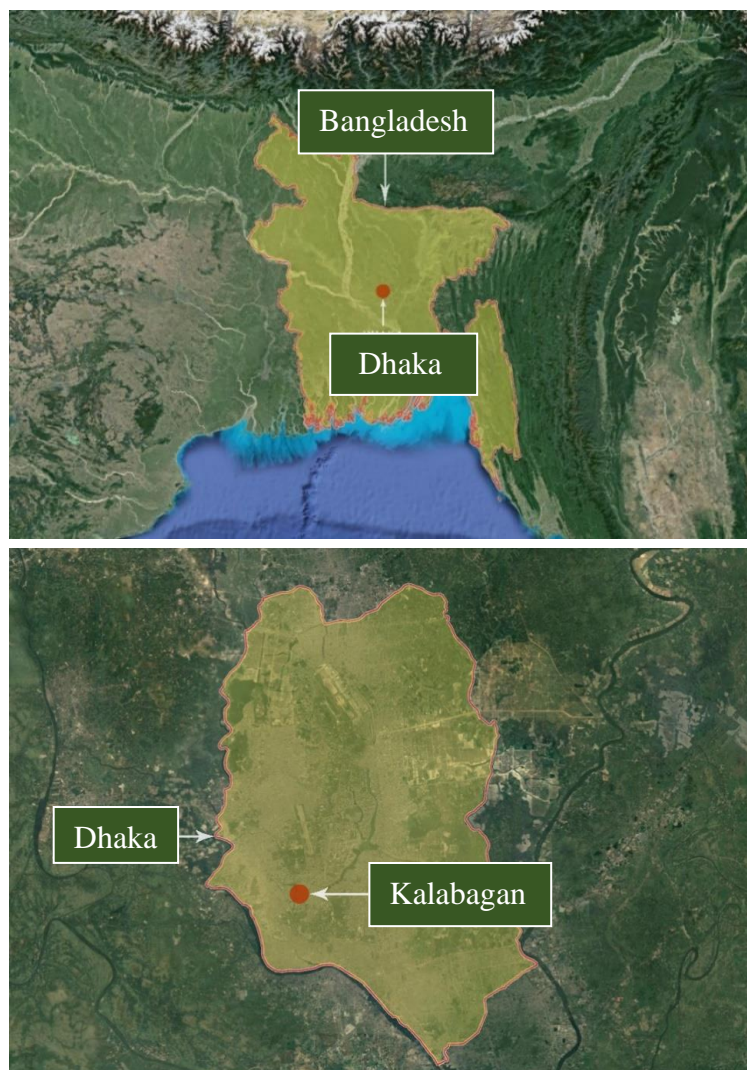


Fig 12: Location of the site (Google map, 2023)

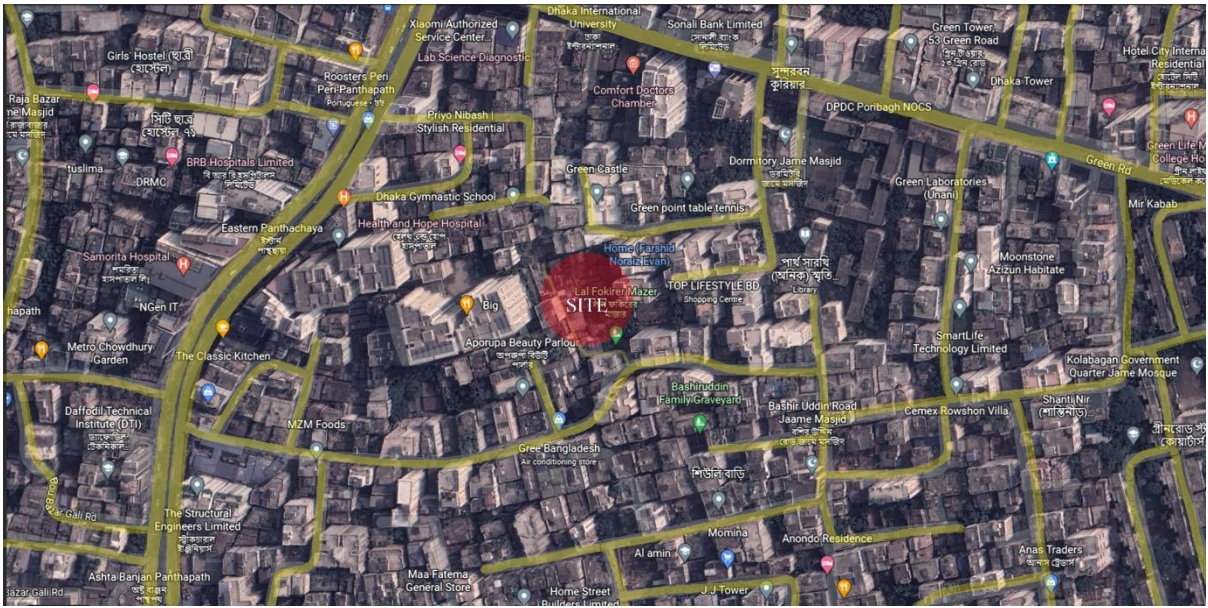


Fig 13: Location of Laal Fakir Majar slum (Google earth, 2022)



Fig 14: Laal Fakir Majar slum (Site survey, 2022)

5.2 Site survey

The site has been studied in detail to understand the real scenario of the informal settlement. The entire slum has been measured in detail with digital measuring tape during site visits. A scaled drawing has been created in AutoCad to generate a plan that provides an overview of the slum formation. The measurements, along with detailed plans, have been listed below:

A single 3 feet 9 inches wide, narrow passage with a dead-end is used as both an entry and an existing road to the informal settlement, with no possible entrance of vehicles. It is a double-story, structured slum, with approximately 600 to 650 people on the ground floor and around 800 to 850 people on the upper floor. The first floor consists of previously existing brick and concrete structures, while the upper floor has been built with scrap materials including tin sheets, bamboo, and recycled wood. The slum branches to the right from the only access road to form 11 alleyways, each consisting of 8 to 10 separate rooms for habitation on the ground floor. The upper floor on lanes 1 and 2 consists of 20 to 25 rooms or more combined, and other rooms consist of 16 rooms on average per lanes. Ground-floor rooms are usually 10 feet by 6 feet in size, while upper-floor rooms are extremely densely packed and used for sleeping purposes only. The upper floor has been built from lane 1 to lane 10, and the stairway exists in between the ground-floor rooms. The staircase is approximately 2 feet 6 inches wide and made of bamboo, recycled wood, and scrap metal pieces in some areas. The majority of these lanes end with a kitchen and a washroom. Exception of lanes 3 and 4, where kitchens are not available. They cook outside, where a gas burner has been set up next to the major structure, exposed to the road. Gas is distributed through GI pipes, which are often exposed on the ground in the passageway. Gas is always available, as a time allotment has been specified for each family due to a shortage of kitchen areas. Burners and portable gas stoves are often used inside the rooms as an alternative to the lack of a kitchen and to avoid using a stove for cooking. A water line is present in lanes 3, 7, and 11, with an expectation of water in lanes 1 and 2, where water is collected from a tube well. Water is distributed through plastic hose pipes, which are often exposed in the passageway.



Fig 15: Detail map of the slum from site survey was drawn in AutoCAD and further inspected to gather information (Site survey, 2022)

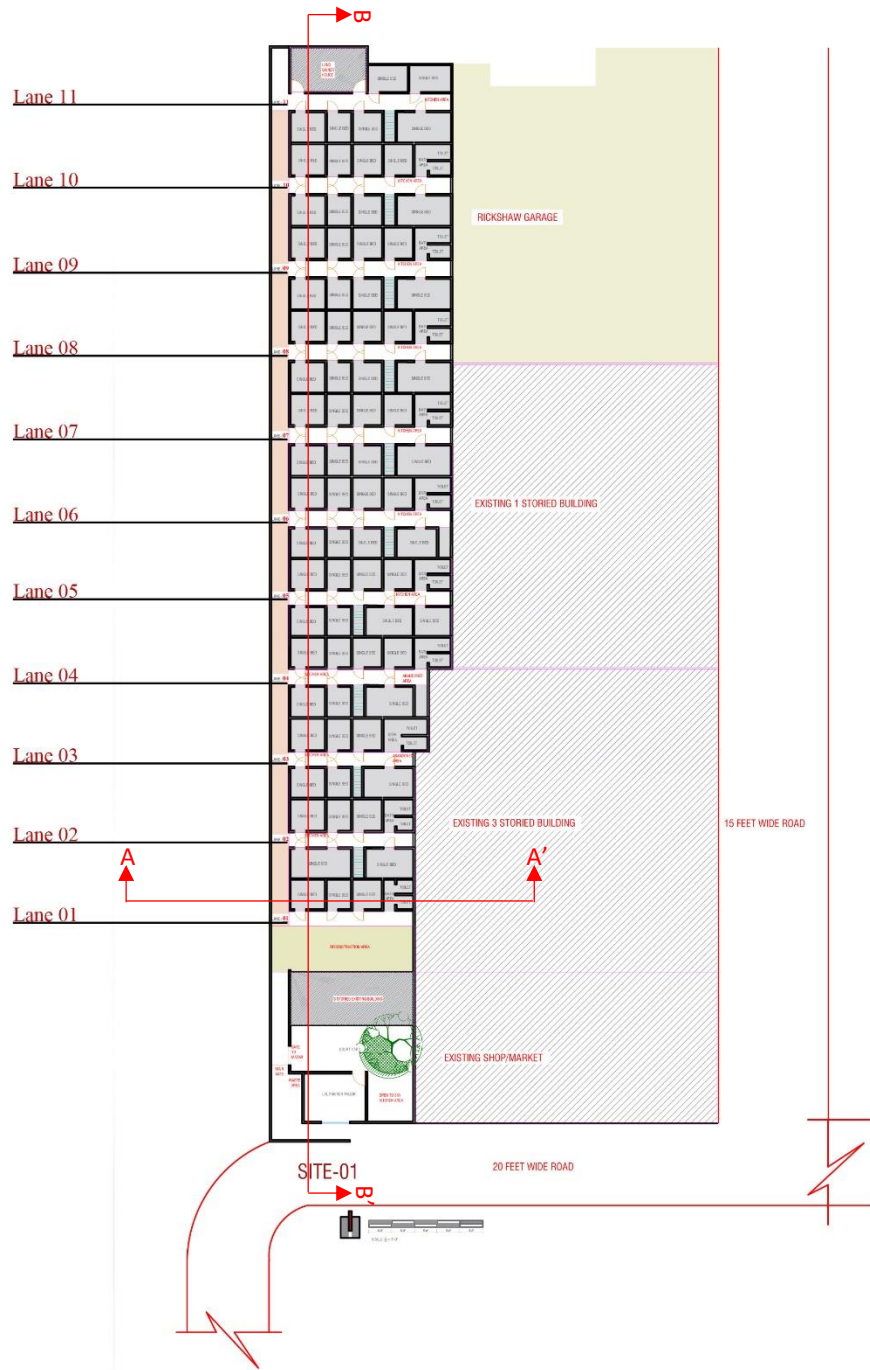
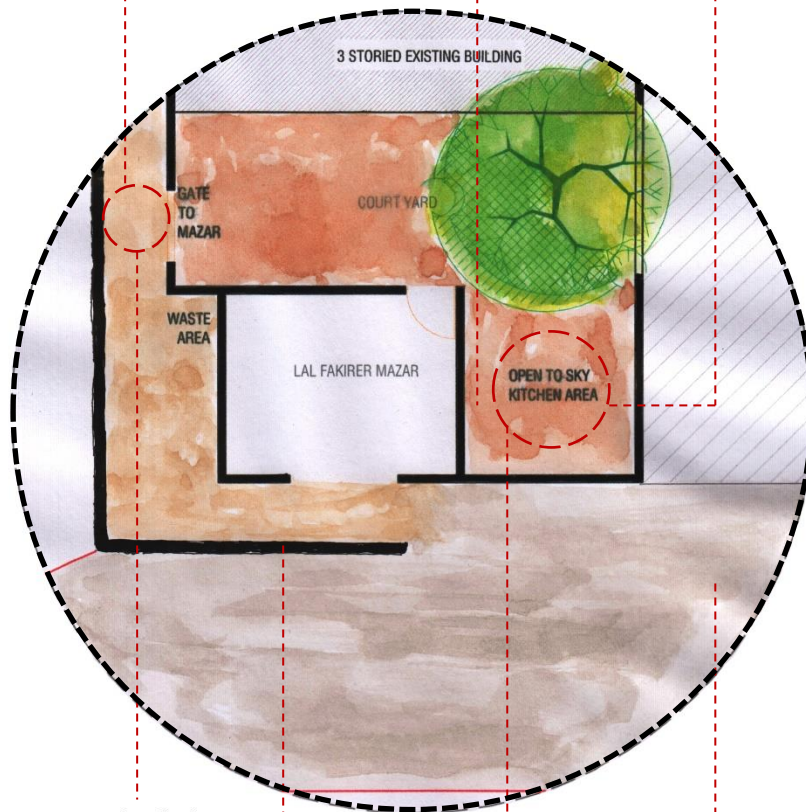


Fig 16: Detailed measured drawing of the site generated through AutoCAD (Site survey, 2022)



Narrow passage used as both entry and exist for the slum with no vehicular access

The slum is well hidden from the main road

Main road

Outdoor kitchen used in times of rush hour by slum dwellers


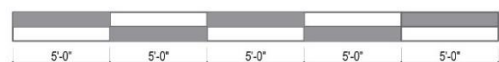
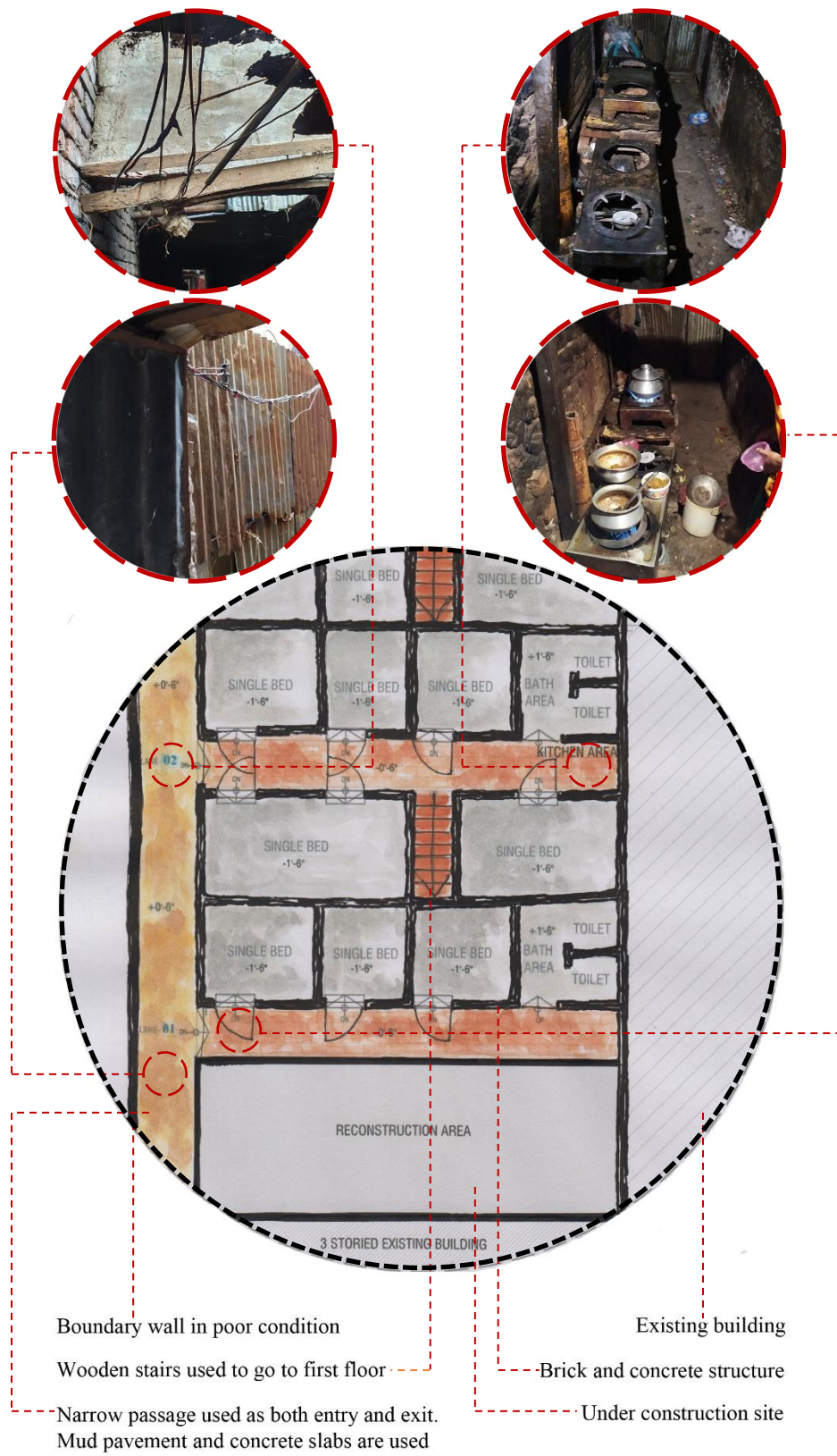
 Risk Zone (Kitchen area, electrical plug and narrow passage with no vehicular access)

Fig 17: Entrance of the slum (Site survey, 2022)






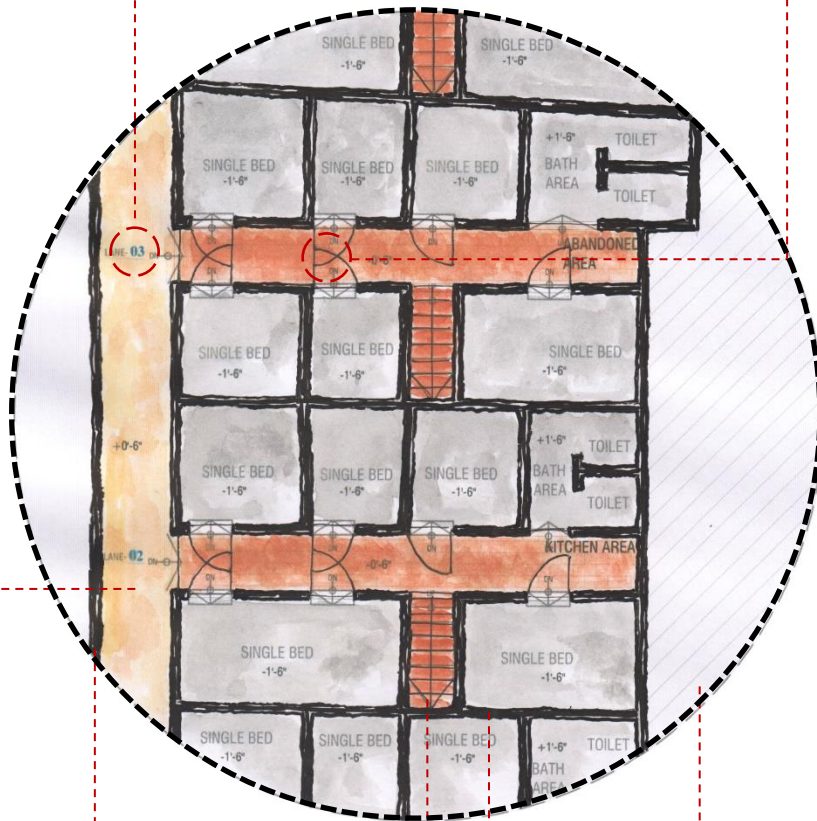
 Risk Zone (Kitchen placement, poor electrical wires bundled up and narrow passage with no vehicular access)

Fig 18: Lane 01 and 02 (Site survey, 2022)





Boundary wall in poor condition

Wooden stairs used to go to first floor

Narrow passage used as both entry and exit. Mud pavement and concrete slabs are used

Existing building

Brick and concrete structure


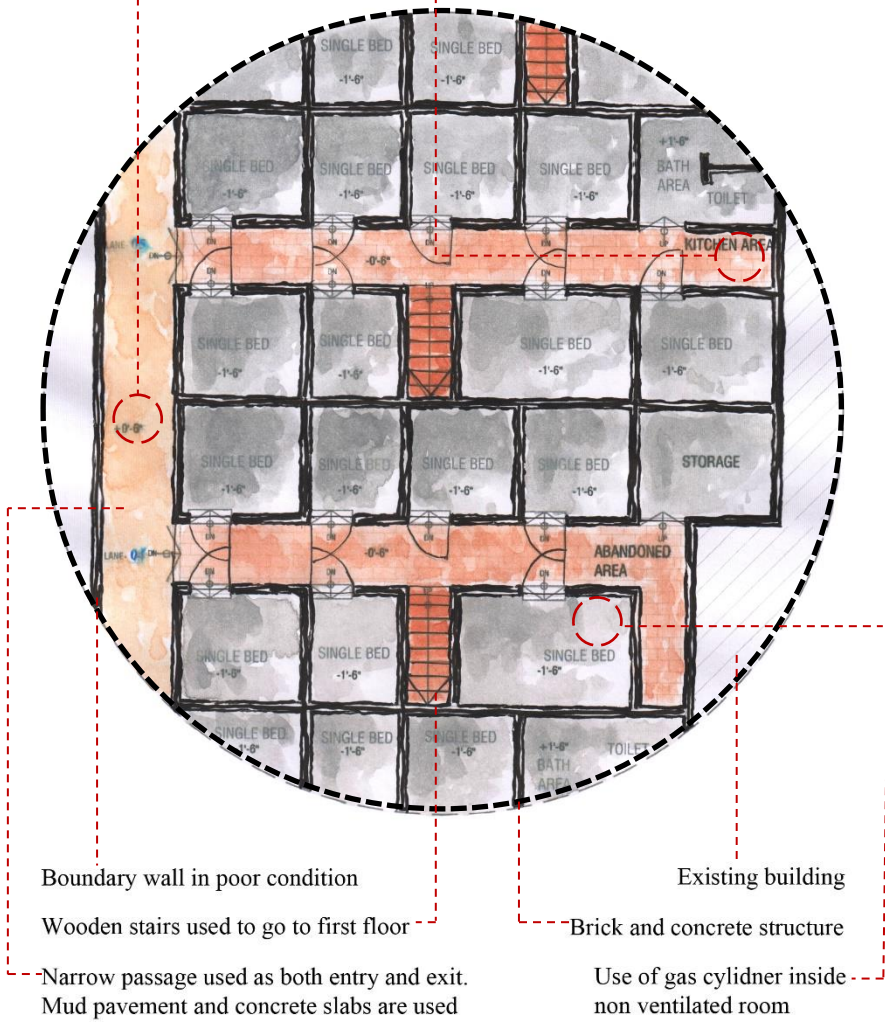
 Risk Zone (poor electrical wires bundled up)

Fig 19: Lane 02 and 03 (Site survey, 2022)






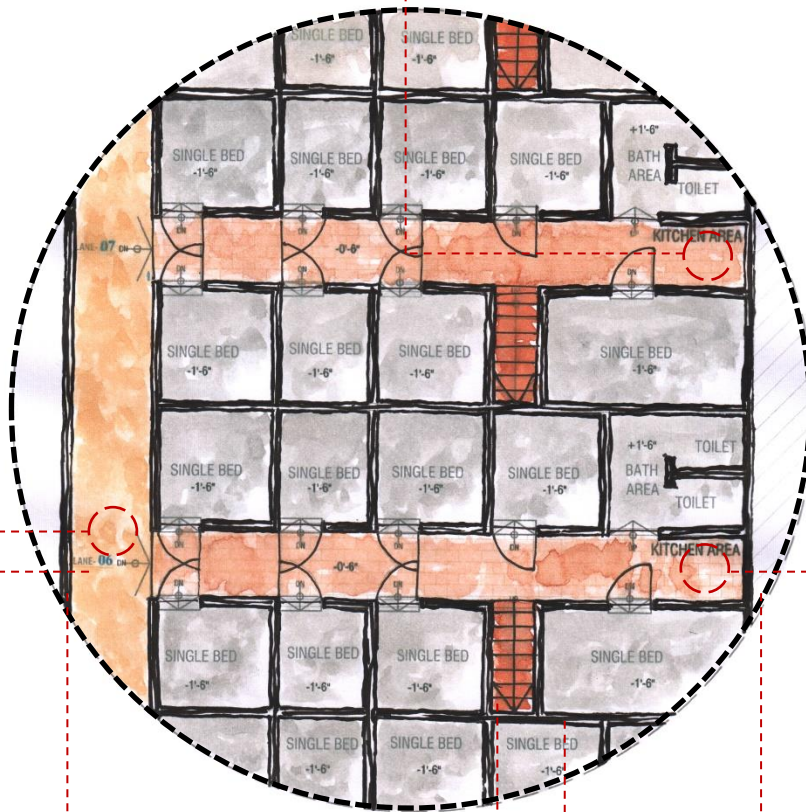
 Risk Zone (Kitchen placement, use of gas cylinder in non-ventilated room and poor electrical wires bundled up)

Fig 20: Lane 04 and 05 (Site survey, 2022)





Boundary wall in poor condition

Wooden stairs used to go to first floor

Narrow passage used as both entry and exit.
Mud pavement and concrete slabs are used

Existing building

Brick and concrete structure


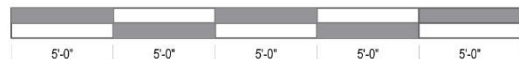
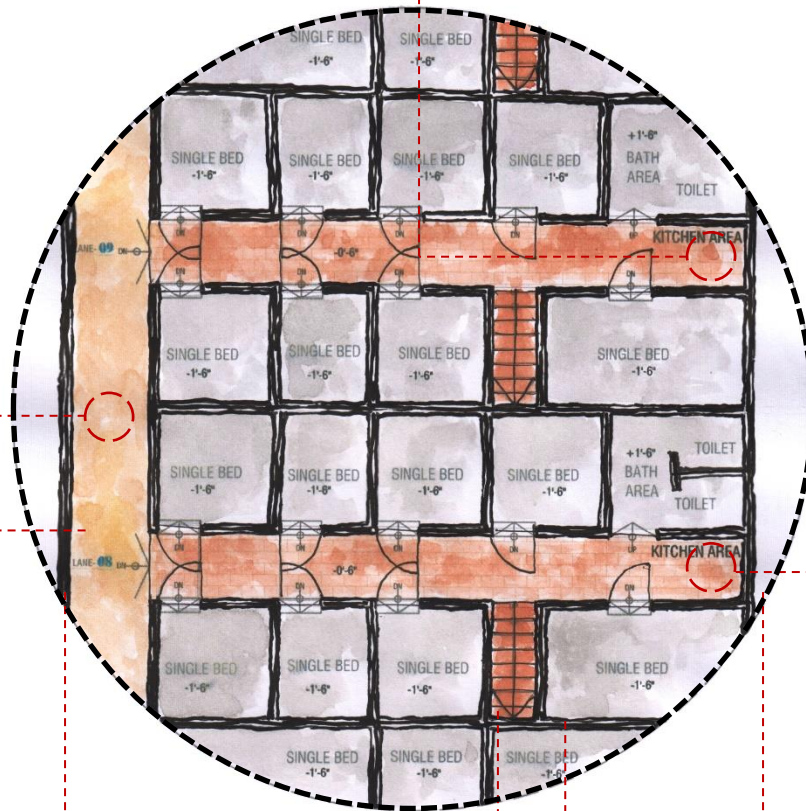
 Risk Zone (Kitchen placement and poor electrical wires bundled up on the passage way with no clear height)

Fig 21: Lane 06 and 07 (Site survey, 2022)





Boundary wall in poor condition

Wooden stairs used to go to first floor

Narrow passage used as both entry and exit.

Mud pavement and concrete slabs are used

Existing building

Brick and concrete structure


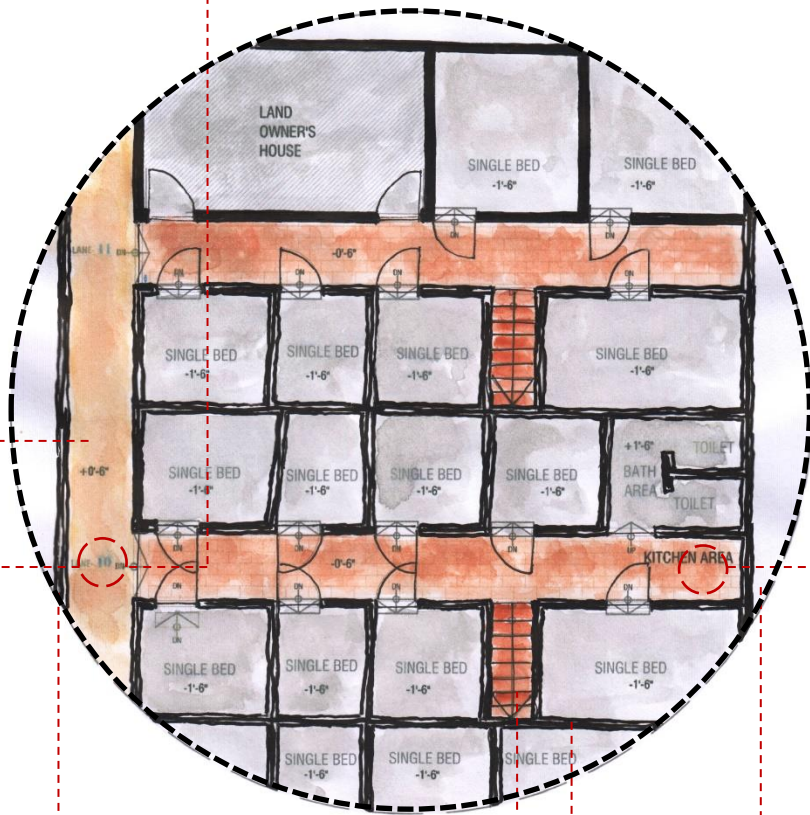
 Risk Zone (Kitchen placement and poor electrical wires bundled up on the passage way with no clear height)

Fig 22: Lane 08 and 09 (Site survey, 2022)





Boundary wall in poor condition

Use of hose pipes for gas supply

Narrow passage used as both entry and exit.
Mud pavement and concrete slabs are used

Existing building

Brick and concrete structure

Wooden stairs used to go to first floor


 Risk Zone (Kitchen placement, use of hose pipe for gas supply throughout the slum and poor electrical wire bundled up with no clear height)

Fig 23: Lane 10 and 11 (Site survey, 2022)



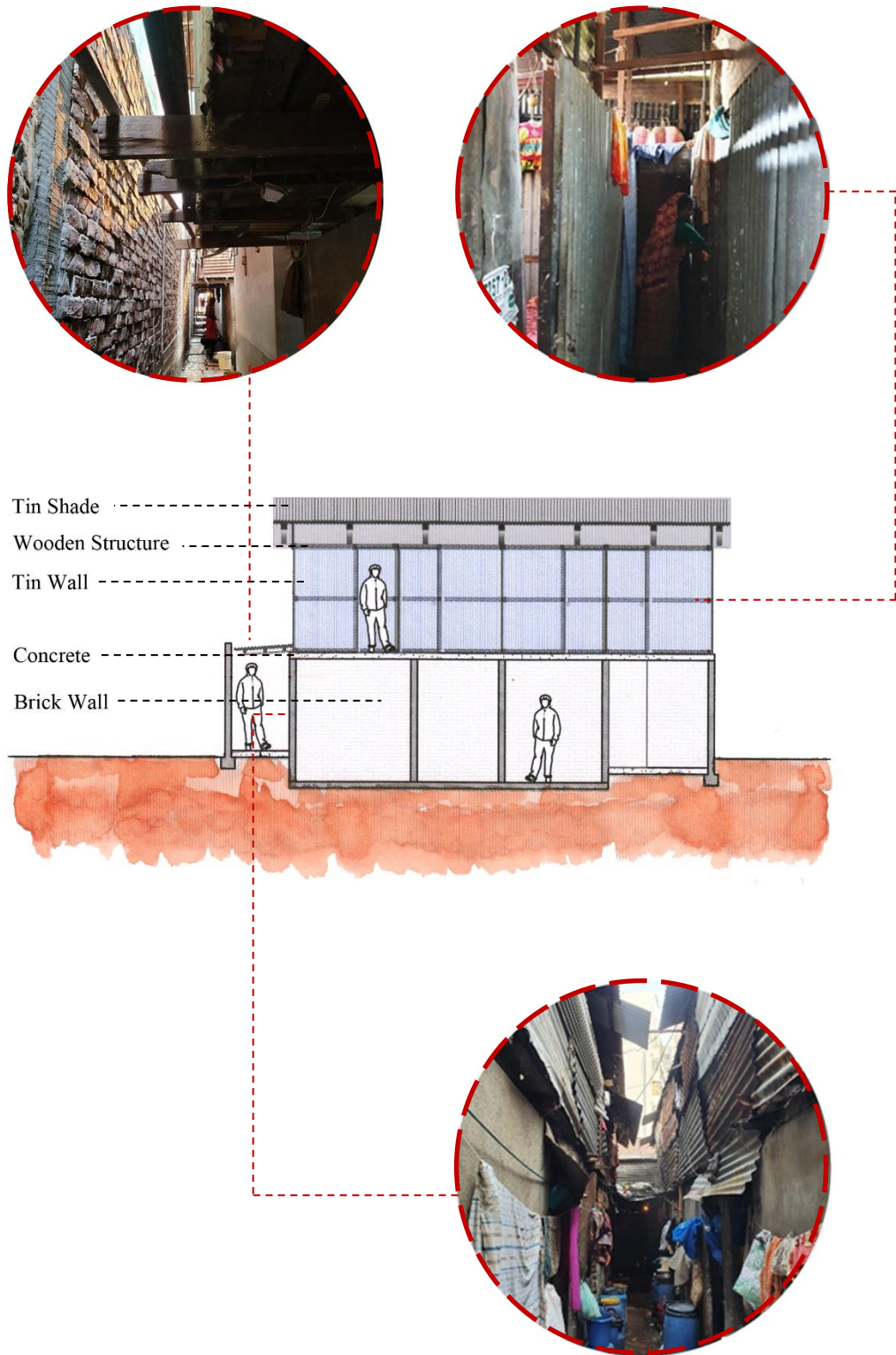
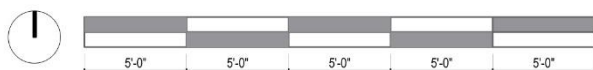


Fig 24: Section AA' shows the unplanned growth of vulnerable poor infrastructure (Site survey, 2022)



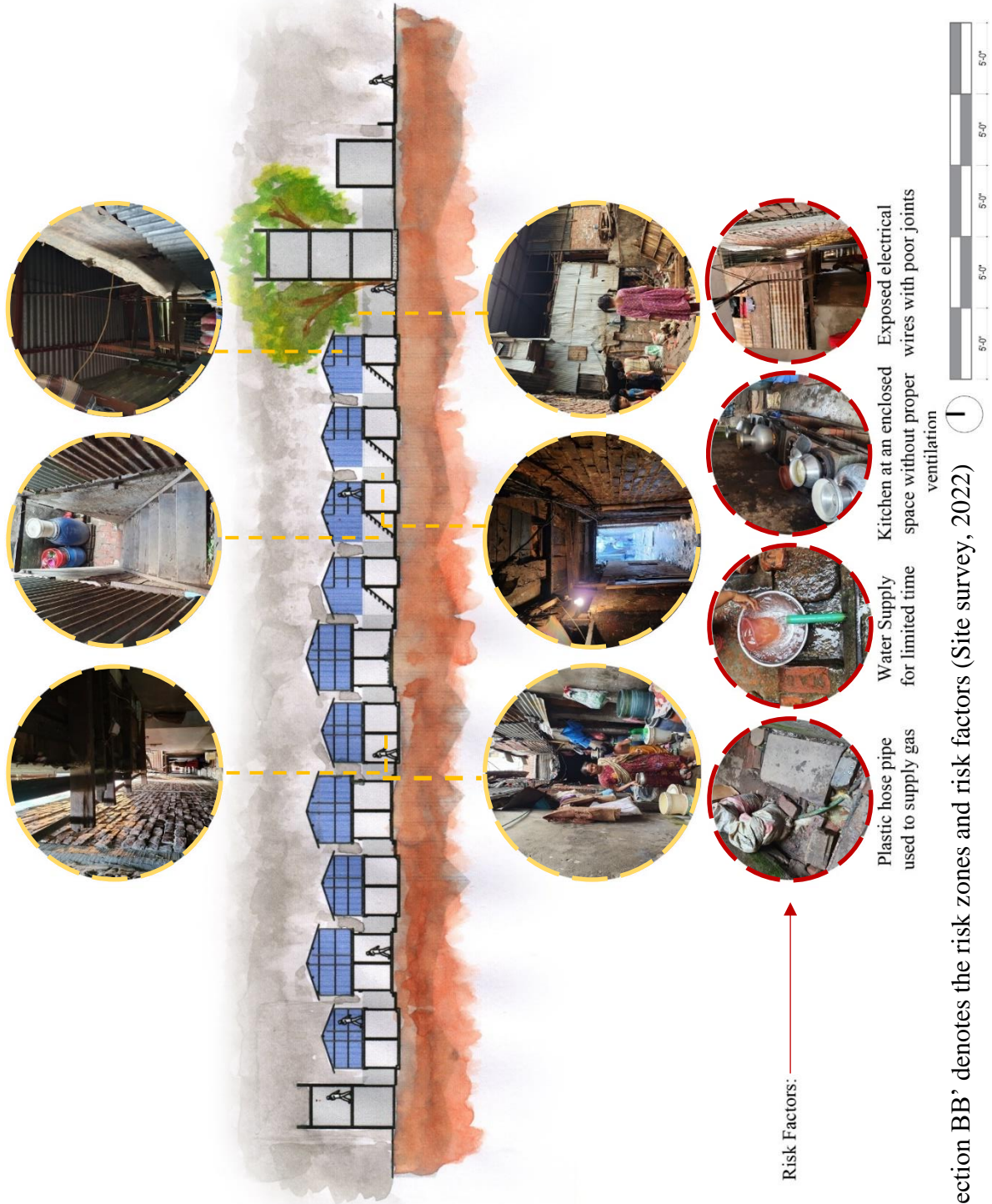


Fig 25: Section BB' denotes the risk zones and risk factors (Site survey, 2022)

5.3 Identification of risk zones based on fire disaster

The targeted group for FGD includes both male and female respondents who are adults. The respondents from each of the 11 lanes have been selected based on their living experience in the informal settlement. A total of 12 slum dwellers participated in the FGD survey.

Risk zones have been identified through observation and FGD. The presence of kitchens in non-ventilated spaces, exposed electrical wires with poor joints, and the use of gas burners were seen during multiple site visits. Targeted 12 respondents identified the risk zones based on their experience with fire disasters.

Respondent from each lane	Electrical short circuit	Kitchen/ gas burners	Gas supply pipes	Lack of awareness
Lane 01	✓	✓		
Lane 02	✓	✓		
Lane 03	✓			
Lane 04		✓		
Lane 05	✓		✓	
Lane 06	✓	✓		
Lane 07	✓	✓		✓
Lane 08	✓		✓	
Lane 09			✓	
Lane 10				✓
Lane 11	✓		✓	

Table 04: Risk zones based on FGD and observation (Site survey, 2022)

5.4 Use of combustible materials

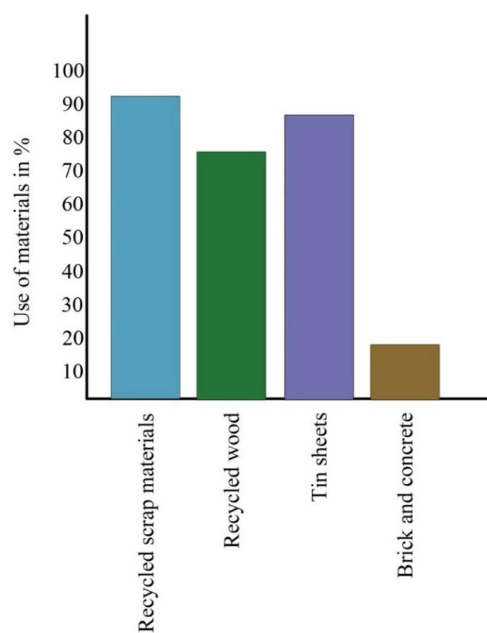


Chart 01: Materials used in the informal settlement based on observation during site visit and information provided by the respondents of FGD (Site survey, 2022)

The slum is built with different recycled and scrap materials. The ground-floor rooms are made of previously existing brick and concrete materials that have not been repaired. The upper-floor rooms are made of recycled wood and tin sheets. Recycled plastics and clothing materials are widely used for screening purposes. Due to the presence of highly flammable materials and a crowded environment, the fire spreads faster within the lanes during a disaster.

5.4 Vulnerability of slum dwellers and their limitations

The respondents to the FGD of the research expressed their concern about living in vulnerable conditions. Although they are aware of the risky situation, there is little to no control they have to improve their living standard. Their financial instability is one of the root causes of them being exploited by the influentials. The respondents informed that they are forced to live in such poor conditions and feel there is no better alternative.

Perception of Slum dwellers and Authorities on Cause of Repetitive Fire Disaster in Slums

To understand the cause of repetitive fire disasters in slums, perception of both slum dwellers and authorities have been taken under consideration. Tools used for this study include a questionnaire survey (127 respondents), focus group discussion (12 respondents), key informant interviews, and on-site observations, which have been conducted to gather data on the existing situation. The collected data has been further interpreted to understand the probable factors that affect the slums and cause vulnerability to fire accidents. Both quantitative and qualitative research methods have been used in this chapter to aid the study.

6.1 Perception of slum dwellers on the cause of repetitive fire disasters in slums

Multiple site visits during different times of the day were made to gather valid responses from the respondents for the questionnaire survey of the study.

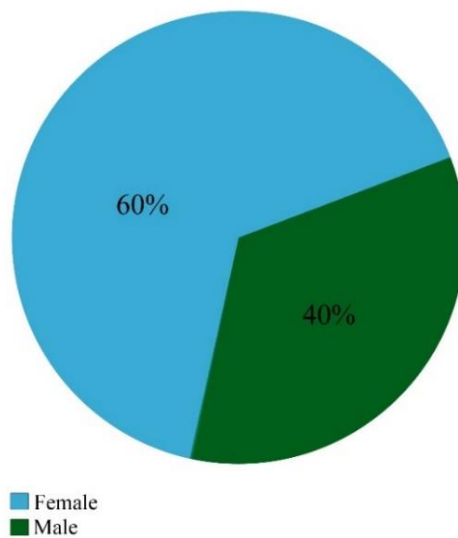


Fig 26: Percentage of female and male respondents (Survey, 2021)

Out of 127 respondents to the questionnaire survey, 60 percent were female and 40 percent were male. The female respondents were mostly available at all times compared to the male respondents, who were usually available during the night. The respondents were more responsive during the day when landlords were absent. Fear of landowners and local musclemen was evident, which restricted many from responding properly. To avoid misinformation, multiple visits have been conducted to gather accurate survey results.

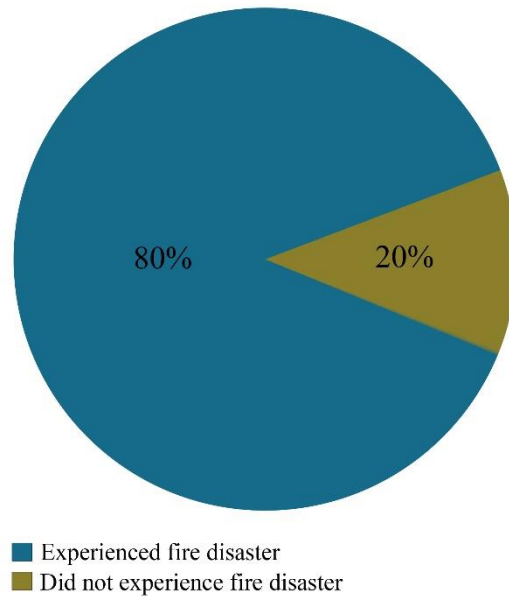


Fig 27: Percentage of slum dwellers who has experienced fire disaster (Survey, 2021)

Respondents to the questionnaire survey were asked if they had experienced a fire disaster in their community. 80 percent of the respondents reported about experiencing fire disasters in their settlements. Some experienced the disaster in their lane, and a few were witnesses to the fire disaster that occurred in other lanes of the slum. A small percentage of 20 percent disagreed to being exposed to the disaster, mostly out of fear of eviction.

6.1.1 Number of fire incidences in Laal Fakir Majar slum

The selected slum consists of 11 lanes that form the slum community. Although the lanes have a similar pattern, the risk level for each zone varies depending on the risk factors. Respondents from FGD informed about the number of fire incidences that occurred in the last 5 years and the factors that caused the repetitive disaster. A total of 23 minor fire incidences have occurred within the slum community, out of which lane 01 and lane 02 have experienced the highest number of fire incidences as the electrical lines are mostly gathered here for distribution, with poor joints that are exposed. The first floors of these two lanes have 20 to 25 rooms, which are very crowded and densely packed compared to the rest of the lanes, where the upper floors have 8 rooms on average. With lanes 01 and 02 being at the front of the only entrance and exit passageway, it increases the vulnerability of the slum dwellers to fire disaster.

LANE	NUMBER OF FIRE INCIDENTS
01	06
02	04
03	01
04	01
05	03
06	02
07	02
08	02
09	01
10	01
11	0

Table 05: Number of fire incidences in each lane in last 5 years according to FGD (Site survey, 2022)

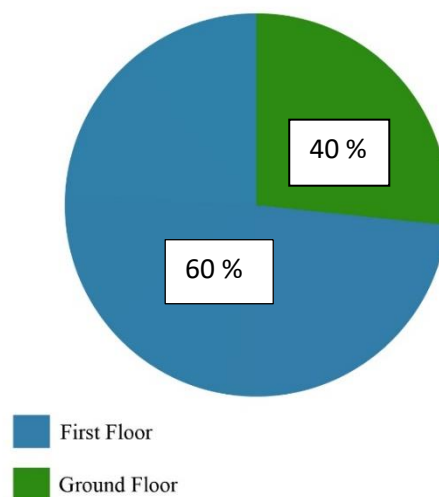


Fig 28: Percentage of vulnerability to fire disaster of ground floor and first floor (Site survey, 2022)

Respondents to the questionnaire survey were asked about the vulnerability of the ground floor and first floor of the slum to fire disasters. 60 percent of the respondents identified the first floor as being most vulnerable to a fire disaster. The risk factors are mostly present on the ground floors, but due to the lack of an escape route for the first-floor inhabitants, the slum

dwellers residing on the upper floors are the most vulnerable to a fire disaster. A respondent stated, "The first floors are so cramped up that we can't even stand. During a fire, the smoke gets unbearable here. We cannot even go downstairs to escape".



Fig 29: Ground floor and first floor of the slum (Site survey, 2022)

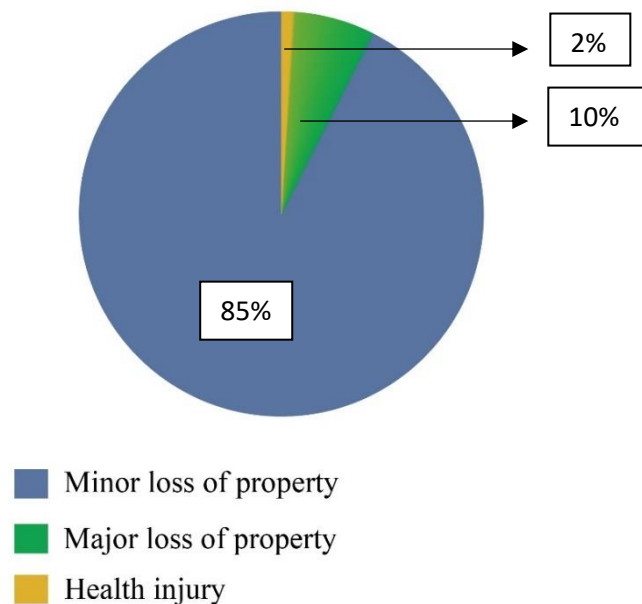


Fig 30: Percentage of health and property loss due to fire disaster (Site survey, 2022)

Respondents to the questionnaire survey were asked about the losses they faced due to the fire disaster. 85 percent of the respondents reported facing minor losses of property due to continuous, repetitive fire incidents. A minor percentage of respondents also mentioned facing

major loss of property and burn injuries. A burned victim among the respondents stated, *"Most of us face loss of belongings. But I once got severely burned to save what little I had left. I still remember that pain"*.

6.1.2 Source of fire

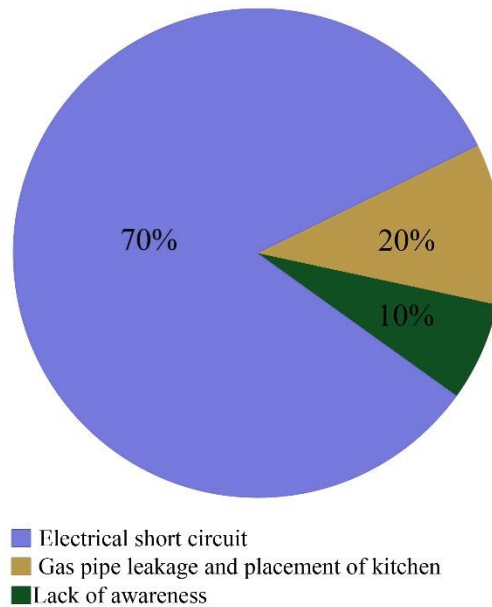


Fig 31: Cause of fire disaster in the informal settlements (Survey, 2021)

To understand the major causes of repetitive fire disasters in the slum, respondents to the questionnaire survey were asked about three main causes of fire hazards. 70 percent of the respondents indicated that electrical short circuits were the major cause of the fire disaster in the slum. Exposed illegal electrical wires with poor connections and joints are the cause of repetitive fire disasters in substandard housing. 20 percent of the respondents identified gas leakage and the non-ventilated placement of the kitchen as the sources of the fire disaster. Gas is supplied through GI pipes and hose pipes, which are uncovered and often stepped on by the dwellers as the pipes lay on the only access or exit road. This has caused multiple tears in the gas pipes, which result in gas leakage that is not monitored or repaired. These illegal connections are not provided by professionals but rather by corrupted local political influentials, which has put the slum dwellers at frequent risk of fire disasters. 10 percent of respondents blamed lack of awareness within the slum community as another reason for their vulnerability.



Fig 32: Exposed illegal electrical wires with poor connections and hose pipes used to supply gas within the slum community (Site survey, 2021)

6.1.3 Lack of awareness

The respondents agreed that lack of awareness within the slum community increases their vulnerability to fire disasters. A few of the activities mentioned by the slum dwellers that have caused fire hazards are:

- Throwing lit cigarette buds unmindfully
- Use of gas burners inside non-ventilated rooms
- Unsupervised use of kitchen stoves
- Connecting electrical wires without professional supervision
- Not monitoring gas pipes and electrical lines
- Use of combustible materials near stoves



Fig 33: Electric connection drawn from outside to one of the rooms without professional supervision (Site survey, 2021)

6.1.4 Perception of slum dwellers on government authorities and NGOs

The FGD of the research generated information on the perception of slum dwellers by government and non-government authorities. The respondents informed that they have not received any support from the authorities. This has made them feel helpless and unnoticed by the regulatory bodies, which has increased their vulnerability. Many expressed their vulnerability to being exploited by unethical influentials as they are forced to live in poor, substandard housing. The slum dwellers are compelled to pay a higher price to receive basic facilities compared to the financially solvent urban population. The minimum service they are receiving is not provided by professionals, which has increased their risk of fire disaster.

6.2 Perception of authorities on informal settlements

A key informant interview (KII) has been carried out to gather knowledge on government policies and actions taken for informal settlements. The interviews have been obtained from the following authorities:

- The National Housing Authority (NHA)
- Urban Development Directorate (UDD)
- Rajdhani Unnayan Kartipakkha (RAJUK)
- Urban Development Programme (UDP) (umbrella organisation of NGO BRAC)
- Bangladesh Fire Service and Civil Defence Head Quarter
- Ward commissioner (ward 17, Kalabagan) of Laal Fakir Majar slum area

6.2.1 Initiatives taken by the authorities for informal settlements

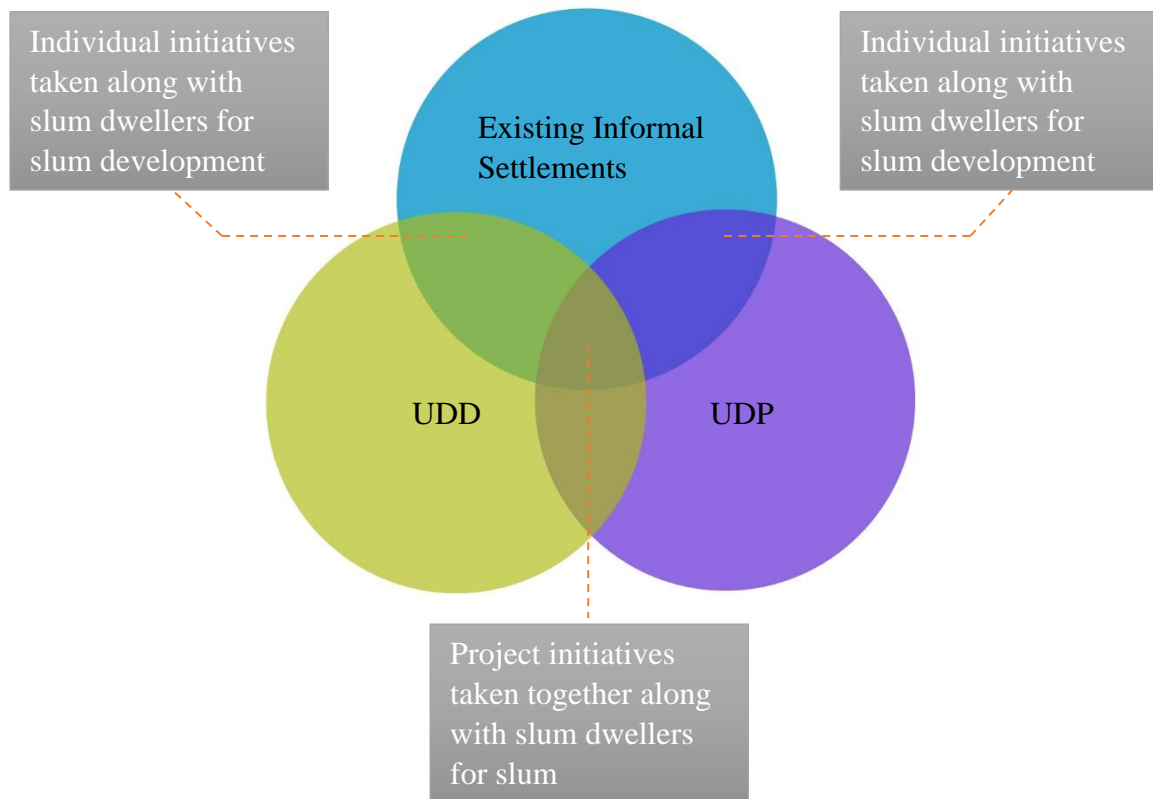


Fig 34: Individual initiatives and joint programs by UDP and UDD along with slum dwellers for betterment of existing slums (Survey, 2023)

UDD and UDP both work individually on targeted slum communities as well as on joint projects as government bodies and private NGOs. The projects are executed with the involvement of the slum dwellers for a better understanding of their situation and an efficient outcome. Although both parties have been working on multiple slum communities, the majority of slums have yet to receive any help.

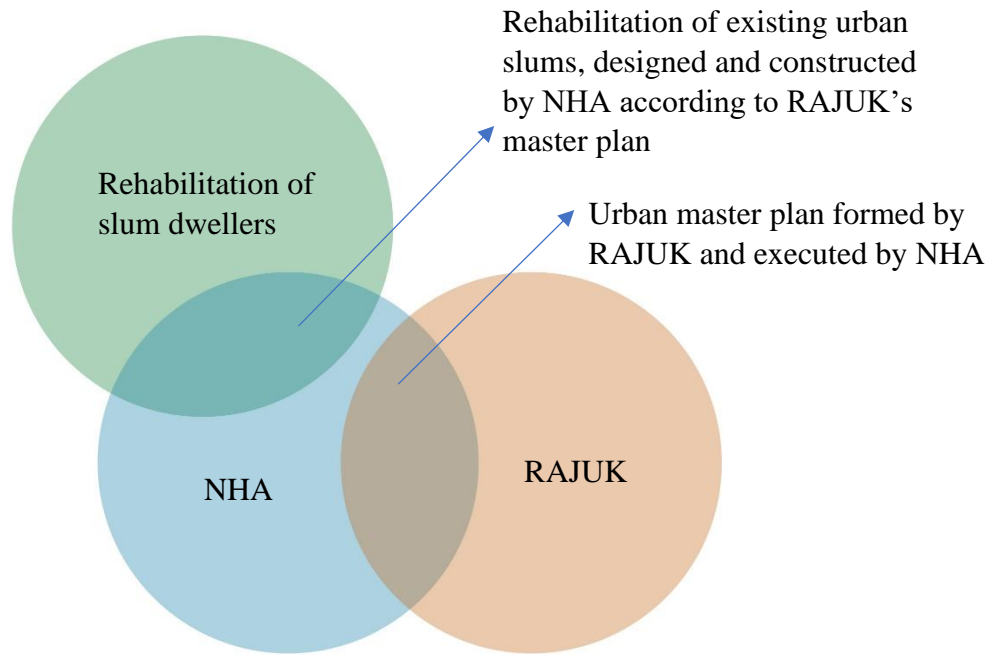


Fig 35: Rehabilitation projects executed by NHA according to RAJUK's urban planning (Survey, 2023)

RAJUK works on generating the master plan of the capital city, Dhaka, while NHA executes the housing plan according to the formulated master plan. NHA does not work on the existing slums within the urban city but focuses on the rehabilitation of the slum dwellers. The rehabilitation projects did not show any positive results, as slum dwellers are not keen to move far away from the city or to pay higher rent for a better standard of living. As the majority of the slum dwellers work within the city, living far from the city would add transportation costs. Many have rented or sold the apartments they have received and moved back to their previous substandard housing.

6.2.2 Collaborative projects by respective authorities on fire prevention

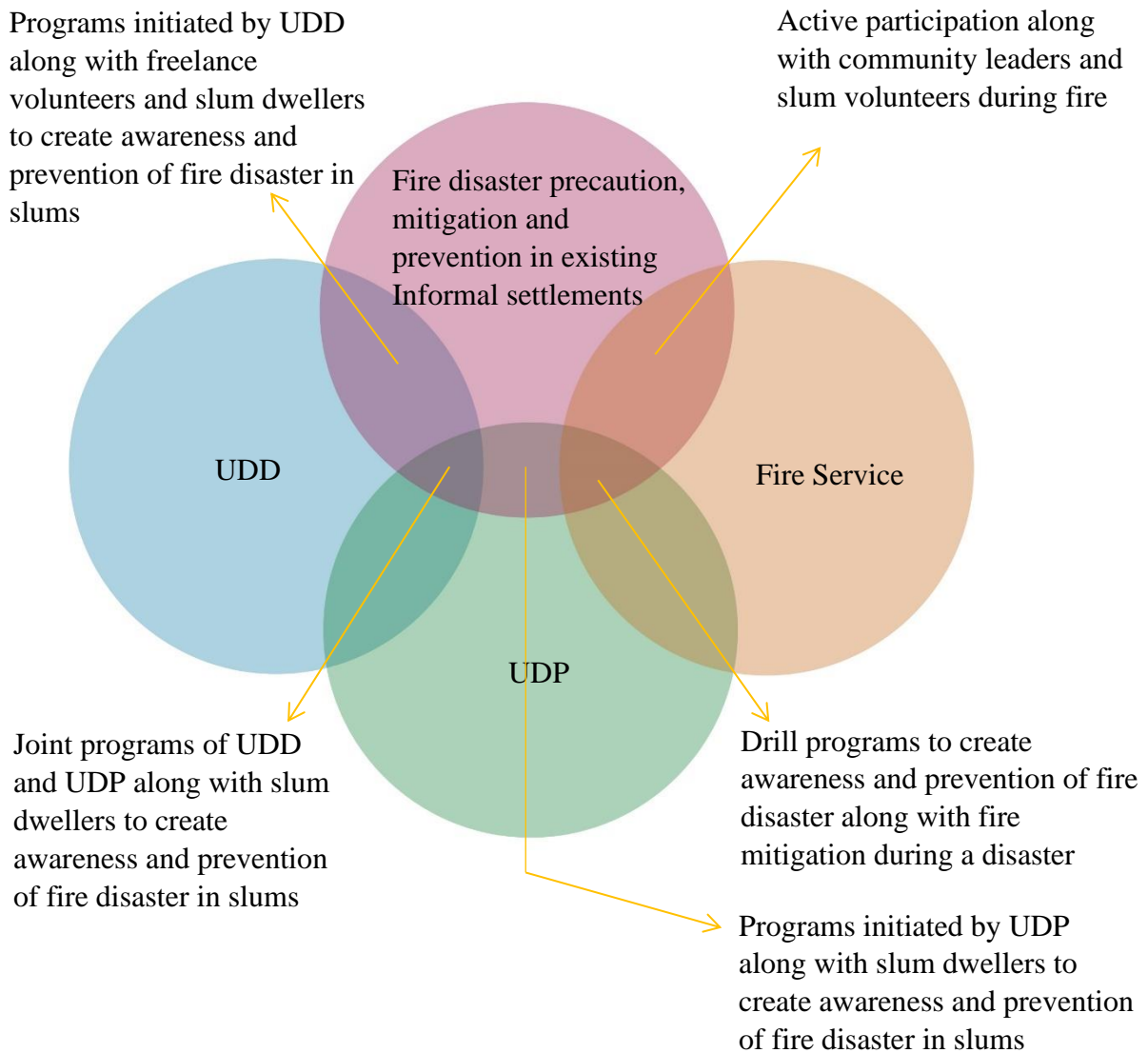


Fig 36: Programs executed by UDD, UDP and Fire service departments to decrease vulnerability of slum dwellers to fire disaster (Survey, 2023)

Repetitive fire disasters within Dhaka city have been alarming. Apart from individual projects, government authorities, NGOs, and fire departments have been working together with slum dwellers in multiple slum communities to prevent fire disasters. Creating awareness amongst the slum dwellers and providing knowledge on fire prevention have been the primary objectives of such projects. According to fire service officers, the number of slum communities receiving active drill program is still very low. Involvement of slum dwellers during fire disasters has shown efficient results. As the sub-standard housing is unplanned with no vehicular access, volunteers from the slum community help to minimize response time and lower loss of life and property as they are familiar with the route.

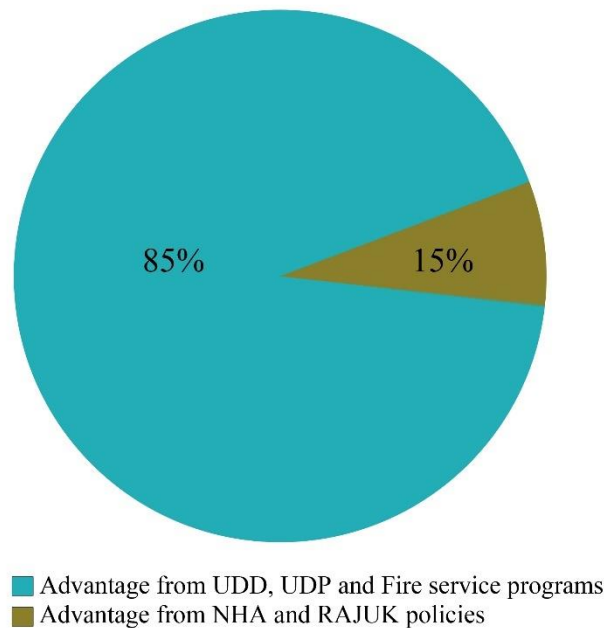


Fig 37: Percentage of slums which received advantage by the programs and policies implied by the authorities (Survey, 2023)

According to an authority from UDD, 85% of the projects in Dhaka have been undertaken by a joint collaboration of UDD, UDP, and fire service departments, along with volunteers from individual slum communities, which has shown positive results. whereas only 15% of rehabilitation projects executed by NHA based on the RAJUK master plan showed efficient results. UDD and UDP often work together with the slum dwellers to create awareness within the existing slum community in the urban city. The initiatives include preparedness, prevention, and mitigation of fire disasters, which are sometimes executed in collaboration with the fire service department. On the contrary, NHA works on the rehabilitation of the slum dwellers from the urban city centre to the outskirts areas, as planned by RAJUK. While both the individual and joint program executed by UDD and UDP showed positive results, NHA programmes are not favoured by the majority of the slum dwellers. Rehabilitation centres being far from the work area of the slum dwellers and the rent of the apartments being higher than what they pay at present, the projects were not well received by the urban poor. As the allocated apartments were sold or rented, it did not provide any solution to the existing problems.

According to an authority of the NHA, *"the slum dwellers would much rather live in risk-prone informal settlements than pay the amount assigned by the government for the facilitated apartments. Many sold or rented the apartments they got and moved back to their previous slums"*.

An authority from the town planner of RAJUK stated that *"the master plan focuses on redesigning the urban city to form a better planned development. Informal settlements are not part of the plan"*.

While many slum communities benefited from the UDD and UDP program, the ratio is still very low as only a handful of informal settlements are being targeted, and many are yet to receive the help they need.

6.2.3 Perception of fire service authorities on fire disaster in informal settlements

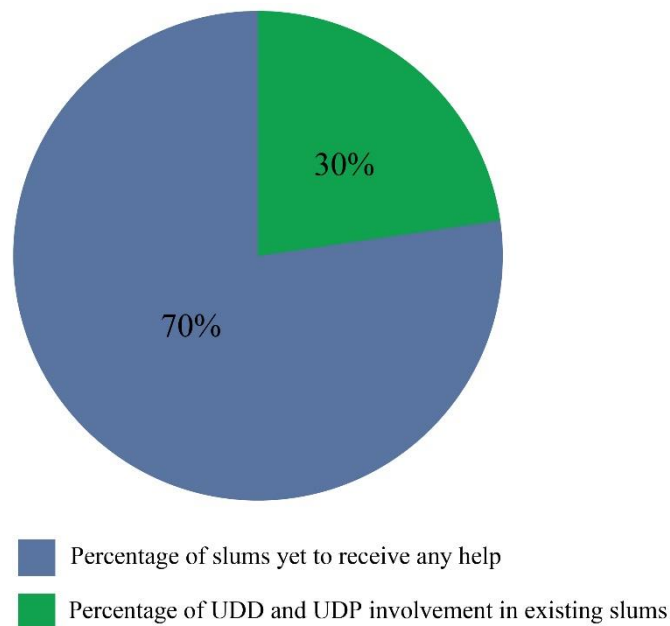


Fig 38: Percentage of slums that UDD and UDP has worked on individually and in collaboration (Survey, 2023)

According to a station officer at the Bangladesh Fire Service and Civil Defence Head Quarter, approximately 30% of informal settlements in Dhaka are receiving attention from the authorities. The targeted slums are either already in the limelight or on a large scale, which provides media attention. About 70% of the rest of the informal settlements are overlooked or neglected. Although the ongoing projects focus on community-based participation, effective drill program are still not actively being organized. The lack of fire prevention and mitigation equipment within the slum communities is evident.

A fire service officer stated that *“the drill program occurs very rarely. There is also a lack of equipment and awareness program. The NGOs mostly arrange one or two program per year during the month of June, but that is not enough”*.

6.2.4 Perception of ward commissioner on fire disaster in Laal Fakir Major slum

According to ward commissioner of ward 17 (Kalabagan), of Laal Fakir Major slum area, the authorities are aware about the hazards and vulnerable living condition of the slum dwellers. However, the slum being established on a private property with multiple owners create various obstacle for government to take any initiative. The commissioner stated, *“the slum owners have been warned about the use of illegal supplies, but due to high demand of supplies and presence of corrupted officials, often implementation of laws get delayed. Slums built on private property is difficult to monitor as often the owners are responsible of exploiting the slum dwellers. The slum dwellers do not share authentic news due to fear of eviction”*.

Role of Community-based Fire Response to Mitigate Fire Disaster in Slums

This chapter of the study includes data collected from a questionnaire survey, focus group discussion (FGD), and observations during site surveys to understand the importance of community participation in fire disaster mitigation in slum communities. Both quantitative and qualitative research methods have been used in this chapter to aid the study.

7.1 Perception of slum dwellers on community-based participation for fire disaster mitigation

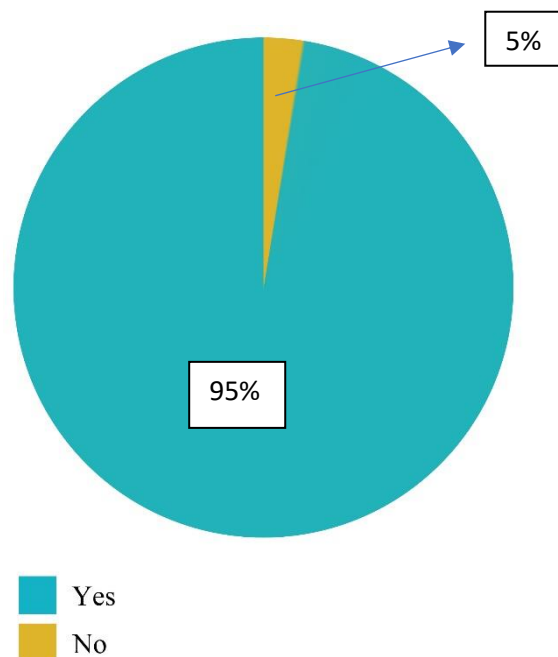


Fig 39: Percentage of respondents who took part in fire mitigation (Site survey, 2022)

Respondents to the questionnaire survey were asked about their involvement in fire mitigation during disasters. 95 percent of the respondents acknowledged taking part in fire mitigation during a disaster. The majority of the slum dwellers work as a community during crisis situations to prevent major loss or injury. They look out for each other, as they have yet to receive any help from the authorities. The residents of the informal settlement are in constant communication as the area is overcrowded with limited mobility space. This gives them an opportunity to be present for one another during any disaster. As most of them have experienced fire disasters and volunteered as participants during emergencies, they use their experience, local knowledge, and methods to take immediate action to minimize response time. A small percentage of 5 percent denied being involved in the fire mitigation process due to not being present during the disaster.

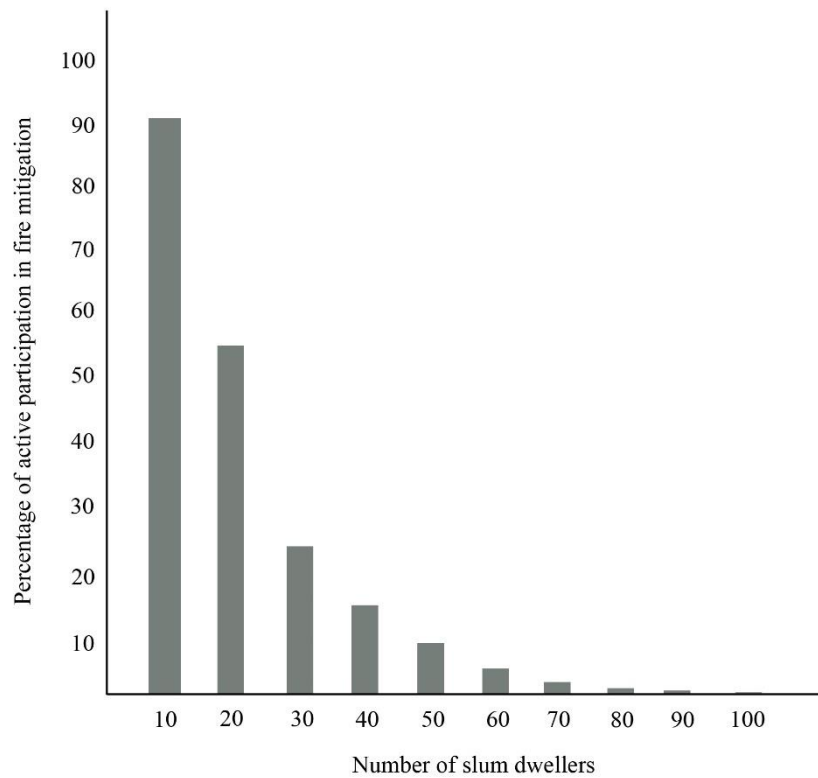


Chart 02: Number of participants who actively participated in fire mitigation (Site survey, 2022)

The respondents to the FGD informed that approximately 10 to 12 slum dwellers actively participate during disasters to prevent the fire from spreading. This group mostly includes young men who are the first to respond during fire outbreaks. Due to their experience and familiarity with the site, their method is much more effective during a disaster.

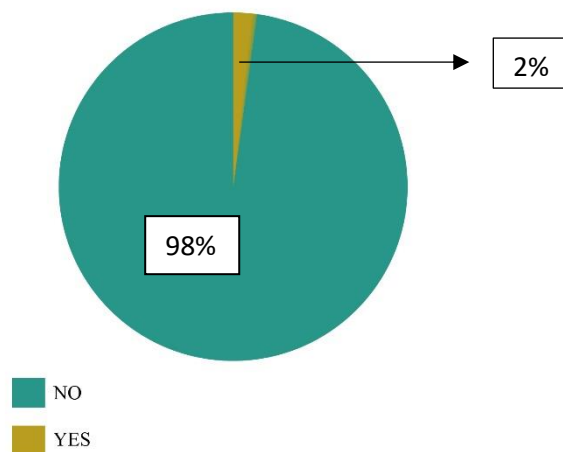


Fig 40: Percentage of fire safety drill programs arranged by the authorities according to the respondents (Site survey, 2022)

Respondents to the questionnaire survey were asked if any drill program have been organized by the respective authorities for fire mitigation. 98 percent of the respondents informed that there has not been any drill program organized by the authority to train them on fire safety. A minor 2 percent of the respondents mentioned having witnessed people from NGOs who informed them about organizing a drill program, but no action from their side has been initiated.

No one has provided them with fire safety equipment, which has compelled them to use their own knowledge from past experiences.

7.2 Community-based risk reduction and mitigation practices

Repetitive fire disasters in the slum have always been a major cause of vulnerability for the slum dwellers. The respondents to both the FGD and questionnaire survey mentioned the local techniques they use for fire prevention as a community due to the authority's lack of concern regarding their safety.

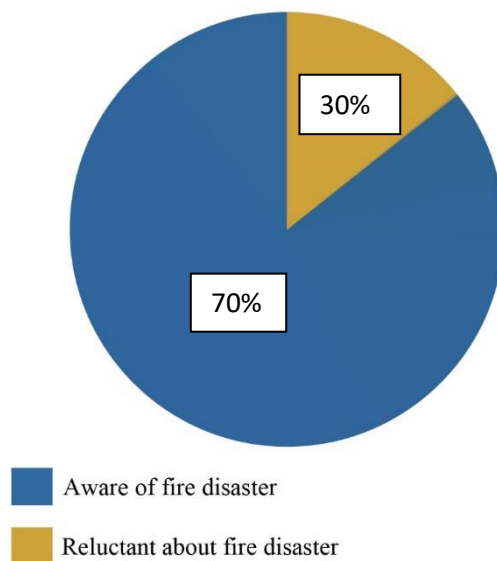


Fig 41: Percentage of slum dwellers aware of fire disaster (Site survey, 2022)

Although fire disasters are a regular occurrence in the slum, about 70 percent of respondents to the questionnaire survey mentioned their concern regarding fire disasters, while 30 percent of the respondents were reluctant about the mitigation practises. A respondent stated, *"We have faced many fires, but that doesn't bother me anymore. I have no ownership here. I send most of the little money that I make to my village. Thus, I have nothing to lose here"*. The concerned majority works as a community to participate in fire mitigation and awareness practises to minimize their vulnerability to fire disaster.

7.2.1 Preventative measures taken by the slum dwellers as a community for fire disaster mitigation

The 12 respondents of the FGD informed about the common fire prevention practises they follow for fire risk reduction and prevention. The slum dwellers have adapted a few preventative measures from their experience due to the unavailability of fire safety equipment. The use of readily available methods and techniques that they have found efficient in fire mitigation has been their only way of preventing fire disasters. As they have yet to receive any outside help and the authorities have not taken any action to ensure their safety, they believe that acting as a community has been their only mode of survival. Some of the mitigation practises have been mentioned below:

- Switching off the electrical connection before leaving the room and during an electrical short circuit
- Acting promptly during any electrical spark.
- Use of stored water in case of a fire outbreak.
- Keeping gas stoves turned off after use
- Being more cautious about throwing lit cigarettes, match sticks, etc. on the ground.
- Working as a community during a disaster for fire mitigation
- Forming active community-based participants who are the first to respond and to inform the fire service department, if needed.
- Working alongside firefighters as volunteers for effective mitigation in a short span of time
- Always being alert.
- Community leaders guide the slum dwellers during fire disasters to prevent chaos and control panic situations.

7.2.2 Fire volunteers from within the slum community

The respondents from FGD informed about a group of 10 to 12 young men from the slum community who work as volunteers during any disaster. This group of volunteers works to create awareness amongst the slum dwellers as well as monitor the community to prevent hazards. During a fire disaster, they are the first to respond and inform the fire service if the situation goes out of control. They actively participate and work with officials in case of disaster, as they are familiar with the route. A volunteer from the respondents stated, *"I actively participate when I see even a small spark of fire, as many do not know what to do and panic. A small group of us try to be aware of fire disasters, but as there are a lot of people in a small, confined space, it gets very tough to manage with no equipment available."*



Fig 42: Stored water used during fire as a mode of fire mitigation (Site survey, 2022)



Fig 43: The narrow passage ways are used as local gathering spots (Site survey, 2022)

CHAPTER EIGHT

Research and Findings

The research for the study focusses on the cause of repetitive fire disasters in slums and the importance of community-based fire mitigation. The intention of the research was to understand in depth what the main causes of fire disaster in informal settlements are, why it is a cause of vulnerability for the slum dwellers, and how community-based fire mitigation is known to play a vital role in addressing the concern. In order to acknowledge the overall situation, the respective authorities were interviewed to get a perspective from the regulatory bodies. The data collected through site surveys, observation, questionnaire surveys, focus group discussions (FGD), and key informant interviews (KII) aided in analyzing the findings of the research. The key findings have been summarized below:

8.1 Limitations in standard guidelines

Bangladesh National Building Code (BNBC), Detailed Area Plan (DAP), National Planning and Building Authority of Kenya, and National Building Code of Nigeria have been studied. The study area being situated in Bangladesh, the standard guidelines of the stated country have been analyzed and compared with the national guidelines of Kenya and Nigeria to find out the limitations of the policies. The policies mentioned in the national guidelines have been compared with the existing scenario based on site visits, observation, and methodology, which aided this segment of the study. Both Kenya and Nigeria have a large number of existing informal settlements in their individual countries, providing a scope for comparison.

Bangladesh standard guidelines	
<p><u>Bangladesh National Building Code:</u></p> <ol style="list-style-type: none">1. Any development on the land should be authorized by the planning authority and must be indicated on the approved master plan.2. Deconstructed site should be cleaned and have proper drainage system.3. Overhead electrical lines should not be less than 2.5m vertically and 1.25m	<p><u>Existing scenario:</u></p> <ol style="list-style-type: none">1. The site is not denoted on the plan and the structure has not been approved by the authority.2. The slum was formed on the remains of old structure that has not been inspected. Previously existing drainage system is being used that has not been maintained.3. No such measures are being followed. The exposed overhead electrical wires are closely connected to the sub-standard housing that is within reach of an arm's length.

<p>horizontally in distance within or at any part of the building.</p> <p>4. The building area should be higher than the road level.</p> <p>5. The boundary wall should be structurally strong to prevent from collapsing.</p> <p>6. The access road should be connected to the national transportation system where fire service vehicle can enter and operate if needed. Access road longer than 30m with a dead end should have turning radius for fire service vehicles. Densely populated area should have access road of minimum 15m wide.</p> <p>7. Setback rules should be followed as implied by respected authorities.</p> <p>8. For row or cluster type of housing, total open area should not be less than 50 percent of the plot area.</p> <p>9. Designated development authority determines the limitation of number of residences.</p> <p>10. The minimum height of a room should be 2.75m from finished surface area of floor to ceiling. The kitchen should have a minimum clear height of 2.75m. The minimum clear height for bathroom is 2.15m. The minimum width of each stairway should be 1120mm.</p>	<p>4. The building area is lower than the road level.</p> <p>5. The existing boundary wall is a remain of old structure that has not been maintained and is of poor condition.</p> <p>6. One single narrow alley which is approximately 1.2m wide is being used as both entry and exist road that has a dead-end. The dead-end alley has no turning radius as no vehicle can enter.</p> <p>7. No such rule has been followed.</p> <p>8. The slum is overcrowded with little to no open area.</p> <p>9. Overcrowded cluster of substandard housings in a small space.</p> <p>10. None of the mentioned guidelines has been followed.</p>
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11. All rooms, staircases and interior spaces intended for inhabitants should have natural or artificial lighting including proper ventilation. Inhabitants should have access to water and sanitation facilities. Kitchens should have washing facilities.

Detailed area plan (DAP):

General objectives of DAP:

1. Implementation of structural plan and urban plan policies.
2. Maintenance of urban development according to plan in selected areas.
3. Providing an urban environment that fulfills basic service needs of the citizens.

11. There is little to no ventilation in the substandard housings. Sanitation facilities are extremely poor with limited access to water. Kitchens are placed in an enclosed space with no washing facilities, closed to the toilets.

Informal settlements are not strategically considered in the policy making.

Comparison between guidelines

Comparison between guidelines	
<p><u>National Planning and Building Authority of Kenya</u></p> <ol style="list-style-type: none"> 1. Materials used to construct should follow the code and standard approved by the Kenya Bureau of Standards. 2. Walls should be fire resistant and non-combustible. 3. The roof of the building should be able to resist any possible force and should be durable and water roof. 4. Timber roofs and design should follow the standard and code approved by the Kenya Standards. It should be treated to prevent infestation. 5. Every building should have a proper mean of escape in case of emergency. 6. Any building that exceeds one storey should have proper and adequate number of staircases and have access for firemen to all the floors during fire disaster. 	<p><u>Bangladesh National Building Code (BNBC)</u></p> <ul style="list-style-type: none"> • Lack of policies regarding use of materials has been denoted. • Regulations in terms of fire safety needs more attention. • Policies lack hazard prevention rules and regulations specific to informal settlements. • The policies mentioned are not in detail which creates scope to overlook regulations. • Policies are more inclined to standard buildings which ignores informal settlements. • The guideline is not organized categorically which might create confusion.
<p><u>National Building Code of Nigeria</u></p> <ol style="list-style-type: none"> 1. Fire protection system should be maintained and taken care of by the owner/ tenant or lessee of the building/ 	

<p>structure to ensure safety of the occupants.</p> <p>2. Fire protection devices should not be disconnected or handled unsupervised without the informing of the fire department. As fire service department is responsible for inspection of fire protection devices and maintenance, respected authority of the building should cooperate during the procedure.</p> <p>3. A proper plan should be submitted to the department with adequate details that helps to identify hazard and evaluate the efficiency of the system. The details should include materials used, placement and the exposure to the hazard.</p>	
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8.2 Lack of implementation and monitoring of implied regulations

The policies stated in the Bangladesh National Building Code (BNBC) are mostly overlooked. Due to a lack of monitoring of the implementation of policies, unethical influentials are benefiting by exploiting the vulnerable urban poor. The overwhelming growth of population per year has increased the formation of informal settlements within the urban city (Nahiduzzaman, 2006). As a result, the slum dwellers are being deprived of basic facilities such as water, electricity, and gas. The only mode of access to these necessities is through local musclemen and political influentials, who are not only charging a high amount to the slum dwellers but also deceiving the government from getting the monetization (Ahmed, 2014).

8.3 Absence of support from government and non-government bodies

The informal settlements are considered illegal as they are not part of the city's master plan. As a result, the slum dwellers are deprived of basic urban facilities. Although they are not included, they do still exist. To address the issue, the government took on rehabilitation projects for the urban poor, which did not succeed. This has continued to increase the vulnerability of the poor. Fire disasters being one of the major concerns of the slum dwellers, little to no support has been received from the authorities. This has raised the need for community-based disaster risk reduction methods that show positive results (Ahmed, 2016). Involvement of NGOs is still very minimal. The respondents informed me that the NGOs showed interest only, but there was a lack of execution of any plans. Only a few slums are receiving benefits from authorities; that too is already in the limelight. A major number of slums have yet to receive any help.

8.4 Vulnerable living conditions are increasing the risk of fire hazards

Basic facilities such as gas, water, and electricity are distributed illegally within the slum communities. This increases the risk of fire hazards in informal settlements. The connections are not provided by professionals, which increases the vulnerability of slum dwellers (Mollah & Hasan, 2019). Upon site observation, questionnaire survey, and focus group discussion, it is denoted that poor electrical connections, use of GI pipes for gas distribution, and non-ventilated space without any proper escape route are the main causes of repetitive fire disasters in informal settlements.

8.5 Use of community-based fire mitigation practises

Community-based disaster risk reduction (CBDRR) has shown positive results compared to previous disaster risk reduction (DDR) policies (Gupta & Barman, 2021). Both government and non-government authorities have expressed the need for the CBDRR approach to address the crisis, as it is the most effective method to minimize hazards. Authorities such as UDD and UDP have initiated projects with the inclusion of CBDRR to get a more efficient solution to the existing problem but implementation is yet very marginalized, focusing only on the larger scale slums at present. Although, the social capital of the community has been actively participating in mitigation practises but due to lack of knowledge and guidance from the professionals, the slum dwellers are in a locked condition with no proper efficient solution to their problem. Enhancing the active group with CBDRM methods and efficient strategies may minimize their vulnerability to hazards.

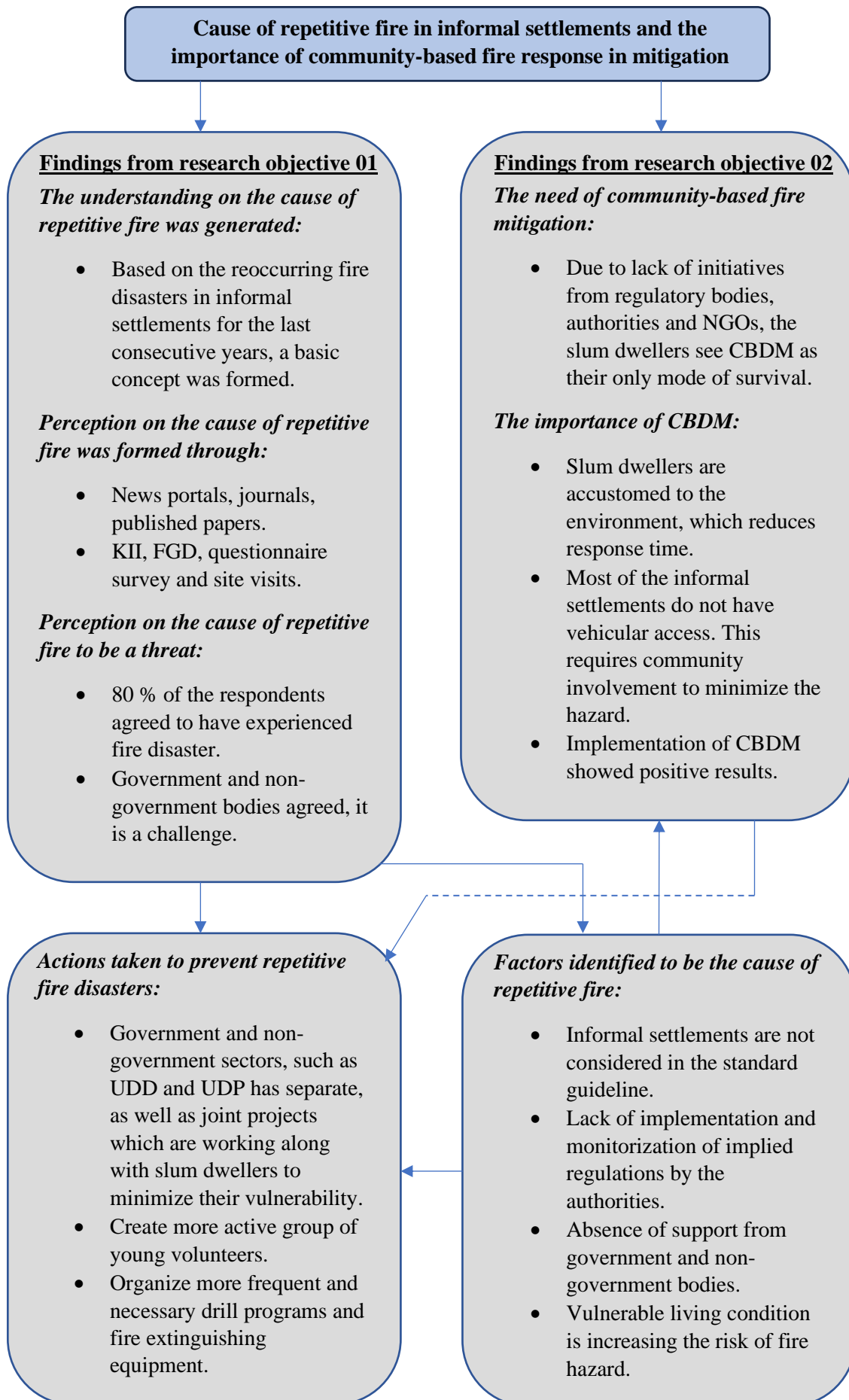


Fig 44: Summary of the research findings by the author

Discussion and Conclusion

This chapter aims to discuss the key findings of the research based on the objectives of the study. The conclusion segment of the chapter summarizes the overall research.

9.1 Discussion

The research question of the study focus on the cause of repetitive fire disasters in slums and how community-based fire response in mitigation plays a vital role in minimizing the hazard. The following discussions have been generalized to address the crisis and its solution, if any.

9.1.1 What are the causes of repetitive fire disaster in slums?

While there are many factors that add up to cause fire disasters in slums, negligence from authorities is a key element. Informal settlements are a growing phenomenon, yet they are considered illegal. Slums are not considered in the master plan or specified with policies in the BNBC, which leaves out slum dwellers from receiving basic facilities. This has initiated the distribution of illegal supplies in substandard housing. Basic facilities such as water, gas, and electricity are being distributed via musclemen and unethical local political influentials. The supplies are not monitored by professionals and are being distributed with locally available, cheap alternatives. This has increased the vulnerability of slum dwellers to fire disasters as the informal settlements are formed unplanned with poor structure and no evacuation route. The majority of the slums have no vehicular access, which, in the case of fire, can be devastating.

Slum dwellers are being neglected by the authorities, even though urban development and the formation of slums go hand in hand. Government policies are not being implemented or monitored within the growing informal settlements in urban cities. This has resulted in negligence towards the rights of slum dwellers as citizens. The gap in government policies and lack of monitoring by regulatory bodies have increased the vulnerability of slum dwellers. This has created a scope for unethical influentials to exploit the vulnerability of the urban poor. The respondents expressed their constant fear of eviction and felt trapped. The slum dwellers are paying a hefty amount for the poor living conditions and illegal basic facilities, which eventually become the cause of repetitive fire disasters. The urban poor have become victims of their circumstances, and their vulnerability has become a mode of income for the influential. This has raised the question of whether the fire disaster is the main problem or if it is a result of accumulated crime.

9.1.2 How does community-based disaster risk reduction response play a vital role in fire mitigation in slums?

The previous government policies had a top-down approach that could not provide an efficient solution. As they left out the people who are in need of help, the authorities in charge failed to address the vital factors that play a major role in disaster. Community-based disaster risk reduction (CBDRR) has a bottom-up approach that focuses on the root problem and includes vulnerable people who are in dire need of help from the authorities. This method includes government authorities, non-government authorities, and slum dwellers, which showed efficient results. The slum dwellers felt involved and noticed, which helped to create awareness within the slum communities. CBDRR helps guide the slum dwellers while acknowledging

their local methods of disaster prevention and also by implementing methods custom-tailored to each community's individual needs. Authorities such as the Urban Development Directorate (UDD) and the Urban Development Program (UDP) (the umbrella organization of NGO BRAC) have initiated separate as well as joint projects in the slums of Dhaka that include CBDRR methods.

Although, CBDRM has been acknowledged and is being implemented in larger scale slums, wider scale implementation and monitoring is yet too low. This eliminates majority of the informal settlements which are smaller yet more vulnerable. As a result, slum dwellers often work together to minimize their vulnerabilities often unknowingly adapting to CBDRM but without proper training, guidance and equipment it is yet to be a feasible solution.

9.2 Conclusion

The case study of Laal Fakir Majar slum revealed that the respondents highly depend on each other during a disaster. Community-based disaster risk reduction has been adapted as a mode of survival by the slum dwellers without any guidance or training as authorities are yet to acknowledge their helplessness. KII gave an understanding of the authorities and their concerns about the crisis and actions are being taken to minimize the disaster. Although, implementation of the CBDRR approach has been executed in a few informal settlements by both government and non-government bodies, CBDRM is yet to be broadly implemented. The projects are being executed in informal settlements that are in the limelight of media coverage, while many extremely vulnerable slums are being overlooked. Lacking in policies, implementation and monitoring has increased the vulnerability of the slum dwellers to multiple hazards amongst which, fire disaster is the most reoccurring disaster.

Data collected through focus group discussion, questionnaire survey and observation identify that slum dwellers work as a community and have adapted to self-taught mitigation practises to enhance their strength to fight against fire disaster. Mitigation procedure includes use of readily available sources as a mode of firefighting strategies. This includes, forming active group of young participants who volunteer during fire disaster, use of stored water to extinguish fire, vocal call for fire alarm at the earliest sign of fire, shutting down electrical main connection and taking lead from the community leaders. These strategies are not sufficient enough during massive spread of fire as informal settlements do not have any proper evacuation route or firefighting equipment. Inaccessibility of fire vehicles, use of combustible recycled materials and crowded environment allows fire to spread rapidly and cause suffocation. As a result, without proper training and guidance from the authorities, informal settlements in unplanned urban cities are a ticking time bomb.

9.3 Research contributions

9.3.1 Methodological contributions

The research study follows an interpretive research approach that is conducted through a variety of tools that are 'participatory' and 'communicative' in nature and have a holistic approach. The primary data of the research includes both quantitative and qualitative methods that have been collected through multiple practical visits at the selected site of the study, a questionnaire survey, focus group discussion, and a key informant interview. The selected respondents of the study participated in the FGD and questionnaire survey of the study, which helped to generate an in-depth understanding of the research topic. Key informant interviews

(KII) include authorities in charge and provide an overview of the regulatory bodies. The perspectives of both the respondents and the authorities seemed viable for the research to generate an overall understanding. The detailed survey of the site provided enriched data for the research.

9.3.2 Empirical contributions

The empirical research of the study includes the perceptions of the slum dwellers about their vulnerability as well as the overview of the authorities on the research topic. Other external factors that might have been the cause of repetitive fire disasters in informal settlements have also been explored to generate thorough research. The study was conducted in the hope that this analysis would aid in future projects to address the issue, either by government or non-government authorities, that would result in a more efficient outcome.

9.3.3 Practical contributions

The research provides practical insights that aid in understanding the relationship between the cause of repetitive fire disasters in informal settlements and the importance of community-based fire response in mitigation. The research has approached the respective authorities to understand the laxity on the subject, even though it has been a topic of concern for years. In search of this, it has been found that political aspects play a vital role in this context. As a result, the fire disaster is found to be a fragment of a problem that is accumulated by many other factors. In such a situation, CBDRR has been deemed the most effective method of fire disaster mitigation.

9.3.4 Policy recommendations

The empirical study has identified a few limitations in the standard guidelines of Bangladesh that have been discussed in Chapter 4, the document review of the research paper. The policy guideline does include hazards but vastly excludes the sectors that are most vulnerable to disasters. Informal settlements are yet to be considered, even though their existence is evident within urbanized cities. The Bangladesh National Building Code (BNBC) has been reviewed, which revealed the absence of in-depth policy regulations. This has created scope to violate rules and regulations, which has further generated complex issues.

- ***Inclusion of informal settlement in the policy***

As the formation of informal settlements is interrelated with urbanization, they exist and are growing rapidly. In such a situation, it is impossible to overlook their presence, and it is important to address the issues generated by the formation of slums within urban cities. Inclusion of slums in policy will help minimize hazards and give slum dwellers a chance to feel included. This will eventually assist in reducing the exploitation of the urban poor by the influentials, which, as a result, will also aid in preventing various hazards.

- ***To ensure monitoring and implementation of regulations***

One of the major problems identified by the authorities is the lack of monitoring of implied regulations. As there is no inspection regulatory body, the unethical political influentials are benefiting from the vulnerability of the slum dwellers. The urban poor are often threatened with eviction, and as a result, they cannot raise their voices. The slum dwellers are forced to pay a high amount for poor living conditions and an illegal and risky supply of basic facilities.

This is deceiving the government into getting the monetization as well as creating a hazardous living situation for the slum dwellers. The authorities expressed the need for regular monitoring for the prevention of such crimes.

- *To increase implementation of CBDRR to minimize disasters and create awareness*

The recent projects initiated by UDD and UDP proved the importance of CBDRR to tackle the increasing number of disaster-prone substandard housing units. The CBDRR method is an inclusive approach that provides an in-depth bottom-up approach. This has helped to focus on the root cause of the problem and provided scope for the authorities to work with the slum dwellers. The local knowledge of the slum dwellers is utilized along with guidance from the designated professionals, which has shown positive results. Currently, only a few of the slums in Dhaka have been targeted, but a large number of informal settlements are yet to be addressed.

9.4 Future research

The research has investigated the cause of fire disasters in slums and how community-based fire response in mitigation plays a vital role in addressing the crisis situation. In respect to research regarding fire disasters, various complex contributing factors have been discovered. While fire disasters are the key topic of the research, they have been found to be the result of an accumulated number of elements that need to be explored and discussed.

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