



From vulnerability to resilience: Community-based strategies in urban informal settlements

Md. Faisal^{1,*}, Tanvir Ahmed¹, Tamima Akhter Tanni¹

¹ Department of Disaster Resilience and Engineering, Faculty of Disaster Management, Patuakhali Science and Technology University, Dumki, Patuakhali 8602, Bangladesh.

*Correspondence: faisal@pstu.ac.bd

Received Date: December 16, 2025

Revised Date: January 13, 2026

Accepted Date: February 27, 2026

ABSTRACT

Background: Increasing urbanization has resulted in a faster growth of slum population. The main triggering factor behind the rapid urbanization is migration of people from rural to urban areas. Many of these people are jobless, capital-less, homeless and have no other alternative other than to live in the slum areas. They live totally in an informal settlement. The main objectives of this study are to identify the vulnerabilities of urban slum dwellers and to find out appropriate measures for reducing vulnerabilities to ensure resiliency. This research is conducted in Palashpur slum of Barisal city. **Methods:** This research is basically based on primary data collection and partially on secondary data collection. The Vulnerability to Resilience (V2R) framework is used for the research and FEMA model is used for the prioritization of vulnerability. There were 100 questionnaire surveys and 3 Focus Group Discussions (FGD) were conducted. **Findings:** the existing human induced hazards in this slum are fire, mismanagement of waste and conflict. The FEMA model has given the highest vulnerability for the mismanagement of waste and then fire, water logging and last of all conflict. So, this slum area is mostly vulnerable for these human induced hazards and mostly vulnerable for mismanagement of waste. So, proper resilience measures like awareness raising, encouraging people to use reusable bags, providing alternative livelihood options, burying electricity lines, establishing proper drainage systems, strengthening social relationships etc. can reduce the vulnerability of the hazards. **Conclusion:** Moreover, existing organizations and Govt. should set their policies and plans according to proper resilience measures based on existing vulnerabilities and implement them in an integrated approach considering good governance. **Novelty/Originality of this article:** If any organizations or Government desire to run any project for the development of this slum, they will get a clear and concise idea on which project will be fruitful for the slum. The study will also enlighten the stakeholders on how to involve the community and integrate existing hazards vulnerability reduction strategies with development activities.

KEYWORDS: resilience; urban slum; vulnerability; V2R.

1. Introduction

Slums, locally known as ‘bastees,’ are areas with poor living conditions and a lack of basic amenities (Rashid, 2009). In short, a slum is a cluster of unplanned and haphazard settlements built on vacant land where poor and deprived people live, struggling with poverty and hunger (Abascal et al., 2022; Latif et al., 2016). Urban slums often grow near industrial and commercial areas (Rahman, 2016). Migrants from rural and peripheral regions are frequently forced to live in these unhygienic places due to economic hardship and the lack of affordable housing (Ahmed, 2006). Rapid urban population growth is driven

Cite This Article:

Faisal, M., Ahmed, T., & Tanni, T. A. (2026). From vulnerability to resilience: Community-based strategies in urban informal settlements. *Journal of Disaster Management and Community Resilience*, 3(1), 16-41. <https://doi.org/10.61511/jdmcr.v3i1.2565>

Copyright: © 2026 by the authors. This article is distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).



mainly by rural-to-urban migration in search of better opportunities and paid employment (Kamruzzaman & Hakim, 2016). As soon as they arrive in cities, many poor migrants settle in slums located on low-cost, temporary vacant land (Panday, 2020).

Poor socio-economic conditions lead slum dwellers to unhealthy lives. They are highly vulnerable to communicable diseases, malnutrition, and workplace accidents (Ameratunga, 2006; Kamruzzaman, 2015). In developing countries, most slum dwellers live below the poverty line and have limited income sources. Access to safe drinking water—a basic human need—is often unavailable (Ompad, 2007; Kamruzzaman & Hakim, 2016). Even in areas with public water supply, the water quality is often poor. Sanitation conditions in slums are extremely inadequate (Panda et al., 1993). Narrow and unpaved streets cause water stagnation during the rainy season, creating an unhygienic environment that leads to many diseases (Kamruzzaman & Hakim, 2016). Another major issue is the lack of land ownership. Slum dwellers usually build makeshift homes on vacant government land, railway setbacks, or marshy areas. When land is unused, they take the opportunity to settle there. These communities are highly vulnerable to natural and human-induced hazards and unsafe surroundings (Kamruzzaman, 2015).

Bangladesh is the world's 7th most populous country, with over 158 million people living in an area of 147,570 km² (Uddin, 2018). The population accounts for 2.19% of the global total, with a density of 1,101 people per km² (BBS, 2011). Although the country has made significant progress in reducing poverty, 24.3% of people still live below the poverty line, including 18.9% in urban areas (BBS, 2017). Rapid urbanization, driven by rural opportunities and rural hardships, has led to a fast expansion of slum settlements. Currently, around 34% of the population lives in urban areas, and this figure is expected to exceed 50% by 2050 (United Nations, 2014). The increasing rural-to-urban migration is a major cause of the growing slum population (Akther, 2014). People move to cities for better livelihoods, employment, and because of poverty, river erosion, eviction, and forced displacement (Hossain & Wadood, 2020). Riverbank erosion and other natural hazards push many rural families into city slums (Ahmed & Neelormi, 2008). In Bangladesh, slum dwellers face numerous problems, including lack of basic services, unemployment, poor sanitation, polluted environments, unsafe water, low literacy, crime, disease, social stigma, and marginalization (Alamgir et al., 2009; Rashid, 2009; Intesar & Parvez, 2022). Human-induced hazards often arise from mismanaged risks and lack of awareness (Hossain & Miah, 2011).

Barishal is one of the major cities in Bangladesh, located 95 km north of the Bay of Bengal, with a population of 0.3 million in an area of 58 km² (Matiur Rahman, 2014). Migration plays a significant role in the city's rapid urbanization and has contributed to the formation of many unplanned slums. Although major natural hazards like drought, salinity, cyclones, and storm surges are less frequent here, the city faces flash floods, heavy rainfall, waterlogging, fires, accidents, unemployment, crime, drainage congestion, and building collapse—problems that affect slum dwellers most severely (Rahman et al., 2017; Mukherjee et al., 2020). Slum conditions are extremely poor and harmful to the environment. Typical features include lack of water supply, unhealthy sanitation, overcrowded and fragile housing, unsafe locations, and insecure land tenure (Panday, 2020). In the study area, slum residents face frequent human-induced hazards. Fire incidents occur due to short circuits, illegal electricity connections, and gas cylinder explosions. Poor waste management worsens waterlogging by blocking drainage systems, creating highly unhygienic living conditions. Pregnant women and newborns suffer the most in such environments. Personal conflicts among residents sometimes lead to deliberate harm, such as intentional fires or removing soil from house foundations. These conditions reflect poor governance, insecure livelihoods, and future uncertainty. Therefore, the study aims to identify the factors that contribute to vulnerability and explore measures to build resilience.

Urban disaster resilience refers to the ability to prepare for, respond to, and recover from multiple hazards with minimal damage to public health, safety, the economy, and security (Leichenko, 2011). Reducing vulnerability to human-induced hazards is now a major focus of resilience-building efforts worldwide (Wedø & Øyhus, 2015). International

organizations support resilience through financial aid, agreements, and community initiatives (Ahmed, 2006). but only some measures effectively help poor people gain secure land and reduce vulnerability (Keare & Parris, 1982). Awareness, preparedness, education, public safety, health knowledge, social networks, institutional cooperation, economic security, and good governance can improve resilience in Barishal (Mukherjee, 2020).

This study focuses on identifying key human-induced hazards in the selected area based on their frequency and severity. Understanding vulnerability components is essential for proper hazard assessment. Factors such as governance, livelihood, hazard preparedness, and future uncertainty were examined to assess vulnerability. The study uses the FEMA model combined with the V2R framework to determine which hazard poses the greatest threat to the slum. It also analyzes resilience strategies to reduce the vulnerabilities of people living in Palashpur slum. This study is guided by several research questions, including what human-induced hazards exist in Palashpur slum, what the underlying causes and impacts of these hazards are, which groups within the community are more vulnerable, and how these vulnerabilities can be reduced to ensure the resilience of the slum. The objectives of the study are to identify the vulnerabilities of Palashpur slum dwellers in Barisal Sadar and to determine appropriate measures to reduce these vulnerabilities and enhance resilience.

2. Methods

2.1 Study area

The study area of this research is Palashpur slum of Barisal Sadar (Fig. 1). This slum has been grown up on the bank of the river Kirtonkhola having latitude 22.7124480 and Longitude 90.3809950. This area has about 3,640 populations and 520 households (BCC, 2015). his area belongs to the Ward No. 5 and 6 of Barisal City Corporation.

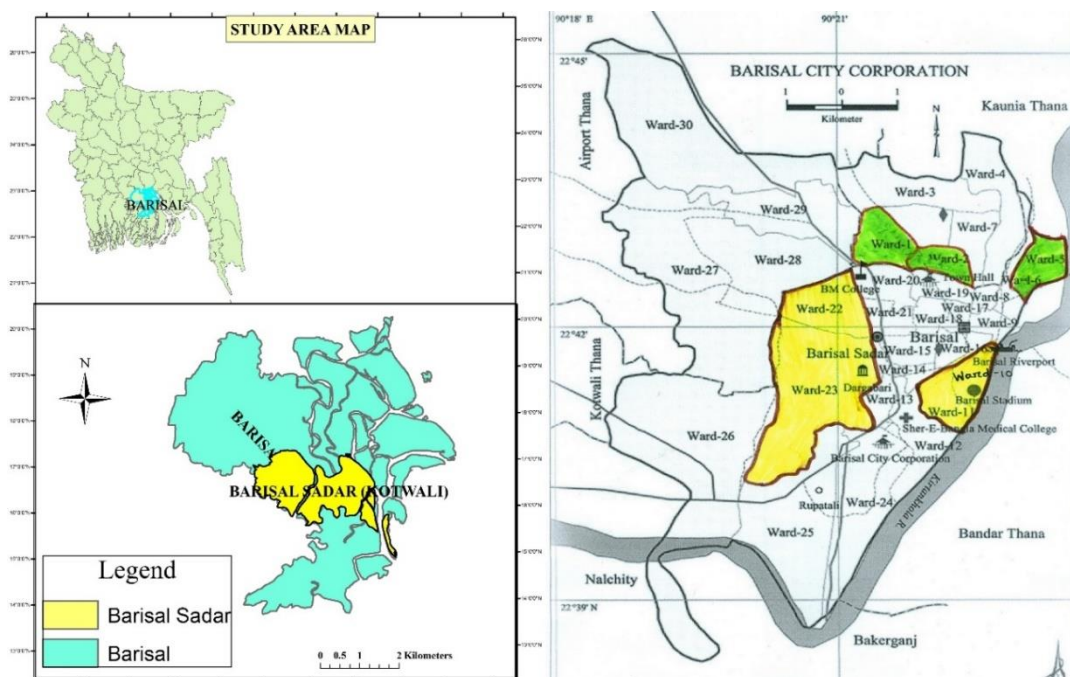


Fig. 1. Map of the study area (Palashpur Slum, Barisal)
(Barisal City Corporation, 2015)

The method must be clear with description of the materials used in the study, the population and sample or key informant, research variables, data sources, the general procedures and techniques, the data collection technique, the analysis method, and data presentation. For research using experiments, the method should also include the design or

the setup of the research. For article review, the author should also describe the theoretical components. For a qualitative method, the author may include the methods in data condensation (for example, coding system), data display (how the data is presented which allow for drawing conclusion), and conclusion drawing. For quantitative methods, the author may include the methods in sampling, data collection, and data analysis.

2.2 Materials and methods

Vulnerabilities of slums and appropriate measures for resilience are assessed by using a mixed method. A concurrent method of two procedures was used for the study, in which qualitative and quantitative data were collected simultaneously. The findings were integrated into the result and discussion part. Respondents were selected randomly to attain appropriate resilience measures for reducing the vulnerabilities of human induced hazards in the slum area. A total number of 100 households of the slum area were selected randomly for the research purpose. Either oral or written consent was obtained from each participant. Both qualitative and quantitative instruments were used in the collection of data for the study. The validity and reliability of the instruments were ensured by following a number of steps. First, a literature review was conducted to identify vulnerabilities related to human induced hazards. Secondly, a questionnaire survey and interview guides for the Focus Group Discussion were conducted in the study area. All collected qualitative data were analyzed according to the respondent's response.

2.3 Methods of data collection

2.3.1 Primary data collection

Palashpur slum of Barisal district has been selected as a sample for questionnaire survey. There are a total of 520 households in the study area. Here the households were categorized randomly. The slum households were affected in different ways in their lifetime by various human induced hazards. Multiple methods were used to collect primary data. These are as follows: Questionnaire survey and Focus Group Discussion (FGD). The questionnaire survey was designed to gather information and data in a more structured format. Therefore, 100 households were selected randomly for questioner surveys from the study area and three FGD's were conducted focused on open ended opinions and views of target study groups.

2.3.2 Secondary data collection

This research is partially based on secondary data collection. The following sources are used to collect the data: journal articles, newspapers, internet sources, magazines, and books. These secondary sources were selected to provide a comprehensive understanding of the research topic, as well as to ensure the availability of diverse, credible, and up-to-date information. In addition, the use of multiple types of sources allows for data triangulation, thereby enhancing the reliability and validity of the findings.

2.4 Research design

A cross sectional descriptive study was carried out to establish the determinants of hazard vulnerabilities in Palashpur slum. The survey was allowed for the collection of data within a short period of time. Both qualitative and quantitative data was solicited through household interviews with households. FGD's were conducted to collect qualitative data.

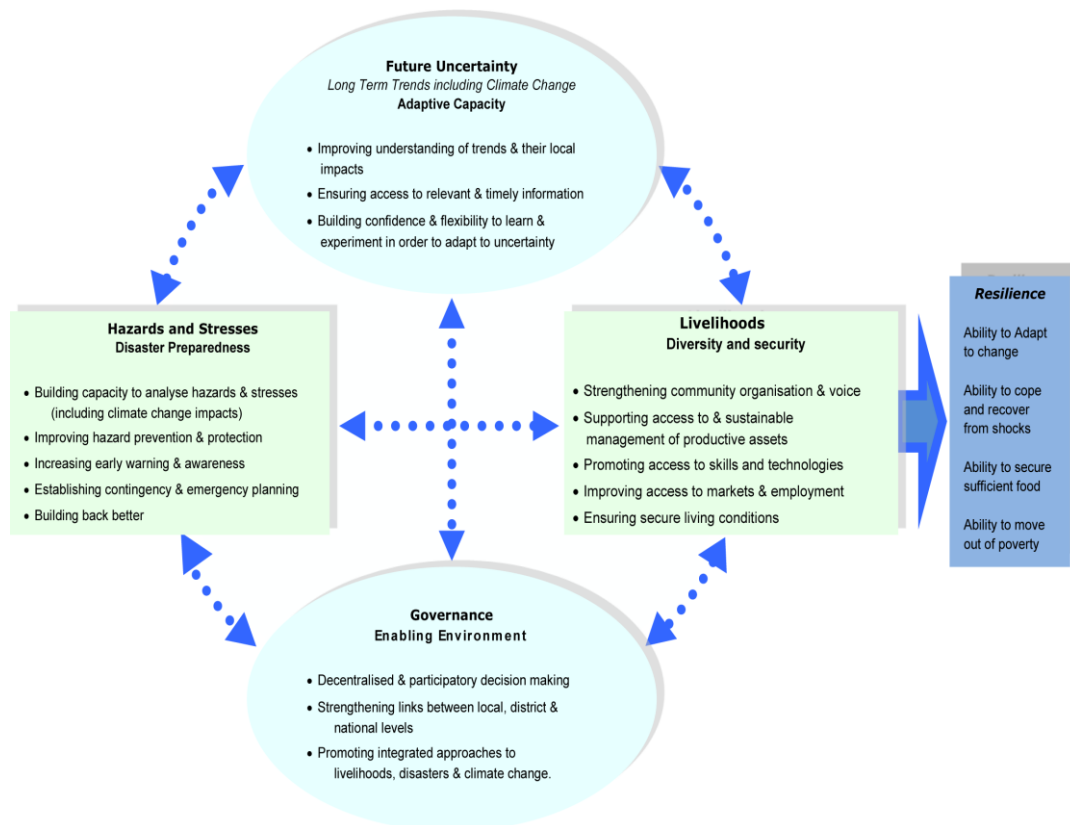


Fig. 2. Vulnerability to Resilience (V2R) framework (Pasteur, 2011)

The questionnaire was formulated based on the V2R framework (Pasteur, 2011). From vulnerability to resilience, or V2R, is a framework (Fig. 2) used for analysis and action to reduce vulnerability and strengthen the resilience of individuals, households and communities. The framework sets out the key indicators that contribute to peoples' vulnerability: exposure to hazards and stresses; fragile livelihoods; future uncertainty; and weak governance. It provides detailed explanations of the linkages between these factors, as well as ideas for action to strengthen resilience. The following framework (Fig. 2) shows that it has four criterions which are needed to be strong to be resilient. The questionnaire had been made to identify the vulnerability of four criterions. Both qualitative and quantitative data had been taken. Then, these data are merged with the FEMA model (Islam et al., 2013) to identify vulnerability. At last proper measures have been proposed based on vulnerability.

2.5 Data analysis

The data has been analyzed according to the FEMA model. In this model there are four criteria like history, vulnerability, maximum threat and probability (Islam et al., 2013). According to these, the V2R framework has been interlinked with the model. As a result, four criteria have been replaced by hazard, future uncertainty, governance and livelihood. Along with, different indicators have been selected under the criteria in case of various types of hazards.

For the evaluation of indicators by respondent's perception value high, medium, low, very low, no value is made for each criterion. These categories are weighed according to the responses (simply by assigning high =1, medium = 0.75, low = 0.5, very low = 0.25 and no = 0 point and weighing the totals by multiplying with the respondent's value and then dividing it by frequency =100 (value of random sampling). Thus a total value for the particular hazard is derived. The category value is calculated using the formula:

$$C=P \times R \quad (\text{Eq. 1})$$

where C represents the category value, P is the category point, and R is the respondent's response value, following DeVellis & Thorpe (2021). This formulation is commonly applied in quantitative analysis to standardize respondents' answers into comparable numerical values. Furthermore, the indicator value is obtained by summing all category values and dividing by the frequency, expressed as:

$$I = \frac{\sum C}{F} \quad (\text{Eq. 2})$$

Before calculating the final result, it is important to ensure that all indicator values have been accurately computed and are consistent across the dataset. This step helps to minimize potential errors and ensures the reliability of the analysis. Finally, the average value is calculated by dividing the total value by the number of indicators, as shown in:

$$\text{Average value} = \frac{\text{Total value}}{\text{Number of Indicators}} \quad (\text{Eq. 3})$$

In these equations, C denotes the category value (high, medium, low, very low), P refers to the assigned point for each category, R represents the respondent's response value, I indicates the indicators, and F represents the frequency. This classification framework facilitates a structured interpretation of respondents' perceptions across different levels of vulnerability. Finally, the average values of all hazards are aggregated to produce the overall vulnerability outcome, enabling the study to identify which hazard contributes most significantly to the vulnerability of the slum.

3. Results and Discussion

3.1 Hazard analysis

Good understanding of hazards and their associated vulnerabilities, or of any action they could take to prevent or prepare for such threats are often lacking by vulnerable people (Chambers, 1989). Building community capacity for analyzing and understanding the hazards that affect their lives as a first step towards taking action to address those hazards is an important component to strengthen resilience (Lyons & Schilderman, 2010). According to this, the first step was taken to identify the most vulnerable hazards for this slum. Respondents said that fire, mismanagement of waste, water logging, and conflict are the existing human induced hazards in the slum. So, to analyze the hazard which is so vulnerable for this community three indicators for instance the rate of frequency, the rate of severity and the degree of negative impact have been selected.

3.1.1 Fire

Fire is a very common and devastating phenomenon in this slum area. When the respondents were asked about the several indicators, they gave the degree of negative impact on slum (0.743) (Fig. 3) the most priority. Its frequency (0.675) (Fig. 3) is medium that means it occurs a few within years but when it occurs its severity turns into a destructive form.

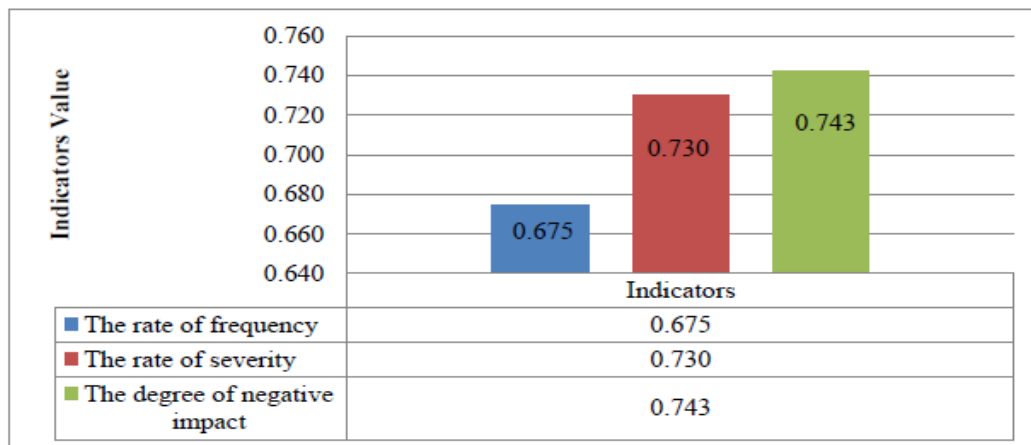


Fig. 3. Analysis of Fire in terms of hazard analysis

3.1.2 Mismanagement of waste

Waste management is so poor in the study area. That's why their response on frequency (0.753) (Fig. 4) was high. It basically hampers the health status of women and children. New born babies and pregnant women are mainly vulnerable due to the insalubrious condition of waste. Besides, those who are disabled can't move well from the slum. As a result the odor and germ disclosed from the waste hampers their health status.

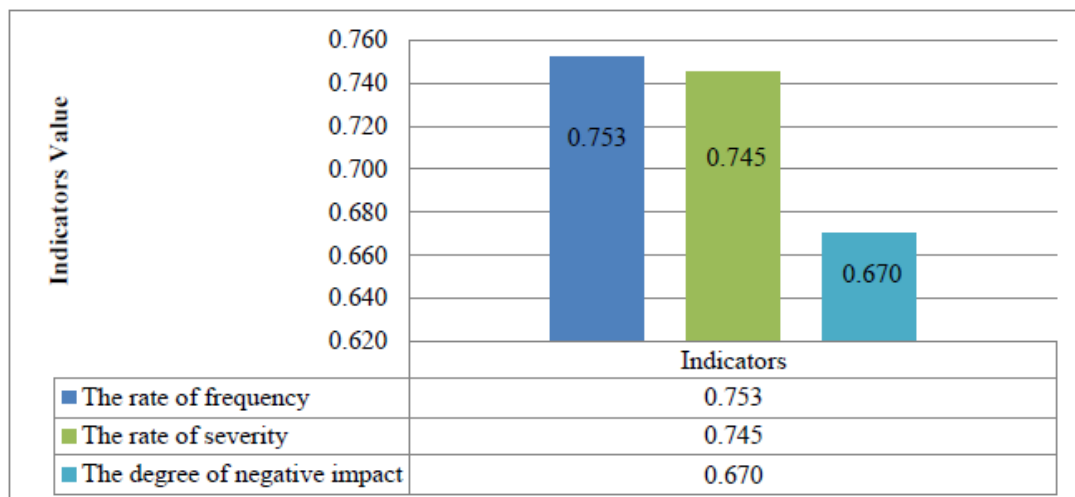


Fig. 4. Analysis of mismanagement of waste in terms of hazard analysis

3.1.3. Water logging

Water logging is caused due to the poor drainage system of the slum. Waste is interlinked with it. However, wastes damage the drainage system and rain water can't pass properly. As a result, water logging occurs frequently. It turns the normal lifestyle into a noxious term along with health status. Respondents have raised their most voice on its severity (0.723) (Fig. 5). SO, water logging is making the slum vulnerable by its severity.

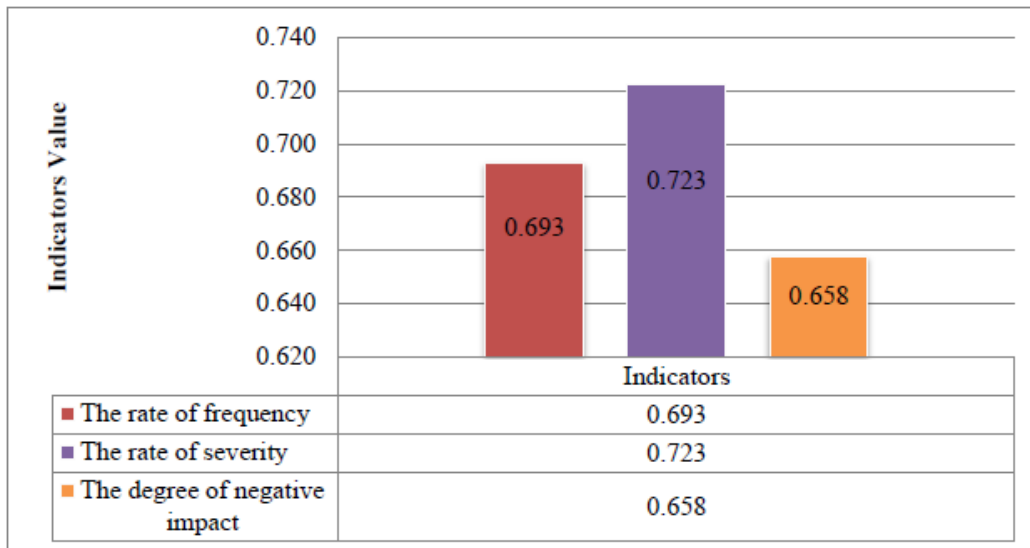


Fig. 5. Analysis of Water logging in terms of hazard analysis

3.1.4. Conflict

It's a very common phenomenon in the slum. Most of the respondents have personal conflict. That is why they try to hamper each other by setting their household on fire deliberately, removing sand from the base of the house which makes their house clumsy and collapses at a time. The frequency of this hazard is (0.6775) (Fig. 6) which is more than other indicators.

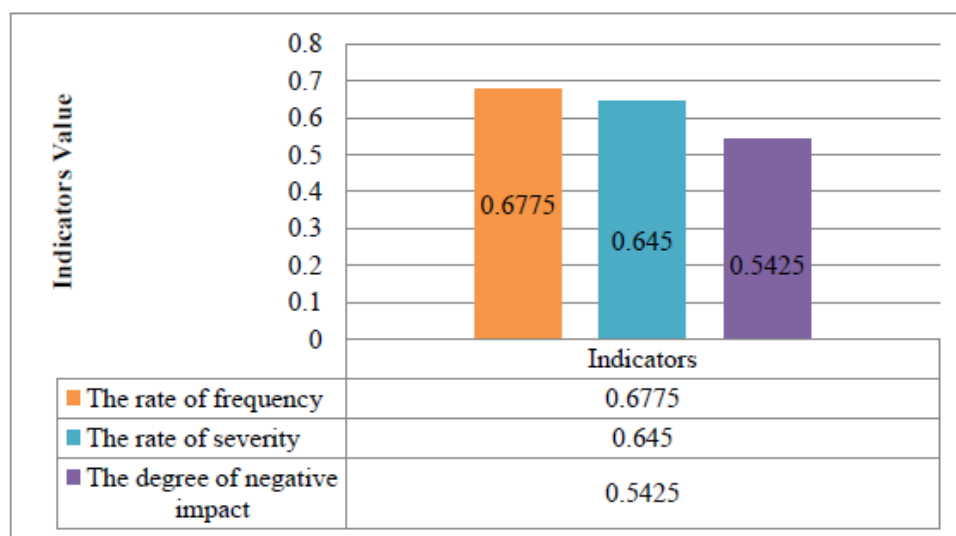


Fig. 6. Analysis of Conflict in terms of hazard analysis

3.1.5. Cumulative values of hazards in terms of hazard analysis

By analyzing all indicators value based on respondent's response it is clear that Fire (0.716) (Fig. 7) is the most prioritized hazard that is making the slum more vulnerable. Above mentioned information shows that the frequency, severity and negative impact is more than other other hazards. So, Fire is the most concerning issue in case of vulnerability.

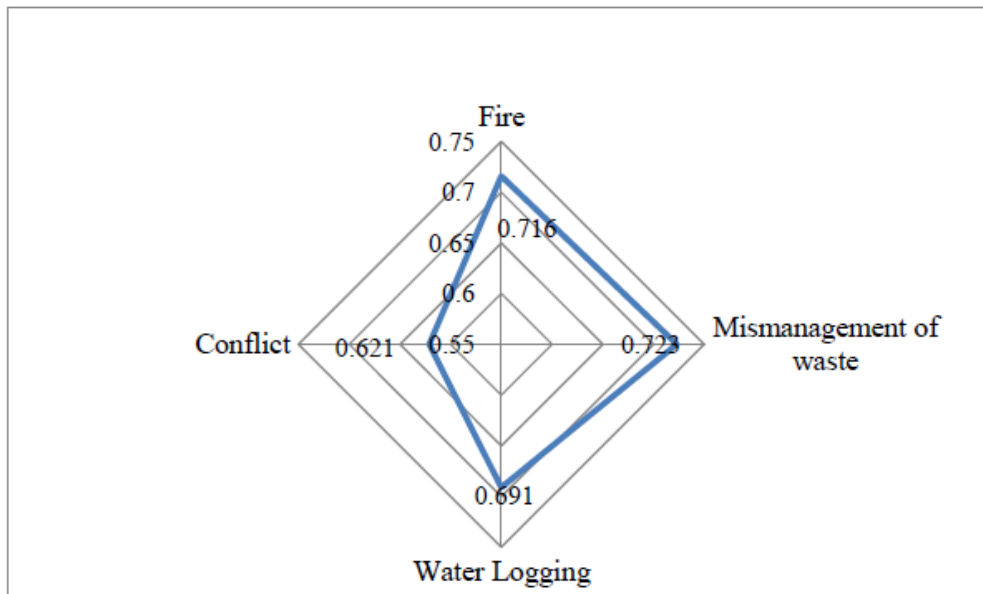


Fig. 7. Cumulative values of hazards in terms of hazard analysis

3.2 Livelihood analysis in case of hazards

For the resiliency of any household they need adequate resources (for example cash, food, local organizations and skills) to draw in times of need (Taha, 2010). They also need livelihoods that are secured and not easily damaged by hazards and stresses (Stage, 2002). For resilience having access to a diversity of resources is important (Del Ninno, 2003). A livelihood contains the resources (including skills, technologies and organizations) and activities required to make a living and have a good quality of life (Adger, 2003). Just looking at people's main source of employment or income does not only mean in case of understanding livelihoods, but at all the different activities and choices within the household and community which provide food, health, income, shelter and other tangible and intangible benefits, such as comfort, safety, respect and fulfillment (Adger, 2005). The livelihood options available to individuals and households depend on the diversity of resources, skills and technologies they are able to access in case of any hazardous situation (Yohe & Tol, 2002). About 36% of people earned less than 5,000 BDT per month, with income parameters scoring 3.02 and employment scoring 2.86 out of 5 in Bangabandhu Colony under Ward No. 11 of Barishal City Corporation (Mukherjee et al., 2020). The security of their livelihood also depends on the security of their available resources. In fact, existing hazards in the community make the livelihood of people so vulnerable but they don't have the capability to understand it. For analyzing the hazard which is making the livelihood so much vulnerable, four indicators have been selected. Respondents valued their response on that indicator and then the analysis has been done.

3.2.1. Fire

Fire interrupts the livelihood a lot. The severity of fire depends on its duration. In the case of livelihood, people have lack of coping strategies (0.773) (Fig. 8) which make them delay to overcome the situation. People face constraints (0.763) (Fig. 8) that they have lack of organizational capacity, skills and technologies, secured living conditions etc. Without these they have gaps with external institutions (0.680) (Fig. 8) like, safety nets, services, financing etc. So, fire affects the livelihood (0.730) (Fig. 8) a lot.

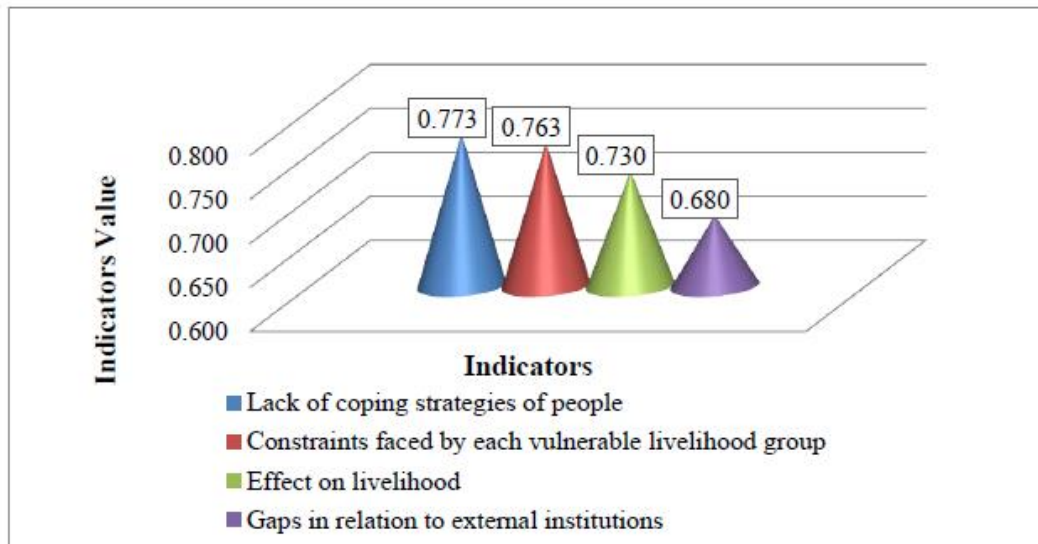


Fig. 8. Analysis of Fire in terms of livelihood analysis

3.2.2 Mismanagement of waste

In the case of livelihood, the most lacking is the gaps in relation to the external institutions (0.703) (Fig. 9). Respondents said that the unhygienic condition of waste makes them sick and they lag behind to go to work. For recovering the situation they have no alternative livelihood options. They have a lack of coping strategies (0.688) (Fig. 9) with the situation. So, all of these indicators mean that the waste management system is very poor in this area.

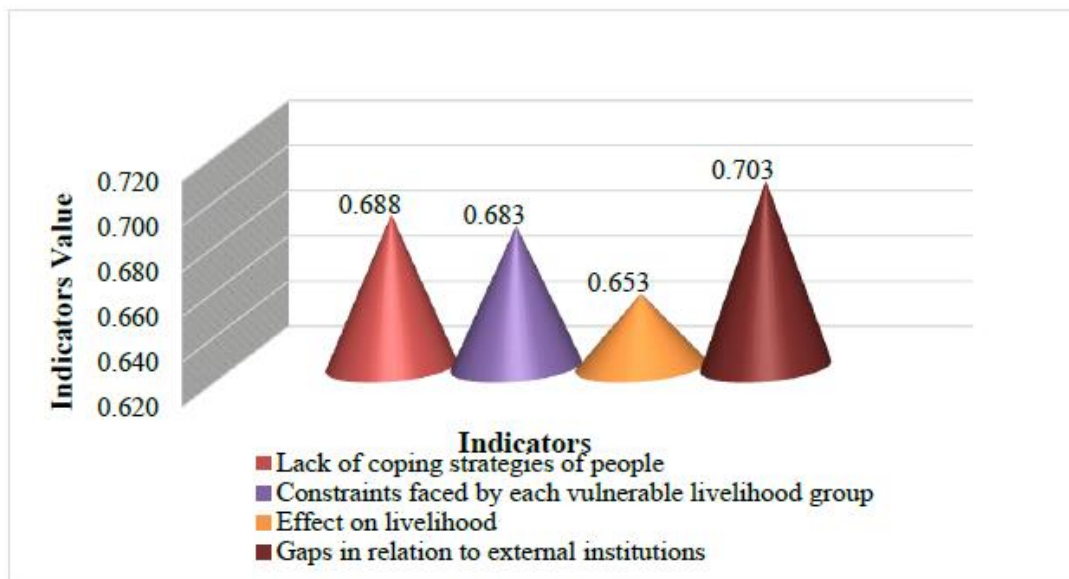


Fig. 9. Analysis of mismanagement of waste in terms of livelihood analysis

3.2.3 Water logging

Water logging is related to mismanagement of waste. In the rainy season it is basically seen. Water doesn't pass through the drain. As a result, the house is submerged with water. The housing structure, furniture are all damaged. Likewise, livelihood is hampered. Gaps in relation with external institutions (Fig. 10) who will provide services, fund is making the slum more vulnerable in this sense.

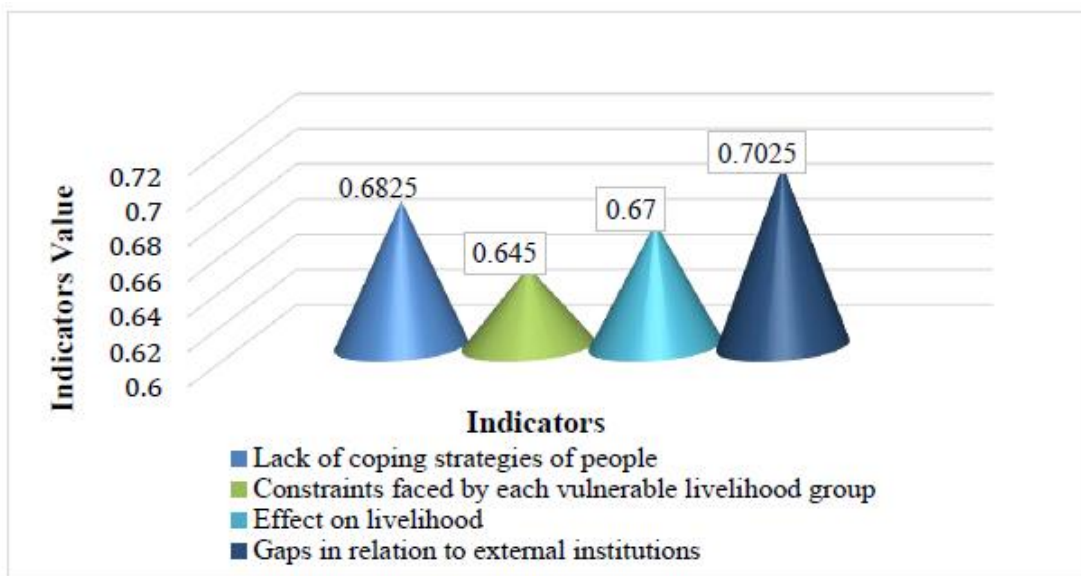


Fig. 10. Analysis of water logging in terms of livelihood analysis

3.2.4 Conflict

It's really very rare that external institutions will provide services or funds for their personal conflicts. The respondent's value of these gaps is (0.713) (Fig. 11). Without these, effects on livelihood (0.700) (Fig. 11) are not negligible. The main problem is conflict like setting house on fire willingly makes a loss to the dwellers. At this moment they don't get support from anywhere. They need to recover their condition by themselves. As a result, constraints faced by each vulnerable livelihood group (0.653) (Fig. 11) and lack of coping strategies (0.660) (Fig. 11) should be taken into consideration also.

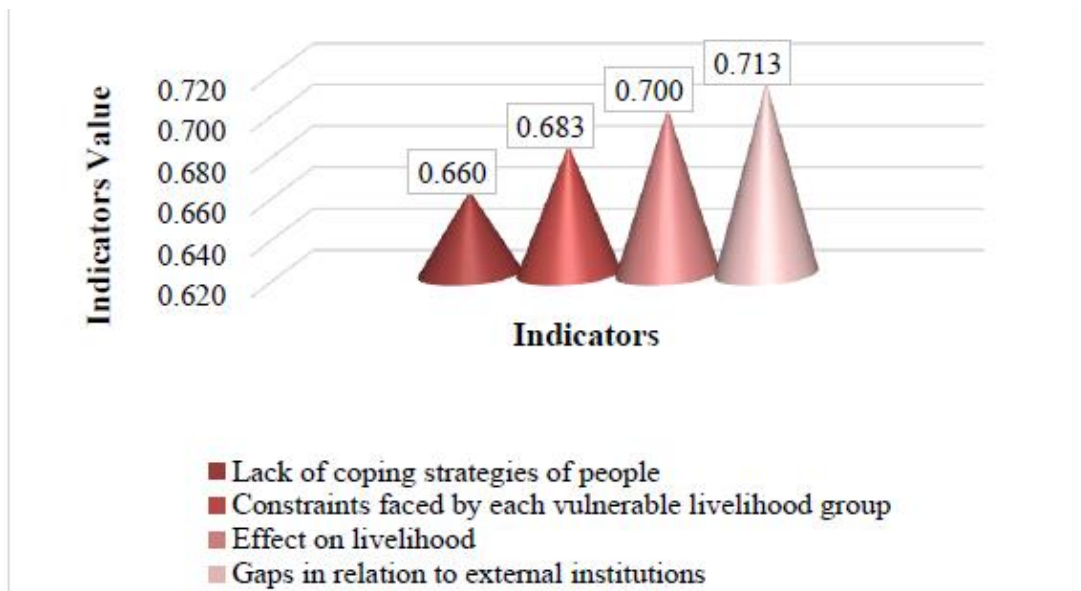


Fig. 11. Analysis of Fire in terms of livelihood analysis

3.2.5 Cumulative values of hazards in terms of livelihood vulnerability analysis

Considering all indicators, it is shown that the livelihood status of slum dwellers is being so much vulnerable due to fire (0.736) (Fig. 12). So, most measures should be taken. The main livelihood of this slum is rickshaw pulling. Really it's hard to continue when any family is affected with such types of hazards. Severe injury may also occur due to these hazards.

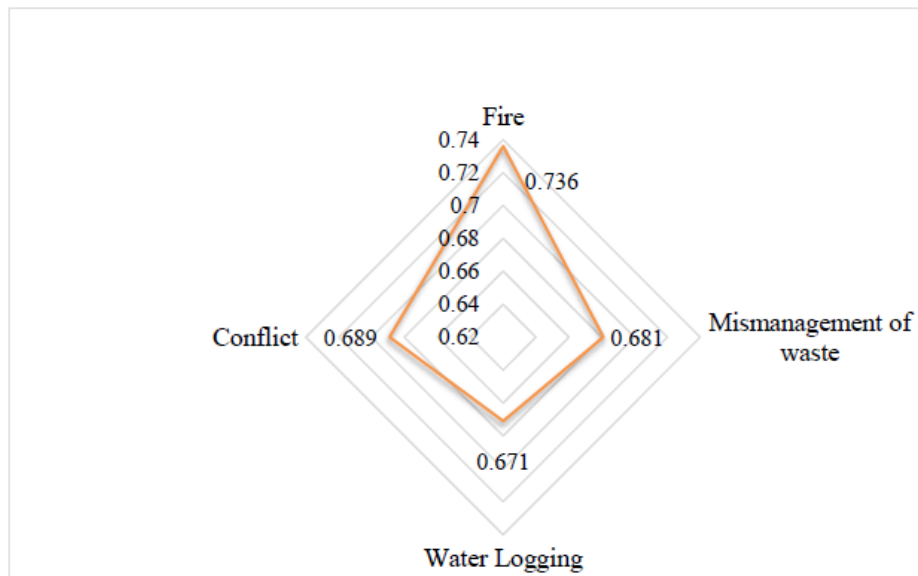


Fig. 12. Cumulative values of hazards in terms of livelihood vulnerability analysis

3.3 Analysis of future uncertainty

A challenge faced by vulnerable communities relates to the uncertainties about their future, brought about by ever increasing changes in their natural, political, social and economic environment, many of which are beyond their control. Long term trends are not the same as hazards and stresses – but they are very often an underlying causal factor. In order to deal effectively with the possible outcomes of future trends, households and communities need to be able to better understand those trends and to adapt their lives and livelihoods in response to them. To analyze the situation on future uncertainty respondents were asked questions on it. Questions were asked based on six indicators in this respect.

3.3.1 Fire

Fire is a common incidence in the study area. Proper awareness raising program training is arranged into the slum by different organizations. But, people are not aware about it. By the opinion of respondents, they valued the expectation to occur in future (0.743) (Fig. 13). Likewise, the probability of impacts is (0.760) (Fig.13) which is the most amongst all values. They get proper training on fire so the lack of institutional response is (0.665) (Fig.13) and lack of opportunities for ensuring resilience (0.648) (Fig.13).

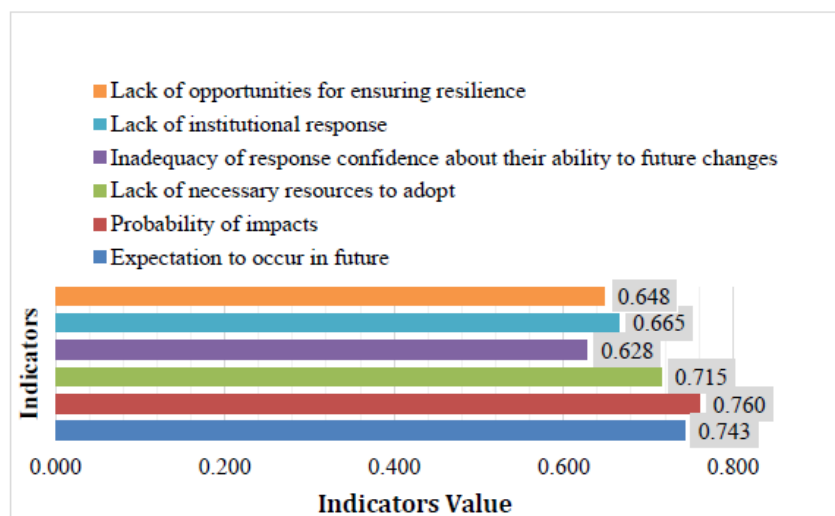


Fig. 13. Analysis of Fire in terms of future uncertainty

3.3.2 Mismanagement of waste

The waste management system is so poor in this slum. There is no dustbin in the area. Without this, no steps are properly taken to make the area salubrious by removing waste or disposing of them. So, the respondents expect that it will occur in future and they valued (0.7825) (Fig.14). Their saying was that, the impact (0.7675) (Fig.14) will basically focus on children and women. Every year, newborn babies and pregnant women suffer a lot due to these unhygienic conditions. They don't have a lack of institutional response (0.775) (Fig.14). But, they are not aware of it. The lowest value is for lack of opportunities for ensuring resiliency (0.6725) (Fig.14).

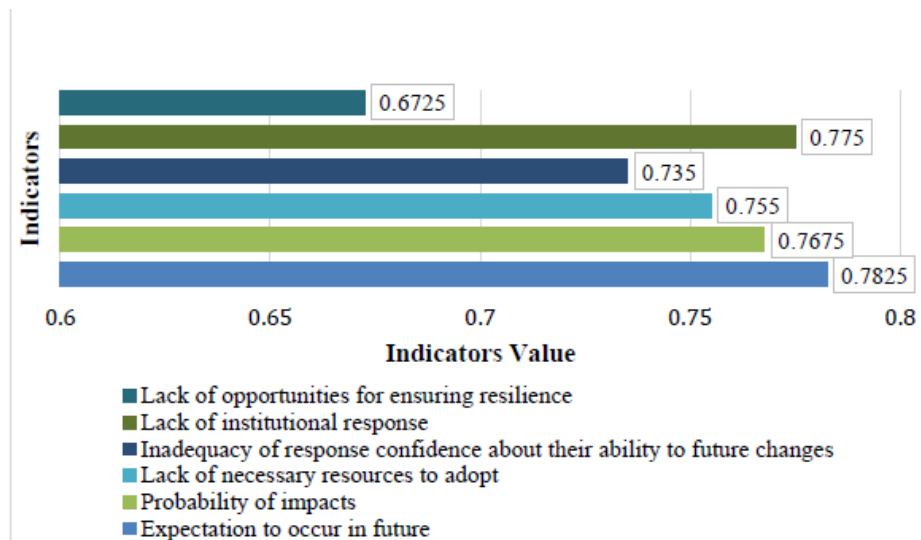


Fig. 14. Analysis of mismanagement of Waste in terms of future uncertainty

3.3.3 Water logging

Water logging is most seen in the rainy season. Wastes are dumped here and there in the slum. As a result, water can't pass through the drain. When respondents were asked questions about various indicators they most valued the lack of necessary resources to adopt (0.790) (Fig. 15). However, when their houses are flooded with water they don't have necessary resources like- stored food, back up of electricity, fast aid kit to adopt. Besides, with response confidence is also low (0.750) (Fig. 15) to evolve this hazard in future.

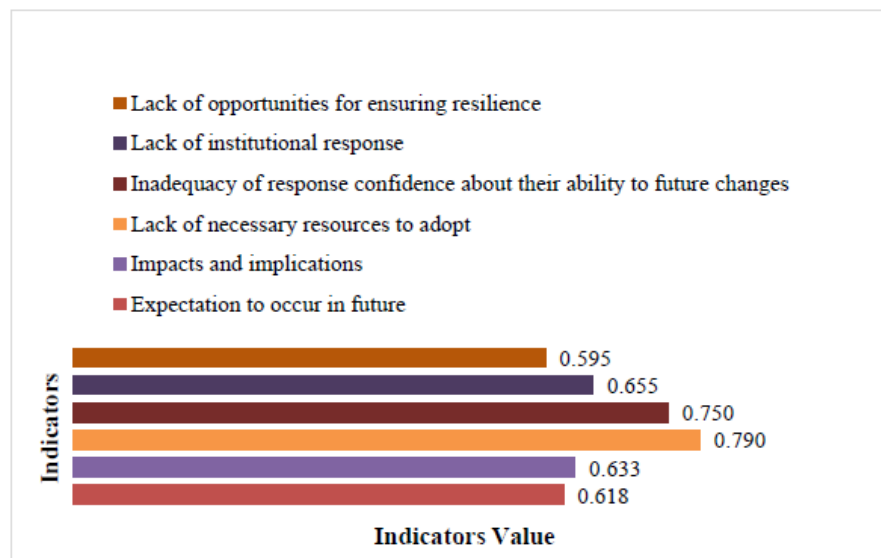


Fig. 15. Analysis of Water logging in terms of future uncertainty

3.3.4 Conflict

Conflict here means personal conflict. In this case, not only any person but also any organization doesn't want to interfere. As a result, victims from conflict have to recover by themselves. But, organizations that work in the slum should emphasize their response to conflict. About conflict the respondents gave the most priority to the lack of institutional response (0.7125) (Fig. 16). Most of them also said that they expect it to occur a lot in future (0.705) (Fig. 16).

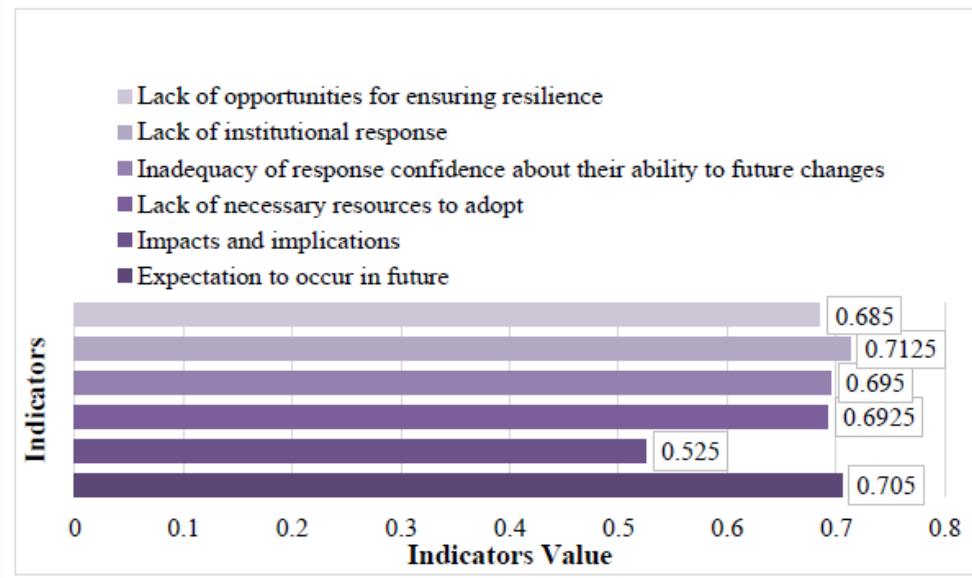


Fig. 16. Analysis of conflict in terms of future uncertainty

3.3.5 Cumulative values of hazard in terms of future uncertainty

In terms of future uncertainty, the highest value (0.748) (Fig. 17) is seen for mismanagement of waste. As of late, it is seen that people are not conscious at all about waste management. They dump waste here and there and there is no fixed dumping site for waste. The use of imperishable materials is rising drastically. The value of fire is (0.693) (Fig. 17). The increase of taking illegal electricity connections is setting the fire towards future uncertainty.

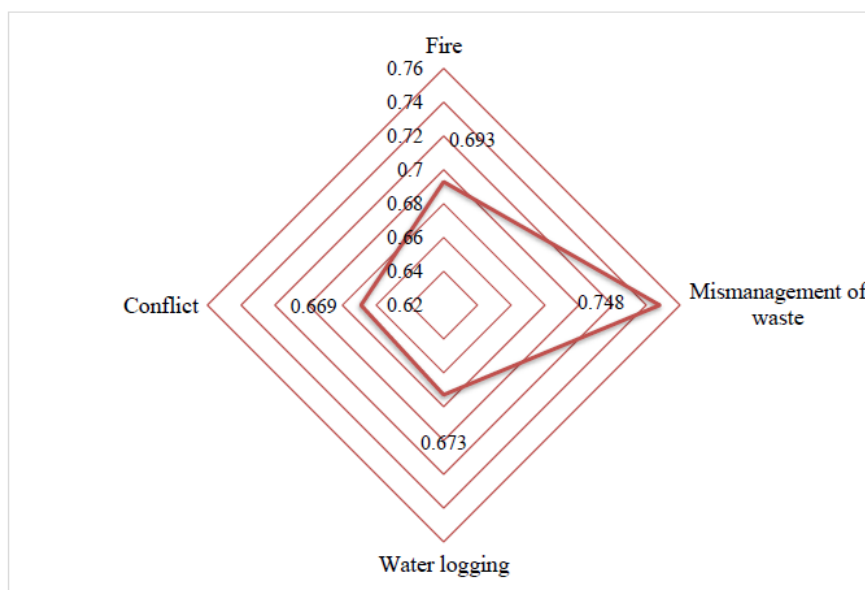


Fig. 17. Cumulative values of hazards in terms of future uncertainty

3.4 Governance analysis in terms of hazards

Vulnerability of people is shaped by a whole range of public and private organizations, institutions, policies and legislation that affect their lives (Pasteur, 2010). All levels from the household and local community through to the international level are operated by these structures. They include not just formal organizations and laws but also informal structures such as cultural codes of conduct. The governance context refers to the range of different organizations, policies and practices operating at different levels from local to international (Della Porta, 2008). Understanding of the governance context is vital to building resilience, because it determines how resources, skills, technologies and markets to strengthen and diversify their livelihoods are accessed by people, how they protect themselves from hazards, and how they access support to help them recover when they are affected (Kathlen, 2002). The institutional and policy context can play a role as an enabling environment, making it easier for people to improve their livelihoods, reduce their exposure to hazards, and adapt to climate change. However, people who are the most vulnerable are typically poorly organized and lack voice in decision-making processes that might affect them. These people often lacked access to the kinds of services which could help them to improve their livelihoods or to prepare for or respond to hazards. Mukherjee et al. (2020) revealed that good governance obtained a score of 2.72 which showed a medium level of resilience under the institutional dimension in Bangabadhu Calony under Ward no 11 of Barishal City Corporation. For understanding the governance of organizations in this community five indicators have been selected. These indicators will find out the lacks and gaps of linked organizations which are working for the development of the slum.

3.4.1 Fire

In terms of Fire, there is good governance in the study area. Interlinked organizations arrange various types of awareness raising programs in the slum. In spite of this, the local to national links strengthening is high (0.705) (Fig. 18). That means, the organization doesn't link the community with the upper level. If local organizations fail to take any attempt at development local people can't reach to the upper level organizations due to this lack. After that, the value of deficiency in ensuring decentralized and participatory decision making is (0.655) (Fig. 18). In fact, various organizations provide the same service to the slum. But, they don't take any decision to collaborate to solve any problem. Due to this, when respondents were asked about the scarcity of promoting integrated approaches, they valued it (0.630) (Fig. 18) which is not negligible. Only these organizations help to enable strengthening hazard preparedness, strengthen livelihood security, adaptive capacity etc. So, they valued it (0.573) (Fig. 18) which is very low.

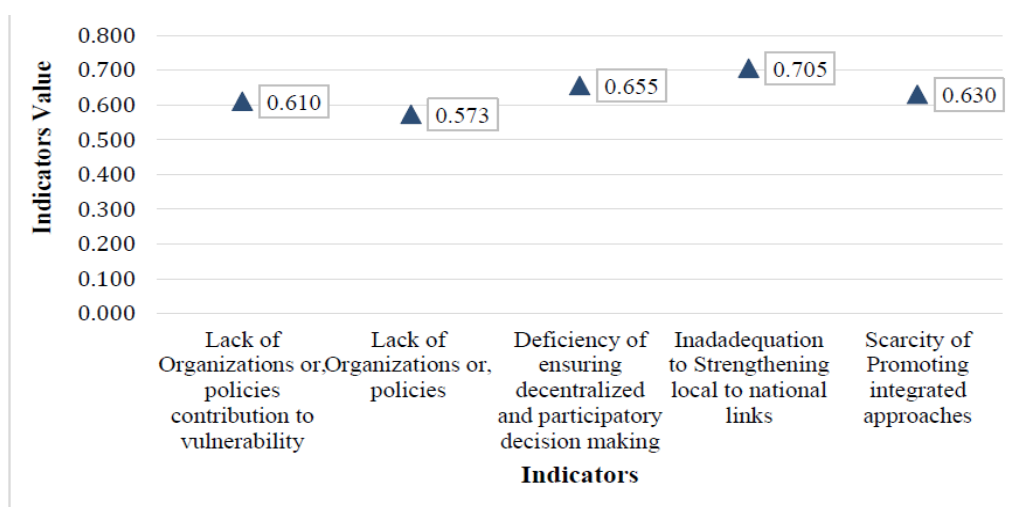


Fig. 18. Analysis of Fire in terms of governance

3.4.2 Mismanagement of waste

Local organizations have so much headache to manage waste in the area. In fact, people living in slums have to suffer a lot due to this problem. So, they organize programs to raise awareness among people to be conscious about their health status, surrounding environment by managing waste. But, they don't take any steps to manage it. Besides, people in the slum are not connected to the upper level as they can submit their proposal to them. So the respondents valued it (0.673) (Fig. 19). The next value is scarcity of promoting integrated approaches (0.653) (Fig. 19). There are many existing organizations in this slum who work on waste. But, they work individually. As a result, no organization can individually fulfill their targets.

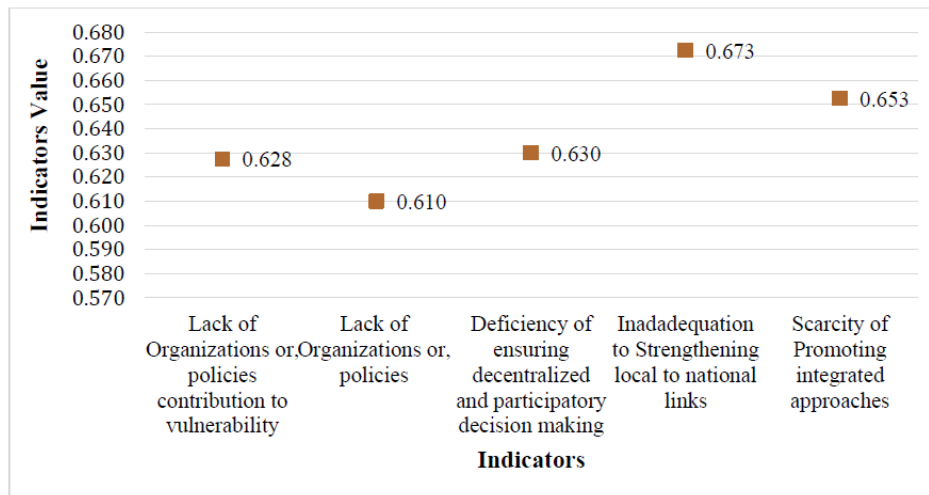


Fig. 19. Analysis of mismanagement of waste in terms of governance

3.4.3 Water logging

Water logging basically occurred due to lack of waste management. Respondents said that they have to face a lot of problems due to water logging in the rainy season. They always desire the best solution from local organizations. But, they really don't know that they have the capability of raising their proposal on a national level. The figure shows that, they also have valued the inadadequation of strengthening local to national link (0.6925) (Fig. 20) and then the scarcity of promoting integrated approach (0.665) (Fig. 20). They gave the lowest value to the deficiency of ensuring decentralized and participatory decision making (0.615) (Fig. 20). because, few organizations work on water logging just like World Vision Bangladesh, Urban, Avash but they don't work in an integrated approach.

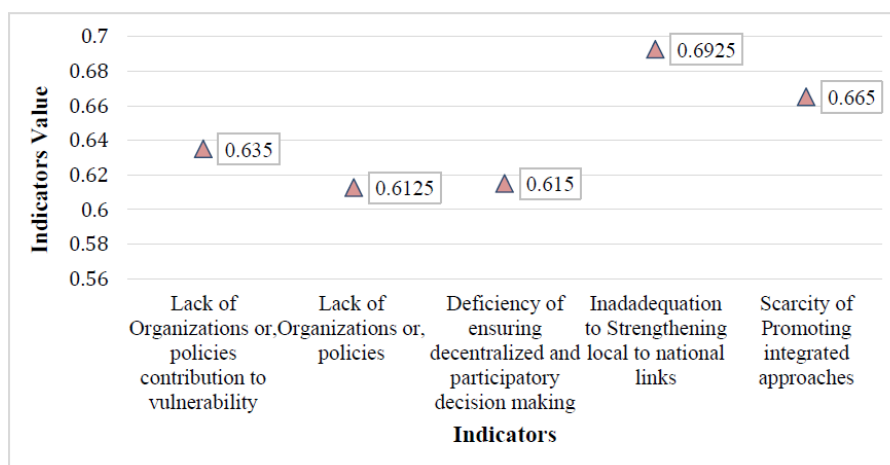


Fig. 20. Analysis of water logging in terms of governance

3.4.4 Conflict

The following chart shows that, the value of lack of organizations or, policies contribution to vulnerability is (0.713) (Fig. 21). That means, organizations and policies have no contribution in this respect. As a result, the value of other indicators is also near about high. Basically, conflict causes a vulnerable situation but it does not make no sense to anyone. At least, awareness should be riased up among all people as they become aware of it.

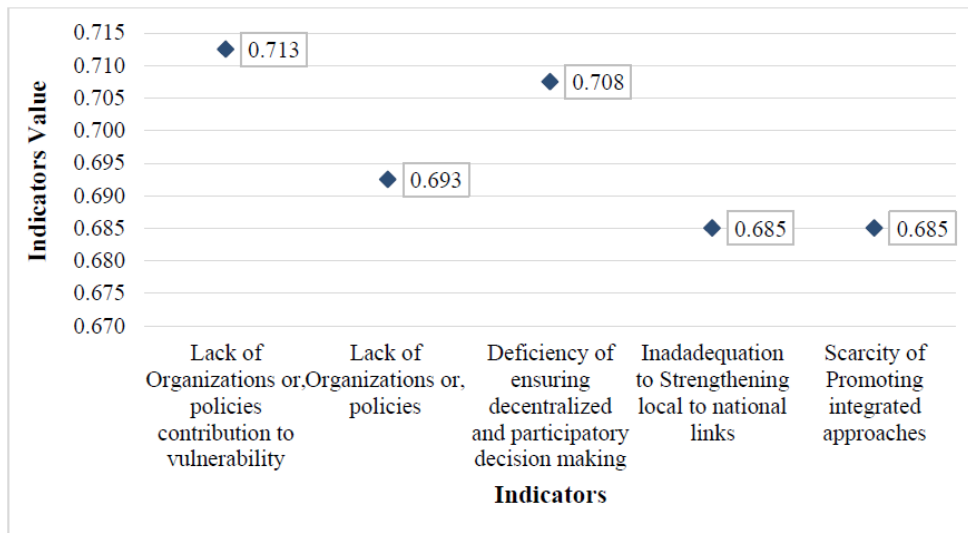


Fig. 21. Analysis of conflict in terms of governance

3.4.5 Cumulative values of hazards in terms of governance analysis

From the following chart, it can be seen that conflict has the highest value (0.697) (Fig. 22). It means, engaged organizations have low focus on conflict. They have no contribution for reducing the vulnerabilities of conflict. On the other hand, Fire has the lowest value (0.635) (Fig. 22). So, Fire is composed of good governance.

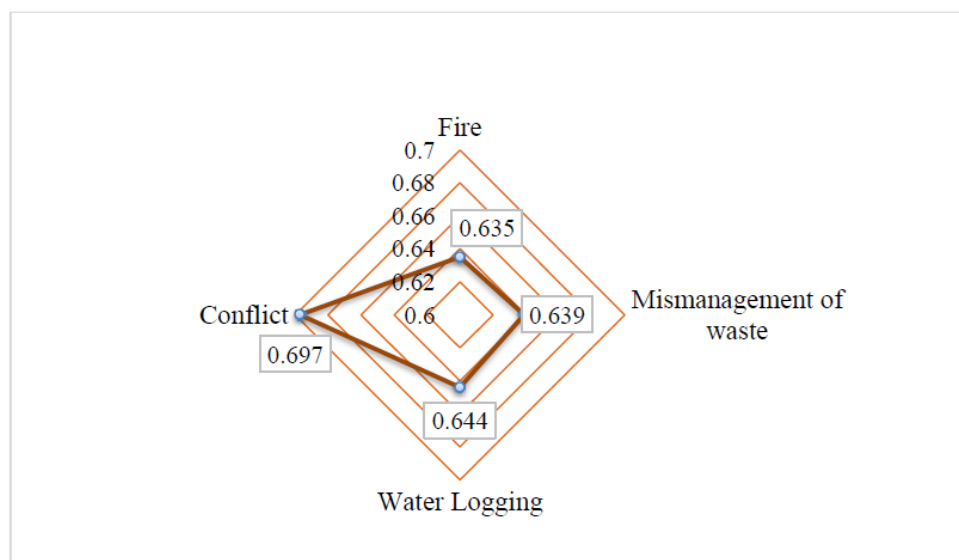


Fig. 22. Cumulative values of hazards in terms of governance analysis

3.5 Total vulnerability outcome

All average values are summed in the following chart considering all indicators. From the chat it is clear that the most prioritized human induced hazard in this area is

mismanagement of waste (2.790) (Fig. 23). The value of fire is (2.780) which is near about the value of mismanagement of waste (Fig. 23). The value of conflict is (2.676) and water logging (2.683) (Fig. 23). So, the most resilience measures should be taken against mismanagement of waste. Because, only this hazard exists in the area continuously and making the area unsuitable to live. Fire hazard is so frequent and every year many households are affected by this hazard. Water logging is the consequence of mismanagement of waste. During the rainy season it appears a lot and water stagnant occurs all over the slum. In terms of conflict, people really have no realization that it is a human induced hazard yet. So, good governance is entirely needed for the resilience of the area against conflict.

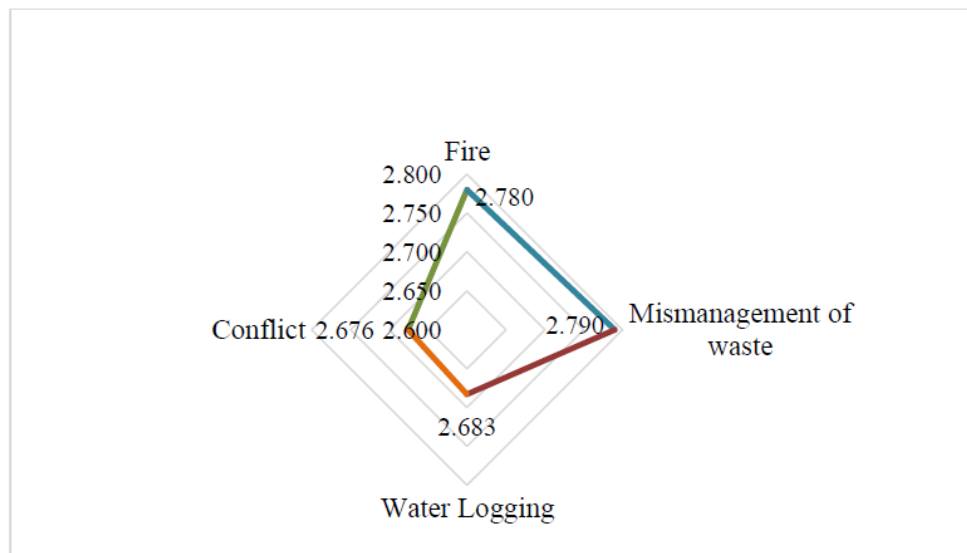


Fig. 23. Total Vulnerability outcome

3.6 Vulnerability to Resiliency (V2R)

Resilience refers to the ability of a system, community or society to resist, absorb, cope with and recover from the effects of hazards and to adapt to longer term changes in a timely and efficient manner without undermining the wellbeing (Watkins, 2007). Resilience can be thought of as the capacity to endure shocks and stresses and bounce back; individuals or communities that can ride out the difficulties that life might bring without their overall situation deteriorating (Venton & Trobe, 2008). Even when affected by significant hazard events, or by longer term negative trends, they must be able to recover or adapt their livelihoods and continue to improve their lives and move out of poverty. Increasing people's resilience means addressing the factors that underlie their vulnerability and can choose to live or work in areas less exposed to hazards, or at least have more resources to draw on in order to cope and recover when they are affected by negative events. Being better prepared for hazards can significantly reduce exposure. Improved understanding of long term trends, including human induced hazards, means that people can draw on their available resources in appropriate ways in order to adapt with these hazards. And finally, by creating a more enabling governance environment then people will be able to access or influence processes of decision making, service provision, and resource allocation. Mukherjee et al. (2020) find that repairing roads, widen the space of walking, covering the drains in order to stop drain water coming in the roads, rainwater harvesting, excavating near water body, reduce the problem of waterlogging, awareness about natural or man-made hazards, implementing laws related to building codes, various risk reduction programs, community activities, arrange different training programs, campaigns are necessary to enhance urban slum resilience. This study also revealed that realizing the need for social relations, bonding, and cooperation is essential to survive after any disaster. Besides these, the study revealed that

institutional collaboration, crisis management framework, good governance, budget allocation for disaster risk reduction, provision of subsidy and insurance, credit facility to face disasters, budget for any development work provided by the city corporation and subsidies for residents to rebuild houses and livelihood after a disaster are a way to enhance slum's resilience. Resilience measures of individual hazards according to the V2R framework is illustrated below.

3.6.1 Vulnerability to Resiliency (V2R) in case of Fire

Hazard preparedness measures should include awareness-raising programs on how to prevent fire hazards, as well as contingency and emergency planning to ensure safer evacuation during fire incidents. Given the highly congested nature of slum settlements, residents should establish fixed but separate evacuation routes for specific households to prevent overcrowding during emergencies. Additionally, electricity lines should be installed at safer levels, preferably above ground, to reduce the risk of electrical fires during natural calamities.

In terms of governance, efforts should focus on providing training programs, such as mock drills, supported by adequate funding to enhance community preparedness. It is also important to ensure the provision of essential services, including financial, health, and educational support, through coordinated efforts among relevant organizations following hazard incidents. Furthermore, supplying fire extinguishers to households at affordable prices can enable residents to respond quickly to fire outbreaks and minimize potential losses.

From a livelihood perspective, residents should be encouraged to diversify their income sources to cope with emergency situations. Relying on a single livelihood option can increase vulnerability if it is disrupted by hazards such as fire. Therefore, alternative income opportunities can serve as a safety net during crises. In addition, access to fire insurance services should be promoted to help individuals recover from losses, while financial incentives from the government or external institutions can support affected populations in rebuilding their livelihoods. Regarding future uncertainty, preventive measures should include discouraging illegal electricity connections, as proper and legal access to electricity can significantly reduce fire risks. Moreover, residents should be encouraged to avoid the use of expired gas cylinders to prevent accidental fires.

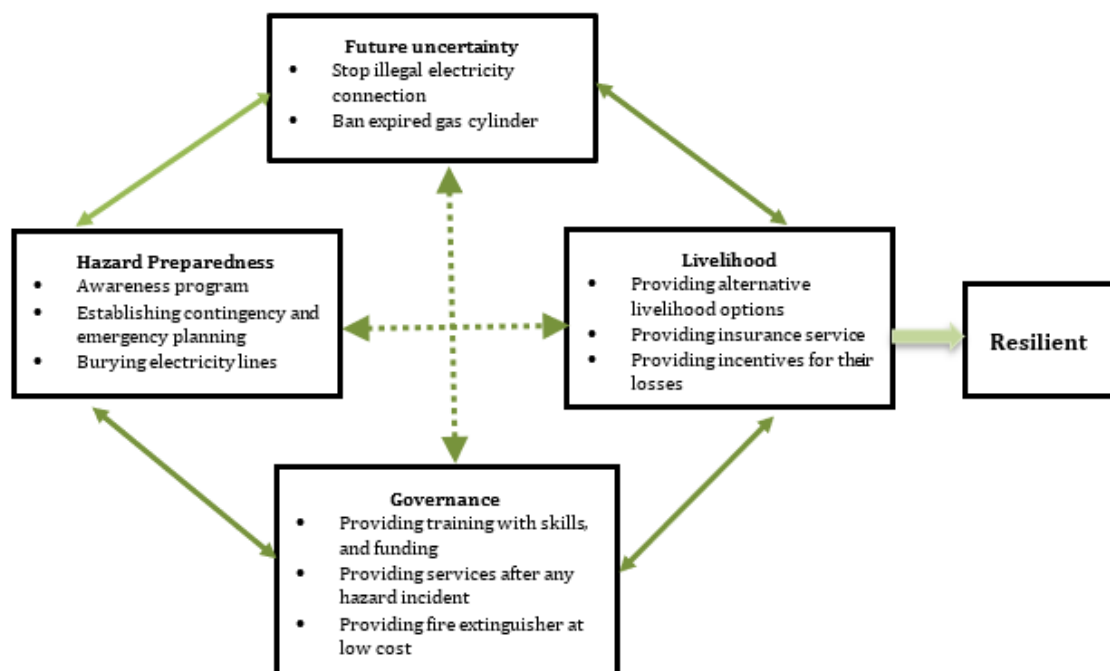


Fig. 24. Vulnerability to Resiliency (V2R) of Fire

3.6.2 Vulnerability to Resiliency (V2R) in case of Mismanagement of waste

Hazard preparedness efforts should include raising awareness among slum residents regarding the mismanagement of waste. Community members should be encouraged to use reusable bags to reduce waste generation and avoid the disposal of non-biodegradable materials, such as plastic bags, into drainage systems, as these materials do not decompose and obstruct proper waste management. In addition, establishing community-based volunteer groups can play a vital role in monitoring waste practices and promoting awareness among residents.

From a governance perspective, adequate waste management infrastructure should be ensured by placing accessible dustbins at multiple points throughout the slum. The city corporation should also guarantee the regular collection of waste on a daily basis. Furthermore, the government should implement and enforce regulations against indiscriminate waste dumping, with appropriate penalties for violations to ensure compliance.

In terms of livelihood, improper waste management contributes to the spread of diseases through flies and other insects that thrive in waste. Therefore, the use of covered containers is essential to minimize health risks. Additionally, as organic waste produces unpleasant odors during decomposition, it should be disposed of promptly before it begins to decay. Regarding future uncertainty, the increasing use of single-use materials, particularly plastics, has significantly contributed to waste mismanagement and should therefore be reduced. Moreover, in urban areas, unused wetlands are often used as dumping sites, which exacerbates environmental degradation and should be strictly controlled.

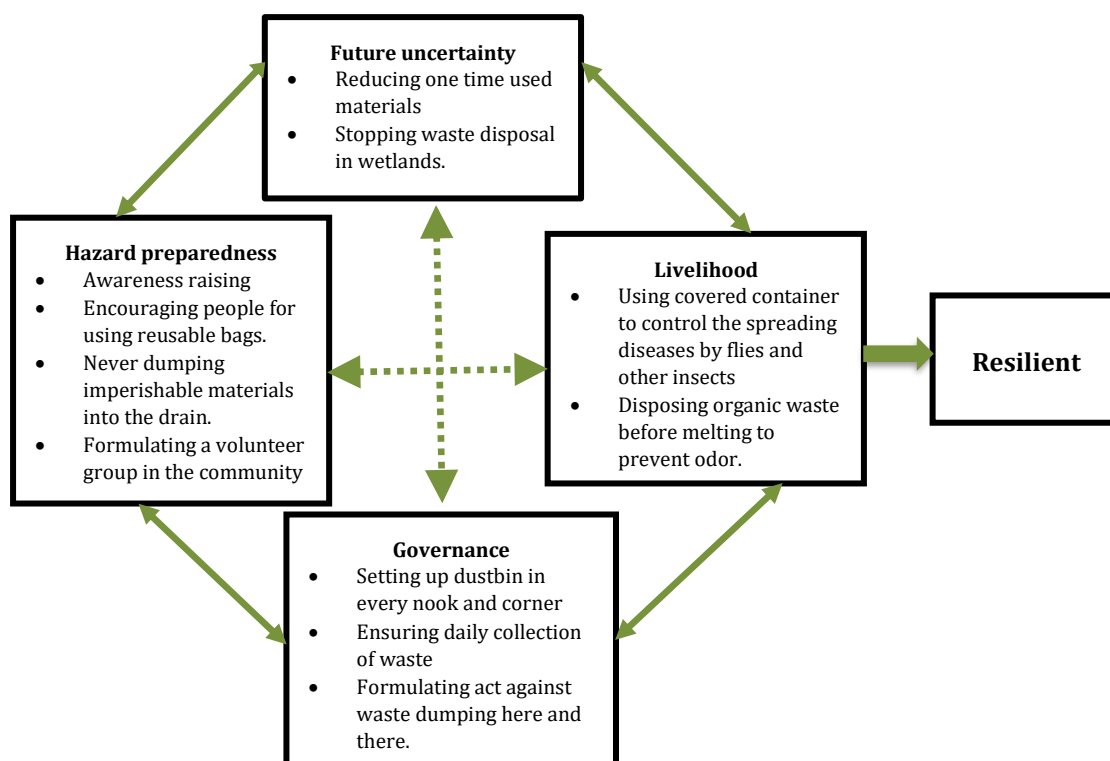


Fig. 25. Vulnerability to Resiliency (V2R) of Mismanagement of Waste

3.6.3 Vulnerability to Resiliency (V2R) in case of Water logging

Hazard preparedness efforts should focus on raising awareness about the negative impacts of waterlogging and its consequences for the community. Since waste mismanagement is a major cause of waterlogging, residents should be encouraged to adopt proper waste disposal practices. In addition, the filling of wetlands with non-biodegradable

materials should be avoided, as these materials block drainage systems and worsen flooding conditions. Ensuring a proper drainage system is essential for community development, particularly during the rainy season, as it allows water to flow efficiently. Furthermore, construction in low-lying areas should be discouraged, as these locations are more prone to water accumulation, which can damage infrastructure foundations.

From a governance perspective, illegally occupied canals, drainage channels, and footpaths should be restored to improve water flow and drainage efficiency. City corporations and relevant authorities should also take responsibility for rehabilitating and maintaining proper drainage systems, especially in areas where infrastructure is currently inadequate. In terms of livelihood, waterlogging often leads to the contamination of pond water due to the mixing of waste, making it unsafe for use. Therefore, pond water should be treated or purified before consumption or domestic use to prevent health risks. Regarding future uncertainty, the increasing use of polybags, despite government restrictions, has contributed significantly to drainage blockages and waterlogging. Therefore, the use of such materials should be minimized or eliminated. Additionally, the disposal of non-biodegradable waste into drainage systems should be strictly prevented to reduce the risk of clogging and subsequent flooding.

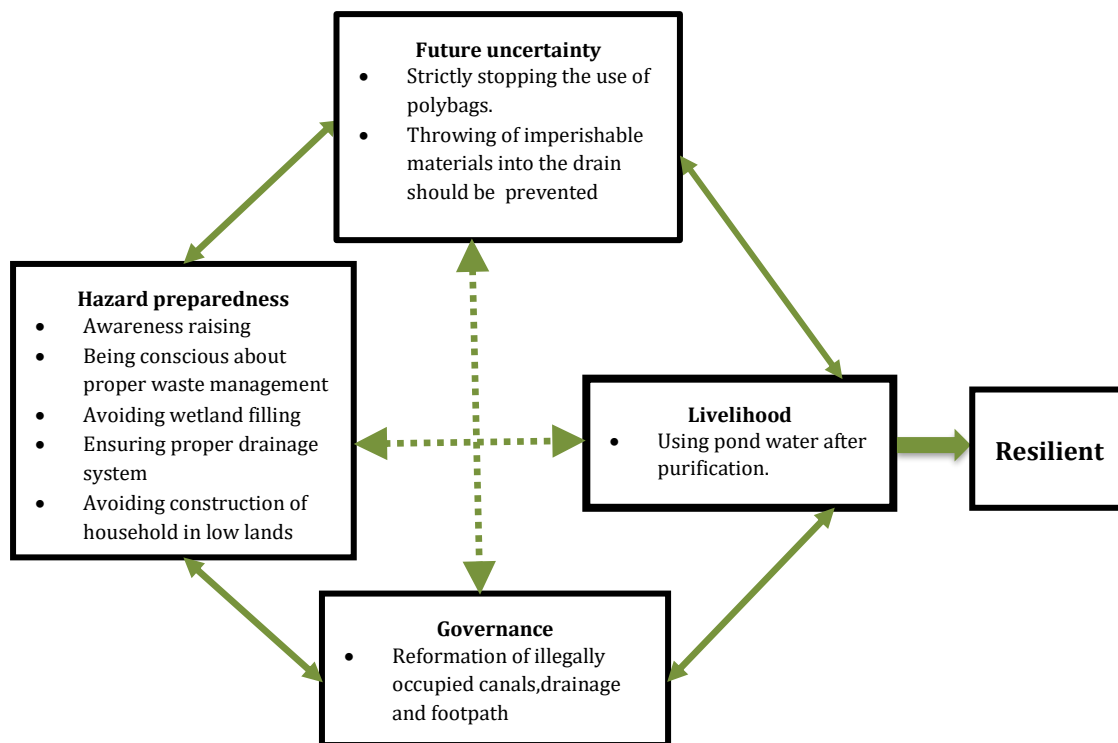


Fig. 26. Vulnerability to Resiliency (V2R) of Water logging.

3.6.4 Vulnerability to Resiliency (V2R) in case of Conflict

Hazard preparedness efforts should focus on strengthening social relationships within the community, as weak social cohesion is a major cause of conflict in slum areas. Enhancing mutual understanding and cooperation among residents can help reduce tensions and prevent disputes. In addition, awareness programs should be conducted to educate community members about the negative impacts of conflict, as many individuals may not fully recognize its potential consequences on social stability and well-being.

From a governance perspective, the protection system in slum areas is often weak, which may create an environment where individuals feel free to engage in harmful conflicts. Therefore, strengthening security measures and enforcing effective protection systems are essential. The formulation and implementation of strict laws can further help control and prevent conflicts. Moreover, unregulated or unattended government land often becomes a

source of dispute, as individuals may attempt to occupy it illegally. Thus, the government should actively manage and monitor such land to prevent illegal occupation and reduce conflict. Additionally, the practice of asserting power to seize property or resources should be discouraged and strictly regulated.

In terms of livelihood, conflicts can lead to physical injuries and economic disruption, resulting in the loss of income sources. Therefore, individuals should be encouraged to maintain alternative livelihood options as a form of resilience. Providing insurance mechanisms can also support affected individuals in recovering from health and property losses, thereby improving their ability to cope with the impacts of conflict.

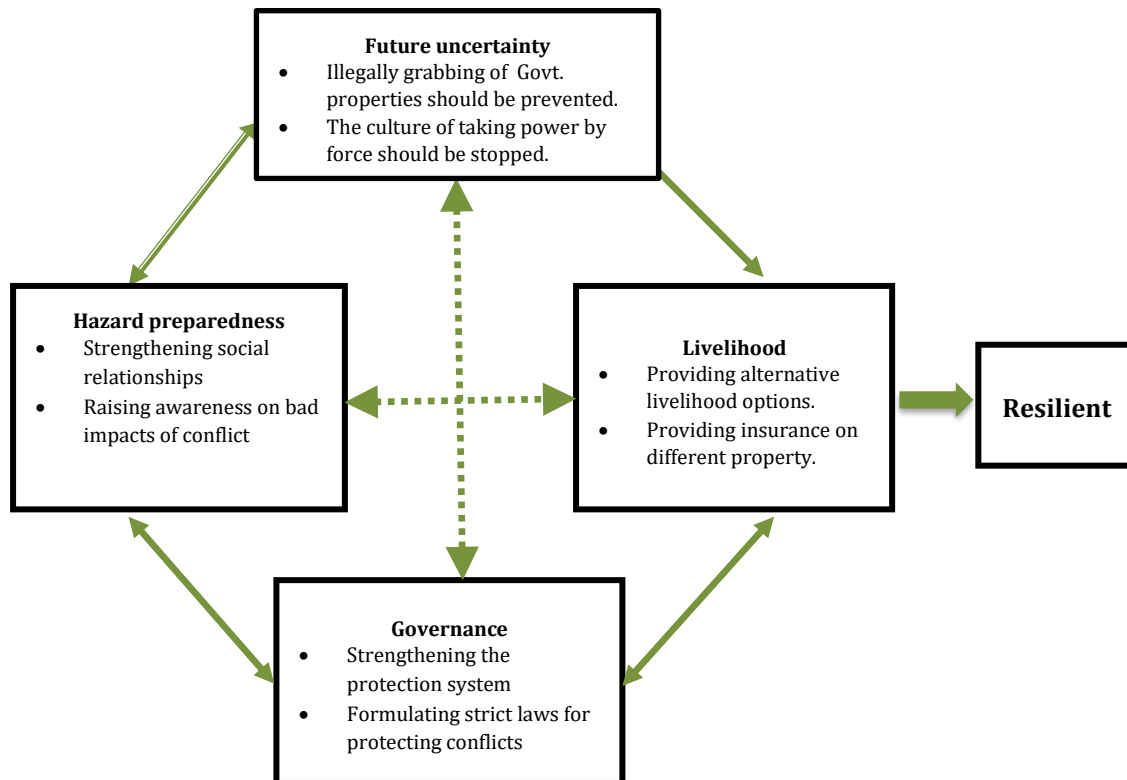


Fig. 27. Vulnerability to Resiliency (V2R) of Conflict

4. Conclusions

A number of basic policy changes are necessary to deal with the slum situation of Palashpur. According to the respondent's opinion, existing human induced hazards (fire, Mismanagement of waste, Water logging, Conflict) are making the area more vulnerable. Illegal electricity connection is causing fire, dumping waste here and there is causing epidemics of various diseases, clogging of drainage systems by waste is causing water logging and conflict is basically caused by bad relationships among all people. But, existing organizations don't have any concern on reducing hazards by ensuring resiliency of these hazards and there is lack of collaboration among all organizations. Ensuring resiliency can be established by awareness raising, burying electricity lines from the ground, avoiding throwing imperishable arterial into the water, proper drainage system establishment, strengthening social relationships etc. Various organizations work individually on their own policies and plans but, there is no collaboration among them. Not only lack of collaboration is responsible but also, the outward signs like, poor governance, inappropriate regulatory framework etc. are also responsible. So, the main reforms are needed in the policy and institutional framework. Regarding the latter, amongst all human induced hazards existing organizations should pay their attention more on reducing the vulnerabilities of mismanagement of waste because, this is the only hazard which is accelerating the vulnerability towards future uncertainty more than other human induced

hazards. To conclude, it can be said that, existing organizations and Govt. should play a role in identifying the vulnerabilities to human induced hazards and set policy and framework based on the appropriate resiliency measures to reduce the vulnerabilities of these hazards.

Acknowledgement

Authors would like to express thankfulness to the community people of Palashpur slum of Barisal Sadar, Banglaesh who cooperate me during the data collection of the research.

Author Contribution

Md. F: Conceptualization, Supervision, Data curation, Formal analysis, Methodology, Resources, Software, Validation, Visualization, Investigation, Writing – original draft, Writing – review & editing. T. A: Conceptualization, Data collection, Formal analysis, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. T. A. T: Conceptualization, Data collection, Writing – review & editing.

Funding

This research received no external funding.

Ethical Review Board Statement

Not available.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

Unavailable due to ethical restrictions.

Conflicts of Interest

The authors declare no conflict of interest.

Open Access

©2026. The author. This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original authors and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third-party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit: <http://creativecommons.org/licenses/by/4.0/>

References

- Abascal, A., Rothwell, N., Shonowo, A., Thomson, D. R., Elias, P., Elsey, H., & Kuffer, M. (2022). Domains of deprivation framework for mapping slums, informal settlements, and other deprived areas in LMICs to improve urban planning and policy: A scoping review. *Computers, Environment and Urban Systems*, 93, 101770. <https://doi.org/10.1016/j.compenvurbsys.2022.101770>
- Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. *Economic Geography*, 79(4), 387–404. <https://doi.org/10.1111/j.1944-8287.2003.tb00220.x>
- Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change*, 15(2), 77–86. <https://doi.org/10.1016/j.gloenvcha.2004.12.005>

- Ahmed, A. U., & Neelormi, S. (2008). *Climate change, loss of livelihoods and forced displacements in Bangladesh: Whither facilitated international migration*. Campaign for Sustainable Rural Livelihoods and Centre for Global Change.
- Ahmed, R. (2006). *A case study on reaching the poorest and vulnerable*. <https://hdl.handle.net/2134/28589>
- Akther, H. (2014). Rural-urban linkages in Bangladesh: Emerging scenario of a secondary urban center. *Dhaka University Journal of Earth and Environmental Sciences*, 3(1). https://scholar.google.com/citations?view_op=view_citation&hl=en&user=J2rmG1QAAAAJ&citation_for_view=J2rmG1QAAAAJ:d1gkVwhDpl0C
- Alamgir, M. S., Jabbar, M. A., & Islam, M. S. (2009). Assessing the livelihood of slum dwellers in Dhaka city. *Journal of the Bangladesh Agricultural University*, 7(2), 373-380. <https://doi.org/10.3329/jbau.v7i2.4749>
- Ameratunga, S., Hijar, M., & Norton, R. (2006). Road-traffic injuries: Confronting disparities to address a global health problem. *The Lancet*, 367(9521), 1533-1540. [https://doi.org/10.1016/S0140-6736\(06\)68654-6](https://doi.org/10.1016/S0140-6736(06)68654-6)
- Bangladesh Bureau of Statistics. (2011). *Population and housing census 2011*.
- Bangladesh Bureau of Statistics. (2017). *Preliminary report on household income and expenditure survey 2016*.
- Barisal City Corporation. (2015). *Report on slum*.
- Chambers, R. (1989). Introduction: Vulnerability: How the poor cope. *IDS Bulletin*, 20(2). <https://bulletin.ids.ac.uk/index.php/idsbo/issue/view/138>
- Del Ninno, C., Dorosh, P. A., & Smith, L. C. (2003). *Public policy, food markets and household coping strategies in Bangladesh: Lessons from the 1998 floods*. <https://doi.org/10.22004/ag.econ.16425>
- Della Porta, D., & Keating, M. (Eds.). (2008). *Approaches and methodologies in the social sciences: A pluralist perspective*. Cambridge University Press.
- DeVellis, R. F., & Thorpe, C. T. (2021). *Scale development: Theory and applications* (5th ed.). SAGE Publications.
- Hossain, B., & Wadood, S. N. (2020). Impact of urban microfinance on the livelihood strategies of borrower slum dwellers in Dhaka city, Bangladesh. *Journal of Urban Management*, 9(2), 151-167. <https://doi.org/10.1016/j.jum.2019.12.003>
- Hossain, M. A., & Miah, M. G. (2011). Environmental disasters in history: Bangladesh perspective. *International Journal of Social Development and Information System*, 2(1), 31-37. https://scholar.google.co.id/citations?view_op=view_citation&hl=id&user=zhYLPwAAAAJ&citation_for_view=zhYLPwAAAAJ:u5HHmVD_u08C
- Intesar, A., & Parvez, M. S. (2022). Triple burden through the eyes of urban slum women in Bangladesh: An anthropological perspective. *SSRN*. <https://doi.org/10.1016/j.ssaho.2024.101014>
- Islam, M. N., Malak, M. A., & Islam, M. N. (2013). Community-based disaster risk and vulnerability models of a coastal municipality in Bangladesh. *Natural Hazards*, 69(3), 2083-2103. <https://doi.org/10.1007/s11069-013-0796-6>
- Kamruzzaman, M., & Hakim, M. A. (2015). Socio-economic status of child beggars in Dhaka city. *Journal of Social Sciences and Humanities*, 1(5), 516-520. <https://doi.org/10.11648/j.ml.20170301.12>
- Kamruzzaman, M., & Hakim, M. A. (2016). Livelihood status of fishing community of Dhaleshwari River in central Bangladesh. *International Journal of Bioinformatics Research and Applications*, 20, 2-86. <http://www.aiscience.org/journal/ijbbe>
- Kamruzzaman, M., & Hakim, M. A. (2016). Socio-economic status of slum dwellers: An empirical study on the capital city of Bangladesh. <http://www.aiscience.org/journal/ajbs>
- Kathlen, N. (2002). *The governance of international migration: Mechanisms, processes and institutions*. Migration Policy Institute.
- Keare, D. H., & Parris, S. (1982). *Evaluation of shelter programs for the urban poor*. World Bank.

- Latif, M. B., Irin, A., & Ferdous, J. (2016). Socio-economic and health status of slum dwellers of the Kalyanpur slum in Dhaka city. *Bangladesh Journal of Scientific Research*, 29(1), 73–83. <https://doi.org/10.3329/bjsr.v29i1.29760>
- Leichenko, R. (2011). Climate change and urban resilience. *Current Opinion in Environmental Sustainability*, 3(3), 164–168. <https://doi.org/10.1016/j.cosust.2010.12.014>
- Lyons, M., & Schilderman, T. (2010). *Building back better: Delivering people-centered housing reconstruction at scale*. Practical Action Publishing.
- Matiur Rahman, M. (2014). Urban vulnerability assessment in South Asia: Challenges and lessons learnt. *Management of Environmental Quality: An International Journal*, 25(3), 273–284. <https://doi.org/10.1108/MEQ-11-2013-0122>
- Mukherjee, A., Faisal, M., & Saha, M. K. (2020). Measuring resilience of urban slum to climate-induced disasters: A study on Barishal City Corporation, Bangladesh. *International Journal of Disaster Management*, 3, 34–47. <https://doi.org/10.24815/ijdm.v3i2.17815>
- Ompad, D. C., Galea, S., Caiaffa, W. T., & Vlahov, D. (2007). Social determinants of the health of urban populations: Methodologic considerations. *Journal of Urban Health*, 84(Suppl 1), 42–53. <https://doi.org/10.1007/s11524-007-9168-4>
- Panda, P., Benjamin, A. I., & Zachariah, P. (1993). Health status of under-fives in a Ludhiana slum. *Health and Population: Perspectives and Issues*, 16(3–4), 133–141. https://scholar.google.com/citations?view_op=view_citation&hl=en&user=NWCaH80AAAAJ&citation_for_view=NWCaH80AAAAJ:5nxA0vEk-isC
- Panday, P. K. (2020a). Formation of slums and slum upgrading initiatives in Bangladesh. In *The face of urbanization and urban poverty in Bangladesh* (pp. 57–85). Springer. https://doi.org/10.1007/978-981-15-3332-7_4
- Panday, P. K. (2020b). Urbanization and urban poverty in Bangladesh. In *The face of urbanization and urban poverty in Bangladesh* (pp. 43–55). Springer. https://doi.org/10.1007/978-981-15-3332-7_3
- Pasteur, K. (2010). *Integrating approaches: Sustainable livelihoods, disaster risk reduction and climate change adaptation*.
- Pasteur, K. (2011). *From vulnerability to resilience: A framework for analysis and action to build community resilience*. Practical Action Publishing. <https://doi.org/10.3362/9781780440583>
- Rahman, M. A. U. (2016). Urban sustainability through strategic planning: A case of metropolitan planning in Khulna city, Bangladesh. *Journal of Urban Management*, 5(1), 16–22. <https://doi.org/10.1016/j.jum.2016.06.001>
- Rahman, M. H., Rahman, M. S., & Rahman, M. M. (2017). Disasters in Bangladesh: Mitigation and management. *Barisal University Journal*, 4(1), 139–163. <https://bu.ac.bd/oldwebsite/uploads/BUJ1V4I1/13.%20Hashinoor.pdf>
- Rashid, S. F. (2009). Strategies to reduce exclusion among populations living in urban slum settlements in Bangladesh. *Journal of Health, Population and Nutrition*, 27(4), 574. <https://doi.org/10.3329/jhpn.v27i4.3403>
- Taha, A. (2010). *Consensus building with participatory action plan development*.
- Uddin, N. (2018). Assessing urban sustainability of slum settlements in Bangladesh: Evidence from Chittagong city. *Journal of Urban Management*, 7(1), 32–42. <https://doi.org/10.1016/j.jum.2018.03.002>
- United Nations. (2014). *World urbanization prospects: The 2014 revision*.
- Venton, P., & Trobe, S. L. (2008). *Linking climate change adaptation and disaster risk reduction*.
- Watkins, K. (2007). *Human development report 2007/2008: Fighting climate change—Human solidarity in a divided world*. UNDP.
- Wedø, P. C., & Øyhus, A. O. (2015). *Building resilient communities through community-managed disaster risk reduction programmes: A case study of CARE Haiti's operation in Carrefour District*. The University of Agder.

Yohe, G., & Tol, R. S. J. (2002). Indicators for social and economic coping capacity—Moving toward a working definition of adaptive capacity. *Global Environmental Change*, 12(1), 25–40. [https://doi.org/10.1016/S0959-3780\(01\)00026-7](https://doi.org/10.1016/S0959-3780(01)00026-7)

Biographies of Authors

Md. Faisal, Associate Professor, Department of Disaster Resilience and Engineering, Faculty of Environmental Science and Disaster Management, Patuakhali Science and Technology University, Dumki, Patuakhali-8602, Bangladesh. Research Interest: Disaster Risk Reduction, Disaster Resilience, Adaptation, Indigenous Knowledge, Nature Based Solution.

- Email: faisal@pstu.ac.bd
- ORCID: 0000-0002-1705-8861
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: <https://pstu.ac.bd/user-profile/355>

Tanvir Ahmed, Department of Disaster Resilience and Engineering, Faculty of Disaster Management, Patuakhali Science and Technology University, Dumki, Patuakhali 8602, Bangladesh.

- Email: tahmedenvswur@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Tamima Akhter Tanni, Department of Disaster Resilience and Engineering, Faculty of Disaster Management, Patuakhali Science and Technology University, Dumki, Patuakhali 8602, Bangladesh.

- Email: tamimaenvsbau@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A