



## Assessment of vulnerability to fire hazards and formulating community-level fire adaptation approaches: A case study in Seroil Colony, Rajshahi

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### Abstract

Fire hazards have become a common occurrence in the densely populated urban areas of Bangladesh due to haphazard urban planning, high building density, and unplanned expansion of cities. Rajshahi City is one of the oldest municipalities in Bangladesh. The population density of Rajshahi City is not very high, but frequent fires in congested areas like Seroil colony are a cause of great concern. So, the study aims at identifying the factors of vulnerability to fire as well as formulating risk reduction strategies through the involvement of local people in that area. Different tools of Participatory Rural Appraisal (PRA) have been used to identify the reasons, consequences, and the community's capacity to manage fire hazards. The research reveals that a majority of fire accidents result from electrical short circuits. Simultaneously, the susceptibility of the area is increased by narrow roads and the use of combustible construction materials. Besides, vulnerability mapping of the study area is represented by using ArcGIS. Ultimately, the research came up with a set of risk mitigation strategies designed to enhance the resilience of the community. The study offers policy and recommendations for the implementation process. Hopefully, this study will provide valuable insights for policymakers and relevant authorities to enhance the city's resilience in future.

**Keywords:** Fire hazard; Seroil colony; Vulnerability; PRA; Risk reduction strategy

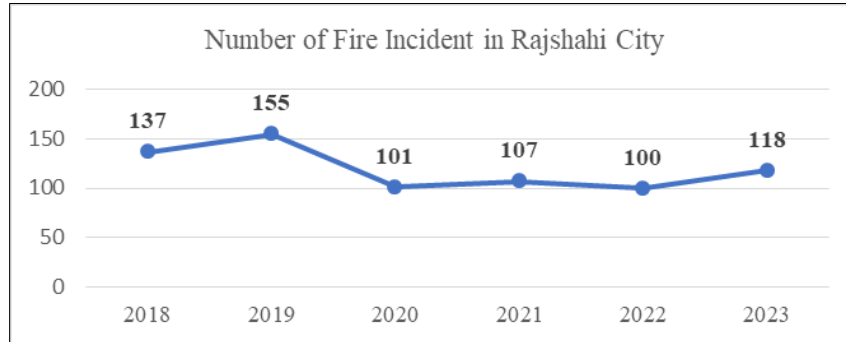
### 1. Introduction

Recently, urban fire hazards have become a great concern all over the world, especially in developing and underdeveloped countries of the Asia Pacific. It is estimated that more than 95% of fire deaths and burn injuries occur in low- and middle-income countries (1). Bangladesh, a developing country in South Asia, has become a hotspot of urban fire (2). Due to the fast-growing population and urban development, the lack of planned housing and congestion is increasing in both residential and commercial areas. Furthermore, numerous unanticipated industries have emerged in urban areas neighboring residential zones due to inadequate planning (2). Essential services like electricity distribution and gas pipelines were improperly established or supervised. This situation is heightening the potential for fire hazards. Around 2, 50,000 fire incidents took place in Bangladesh from January 1, 1997, to December 31, 2018 (3). In the year 2020, 21073 fire mishaps happened, resulting the property losses of 20,218,679.58\$ (4). The consequences of fire hazards encompass the loss of human lives, damage to property, and the infliction of severe injuries.

As Rajshahi is one of the oldest cities in Bangladesh, most of its neighborhoods are very old and unplanned. Moreover, migration of people to Rajshahi from several nearby districts has led to the haphazard and unplanned construction of numerous densely populated settlements (2). Most of these migrants are rural, with little knowledge about fire hazards, preparedness measures, and fire-resistant construction (3). As a result, Rajshahi City has witnessed many fire accidents

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in past few years. In the last 5 years, about 100 accidents have occurred in Rajshahi City every year (Figure 1). According to the fire stations under the jurisdiction of Rajshahi City, economic loss due to fire accidents was more than \$245,910 in last year, and already 118 fire accidents have occurred from January to September in 2023 (5).

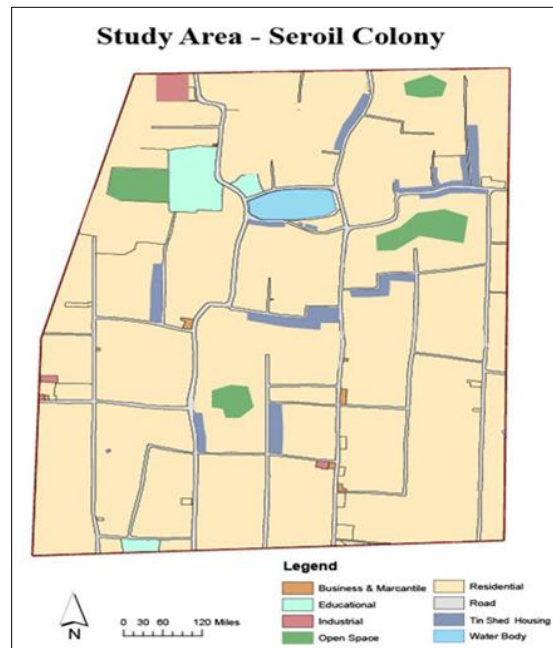


**Figure 1** Number of fire accidents (5)

Most research on fire risk assessment focuses on Dhaka City, covering both residential and commercial areas (6, 7, 8, 9). While some studies have examined industrial zones like Chittagong and other regions (10, 11), limited research has been conducted on Rajshahi Metropolitan City. Certain commercial hubs in Rajshahi, such as Saheb Bazar and RDA markets, are already recognized as fire hazard-prone areas (3, 12). However, lower-income residential areas like colonies and slums remain largely overlooked by researchers. Existing studies primarily rely on geospatial analysis or expert opinions to evaluate policies and regulations, often failing to bridge the communication gap between authorities and local residents (13, 14). Given these considerations, the researchers have selected Seroil Colony as the study area, as it is one of the most densely populated neighborhoods in Rajshahi City and is highly susceptible to fire hazards. The primary objective of this research is to identify the key causes of fire incidents through Participatory Rural Appraisal (PRA) and to develop risk reduction strategies by actively involving the local community.

## 2. Methodology

### 2.1. Study Area Profile



**Figure 2** Base map of the area

Seroil Colony is situated at ward 19, the heart of Rajshahi City is on the north side of the Rajshahi Railway Station. Different types of people living in that area have different occupations and socio-demographic status. But overall, demographic development is not satisfactory at all. The Rajshahi District Stadium is on the west side of the study area. Here, the total area is almost 55 acres. The area is divided into different parts. The study area is very congested, consisting of narrow roads. There is a high school in the northwest part of the area. The coordinates of this area are 24°22'31.8"N 88°36'32.5" E, respectively. The area is under the Boalia Thana of Rajshahi district (Figure 2).

## 2.2. Data Collection Process

After identifying the problem and formulating research objectives, a reconnaissance survey was conducted to explore the causes of fire vulnerability within the study area. This assessment provided insights into hazards, risk factors, and community preparedness (Table 1). Both primary and secondary data sources were utilized. Secondary data was collected through a review of journal articles, research reports, and policy documents, helping to understand fire risk factors and identify effective mitigation strategies. Primary data collection involved participatory tools categorized into space-related, time-related, and relational tools. Space-related tools, such as participatory mapping and transect walks, identified fire-prone areas and unsafe infrastructure. Time-related tools analyzed fire incident patterns and seasonal risk variations. Relational tools examined socio-economic conditions, community awareness, and institutional support. Vulnerability mapping played a crucial role in identifying areas lacking resilience and safety measures. This spatial analysis pinpointed high-risk zones, infrastructure gaps, and weaknesses in fire prevention and emergency response. By visualizing these vulnerabilities, the study provided valuable data for designing targeted interventions. Furthermore, fire vulnerability mapping enhanced disaster response strategies by enabling policymakers, urban planners, and emergency responders to allocate resources efficiently and prioritize at-risk communities. The findings from the reconnaissance survey and mapping exercises contributed to a deeper understanding of fire risks, informing strategies to mitigate hazards and strengthen community resilience.

**Table 1** Details methodology

| Objectives                                                                                | Tools                   | Purpose                                                                                            |
|-------------------------------------------------------------------------------------------|-------------------------|----------------------------------------------------------------------------------------------------|
| To identify the major causes of fire vulnerability through participatory Rural Appraisal. | Key Informant Interview | To identify the fire-vulnerable areas as well as the economic loss of the accidents                |
|                                                                                           | Social and Resource Map | Identify the habitation pattern, community facilities and important natural resources of the area. |
|                                                                                           | Timeline                | To find out the chronology of fire-related events.                                                 |
|                                                                                           | Cause effect diagram    | To identify the probable cause and effects of fire accidents in the community                      |
|                                                                                           | Pair-wise ranking       | To identify the problems that lead to the most vulnerability                                       |
| To develop risk reduction strategies by integrating local community.                      | Venn diagram            | Provide a visual representation of linkages between community people and different institutions.   |
|                                                                                           | Pair-wise ranking       | To identify the most effective adaptation strategies.                                              |
|                                                                                           | Vulnerability Mapping   | To identify fire-prone areas to minimize potential damage and protect communities.                 |
|                                                                                           | Dream Map               | To identify the aspects that people want to change in the future.                                  |

## 3. Results and discussion

Identifying the major causes of fire vulnerability is the first objective of the research. A focus group discussion (FGD) in the study area has been arranged to know the existing demographic scenario, chronology of fire accidents, and existing problems that lead to vulnerability in the study area. Various Participatory Rural Appraisal (PRA) techniques have been applied to collect and analyze this information.

### 3.1. Socio Infrastructural Conditions and Natural Resources

One of the most conventional PRA techniques, social mapping is a visual representation of the relationships and social interactions within a community or specific location. Drawing dwellings as well as other social infrastructure and

facilities (such as temples, shops, rice factories, schools, pharmacies, trails and roads, irrigation systems, water pumps, and recreation areas) in a community is known as social mapping. To conduct the study, choosing Seroil Colony, focusing on the residents' location and their access to other places. One of the residents of that area who has been living there for almost 23 years said,

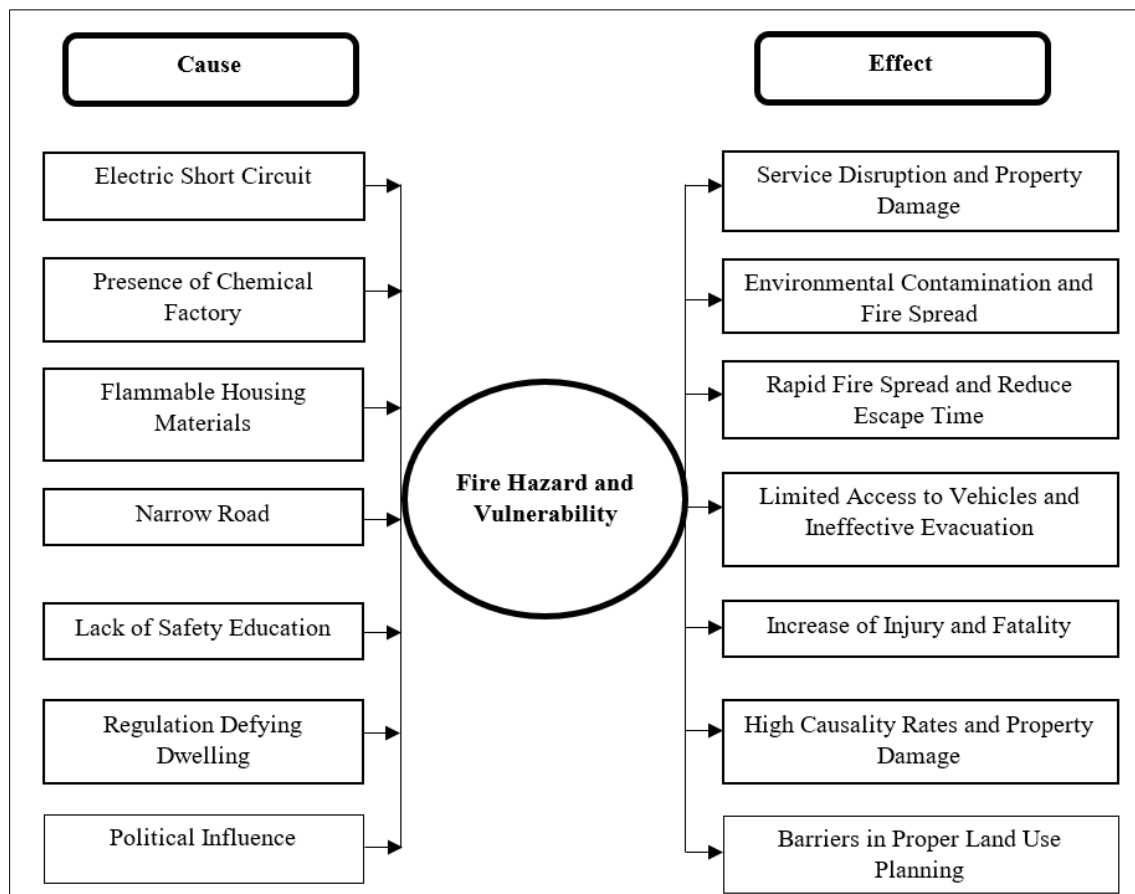
*"I have been living here for almost twenty years. We know that this area has many drawbacks to live in, yet we like to stay here. Even in my house there has been occurred a fire accident in 2020. I and my son got injured badly due to that."*

Another respondent said,

*"During a fire accident, a fire truck couldn't come near the house because of the congestion of the roads. Also, here if you say a word in your home, it can be heard from two more houses beside."*

This statement describes how congested the area is. Most of the houses are made of tin and bricks. Moreover, the roads are very narrow here; the width of the roads are maximum of 10 feet or less. This area also consists of mixed land uses. There are different kinds of shops, food carts, and two chemical factories beside the residences. The most important thing to the people of that locality is that there is a primary and a high school in Seroil Colony. These schools have been beneficial for the kids in that area. The majority of residents' lives are significantly influenced by Muslim culture. There are seven mosques and two Islamic schools for providing Islamic education to the children. The area does not have a strong vegetation coverage, as in most urban areas. The open spaces are so small that in case of an earthquake and fire, local people could not shelter themselves there. Moreover, there is no large playground in the densely populated area. Another important feature of that area was a big pond that surrounded the locality.

### 3.2. Constraints and Consequences



**Figure 3** Cause effect diagram

According to the opinion of local people, an electric short circuit is one of the main reasons for fire accidents in the study area. When too much electricity flows through the path, leading to overheating, an electrical short circuit occurs. This high temperature causes significant fire hazards. Due to system loss and uneven distribution of electricity, this problem

is increasing alarmingly. There is a chemical factory in this densely populated area. In this factory, different types of chemicals are used to produce cosmetics. This is one of the biggest reasons for breaking out a fire in that area, and two big fire accidents have already occurred. Besides, most of the houses in the area are not well constructed with traditional bricks and cement. Also lack of natural gas supply, and people here use cylinders or stoves made of soil for cooking, which is one of the main issues. This assists the fire to spread rapidly. Most of the building owners are not concerned about the structural safety of their buildings. At the same time, they don't know what to do if there's a fire accident that's going to increase the damage to property and lives lost. Therefore, if any kind of fire breaks out, people can't evacuate the area quickly because of the narrow roads, and even the firefighting vehicles won't be able to enter the area (Figure 3).

### 3.3. Major Causes of Fire Accidents

A pairwise ranking method was conducted in Seroil colony on prioritization of identifying the cause of fire accidents (Table 2). Employing the pairwise ranking method, the primary cause of fire incidents and associated hazards, as perceived by local residents, is electrical short circuits. The presence of chemical factories and narrow roads were equally ranked in the second position, indicating their significant contribution to fire risks. Surprisingly, congested buildings and political influence were not identified as contributing factors to fire hazards.

**Table 2** Pairwise ranking matrix

| Problem                            | Electric Short Circuit | Flammable Housing Materials | Presence of Chemical Factory | Lack of Awareness and Training | Congested Building | Narrow Road | Political Influence | Frequency | Rank |
|------------------------------------|------------------------|-----------------------------|------------------------------|--------------------------------|--------------------|-------------|---------------------|-----------|------|
| Electric Short Circuit (1)         | x                      | 1                           | 1                            | 1                              | 1                  | 1           | 1                   | 6         | 1st  |
| Flammable Housing Materials (2)    | x                      | x                           | 3                            | 2                              | 2                  | 6           | 2                   | 3         | 3rd  |
| Presence of Chemical Factory (3)   | x                      | x                           | x                            | 3                              | 3                  | 6           | 3                   | 4         | 2nd  |
| Lack of Awareness and Training (4) | x                      | x                           | x                            | x                              | 4                  | 4           | 7                   | 2         | 4th  |
| Congested Building (5)             | x                      | x                           | x                            | x                              | x                  | 6           | 5                   | 1         | 5th  |
| Narrow road (6)                    | x                      | x                           | x                            | x                              | x                  | x           | 6                   | 4         | 2nd  |
| Political Influence (7)            | x                      | x                           | x                            | x                              | x                  | x           | x                   | 0         | 6th  |

#### 3.3.1. Electric Short Circuit

An electric short circuit is one of the main reasons for fire accidents in the study area. When too much electricity flows through the path, leading to overheating, an electrical short circuit occurs. This high temperature creates significant fire hazards. Due to system loss and uneven distribution of electricity, this problem is increasing alarmingly. And the distance between electric pole and household is too less, which increases the rate of vulnerability of the area.

#### 3.3.2. Presence of Chemical Factory

One of the main reasons for the ignition of fire might be the reaction of different types of chemicals. It is a matter of astonishing that in the selected area, Seroil Colony, there is a chemical factory on road no. 1 within very congested residential houses. In this factory, different types of chemicals used for producing cosmetics are made. This is one of the biggest reasons for breaking out a fire in that area, and already 2 big fire accidents have already occurred. It affected the environment very badly.

#### 3.3.3. Flammable Housing Materials

Belonging mostly to middle-class and low-class families, most of the houses in the area are not well constructed with traditional bricks and cement. Here, almost 80% of houses are made of tin. Also lack of natural gas supply, people here use cylinders or stoves made of soil for cooking, which is one of the main issues. This assists the fire to spread rapidly.

#### 3.3.4. *Lack of Awareness and Training*

One of the major reasons for fire vulnerability is people's lack of awareness. Most of the building owners are not concerned about the structural safety of their buildings. At the same time, they don't know what to do if there's a fire accident that's going to increase the damage to property and lives lost.

#### 3.3.5. *Congested Building*

Most of the buildings of the Seroil colony are old, and most of them were not built to maintain building codes. They are so congested that if any fire accident occurs in a building within a very short period of time, it spreads to the other buildings surrounding it. Thus, it increases the vulnerability to fire hazards in the area.

#### 3.3.6. *Narrow Roads*

Due to a small area but a vast population, the accommodation of people wouldn't be possible if there weren't houses close to each other. For this reason, the roads between the Seroil Colony have become very narrow. Therefore, if any kind of fire breaks out, people can't evacuate the area quickly, and the most frightening matter is that firefighting vehicles won't be able to enter the roads, apparently it will cause rapid fire spread.

#### 3.3.7. *Political Influence*

Political influence has impeded the effective segregation of industrial facilities from residential areas, resulting in potential negative consequences for communities, especially because it increases the risk of vulnerability in the area. As a consequence, communities may face increased exposure to environmental pollutants and safety hazards due to the close proximity of industrial activities to residential spaces.

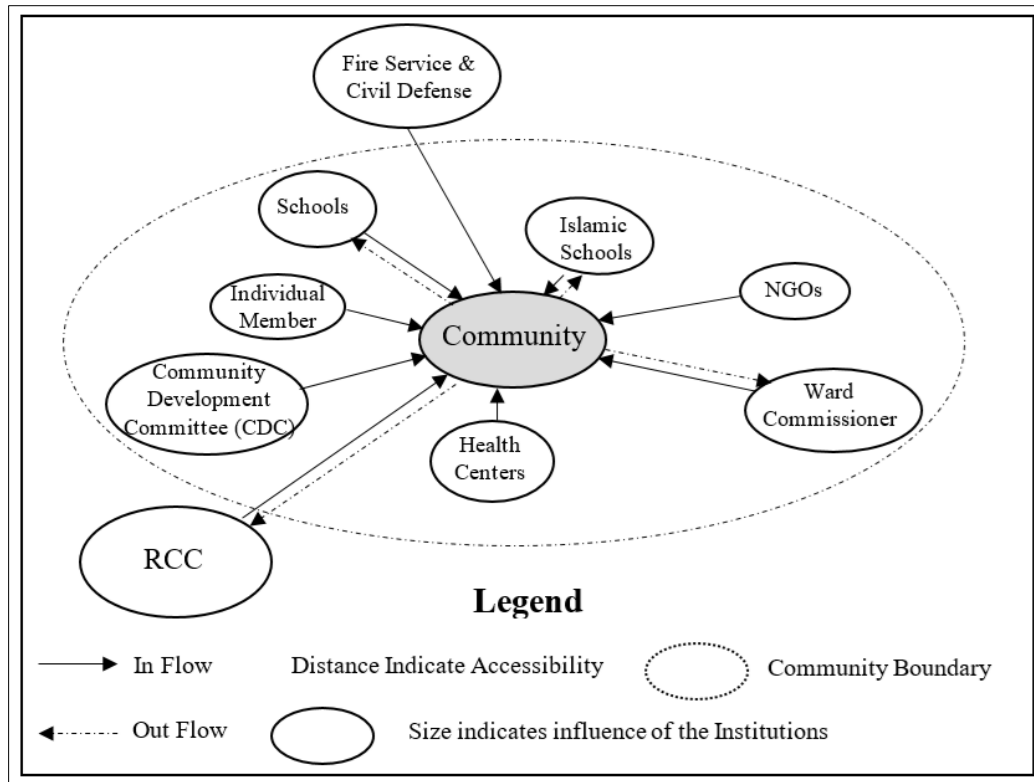
### 3.4. **Risk Reduction Strategies**

The development of risk reduction strategies for fire hazards in Seroil Colony is another objective of this study. The risk reduction strategies have been developed by incorporating the perspective of local community. It may help enhance the community's capacity to build fire hazard resilience in the future. Some focus group discussions (FGDs) in the study area have been arranged to know the existing practice of risk reduction, institutional linkage between existing organizations, and people's desire to minimize vulnerability in the study area. Various Participatory Rural Appraisal (PRA) techniques have been applied to collect and analyze this information.

#### 3.4.1. *Institutional Linkage with Seroil Colony*

The institutions located at the center of the diagram (Figure 4) are the internal institutions, which include the schools, ward commissioner, NGOs, health centers, Islamic schools, and Community Development Committee (CDC). The Rajshahi City Corporation (RCC) and the Fire Service and Civil Defense are among the external organizations that surround the community center.

The internal institutions that have a higher influence on the community are: the Community Development Committee, which consists of some members who always come forward in case of any emergency conditions and development activities in the area. Among the external institutions, the Rajshahi City Corporation (RCC) has a higher influence on that area. As an external institution, the fire service situated at the side of Rajshahi Eidgah (an open-air enclosure used for Eid prayers) always comes forward in any case of fire accidents, and they also train volunteers at regular intervals. Stepping into medium influences, the internal institutions schools, Islamic schools, and health centers, have lesser influence than the previously mentioned ones. On the other hand Fire Service and Civil Defense have medium influences on the area as external institutions. Here, it is worth mentioning that schools and Islamic schools have two-way interaction, whereas health centers, the Fire Service and Civil Defense have one-way interaction. It is also found that there are some people living there who always work for the people of that area individually. They also have medium influences. Lastly, the institutions that have a slight influence on the area are NGOs, as an internal institution that has one-way interaction.



**Figure 4** Venn diagram

### 3.4.2. Vulnerability Analysis

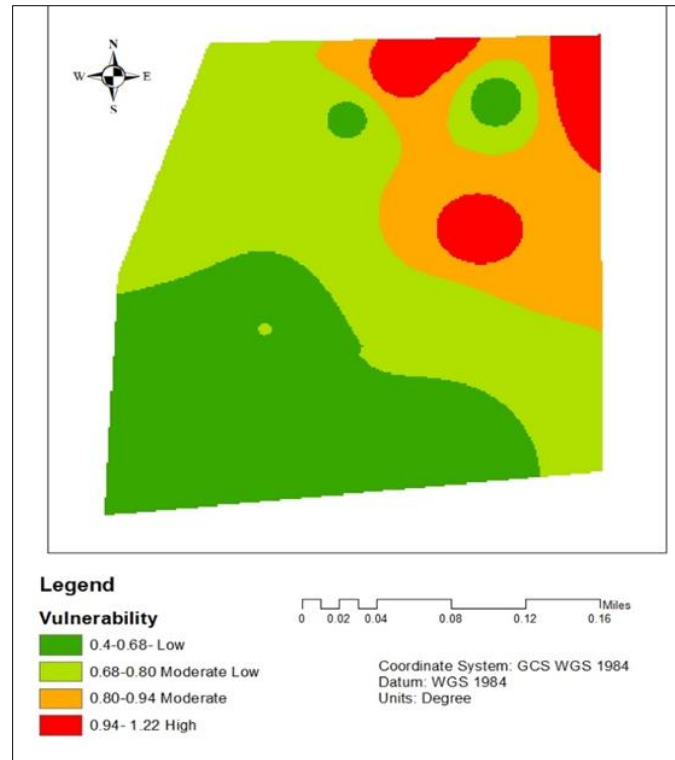
The fire hazard vulnerability analysis in the study area has been conducted in a few steps. The first of them is defining factors after conducting a literature reviews. Then, a survey of 30 samples has been carried out to collect information, and finally, a map has been produced showing different categories of vulnerable zones in the study area (Figure 5). Four factors were identified: construction type, number of storeys, fire source around the building, and accessibility (Table 3).

**Table 3** Fire hazard vulnerability indicators and assigned weights

| Factors                     | Value                   |                              | Weight |
|-----------------------------|-------------------------|------------------------------|--------|
| Construction Type           | Permanent structure = 1 | Semi-permanent structure = 2 | 0.23   |
| No of Storeys               | Up to 1-storey = 1      | 2-5 storied = 2              | 0.17   |
| Fire Source Around Building | No = 0                  | Yes = 1                      | 0.12   |
| Accessibility               | Road $\geq 10$ ft = 0   | Road $< 10$ ft = 1           | 0.48   |

Generally, structures made of less durable materials (non-permanent structures) are more susceptible to fire compared to those made of more solid materials (permanent structures). Consequently, a kutchra building is assigned a score of 3, while semi-permanent structures and permanent structure buildings receive scores of 2 and 1, respectively. So, buildings with one storey are assigned a score of 1, those with 2-5 storeys receive a score of 2, and high-rise buildings (above 6 storeys) are given a score of 3 (15). Buildings should be at least 3 meters away from fire sources like electric poles and transformers, as per international standards. Buildings with close proximity to these sources are given a 1 if they have a spark. Last of all, a minimum width of 10 feet of adjacent road is considered accessible by firefighting experts.

$$FS = \text{Construction Type} \times 0.23 + \text{Number of storeys} \times 0.17 + \text{Fire source around building} \times 0.12 + \text{Accessibility} \times 0.48$$



**Figure 5** Vulnerability mapping of Seroil Colony

### 3.4.3. People's Preference for Risk Reduction Strategies

The authors looked at how vulnerable the situation is now and came up with a plan to reduce the risks, considering what the local people think. They believe that the best way to reduce risk is to educate people through awareness programs. The community also thinks it's important to train volunteers locally. They suggest that all schools should make sure students at secondary and higher secondary levels receive mandatory training. Improving road access is the third priority, and then comes better access to resources, which can make the area stronger in dealing with challenges. Besides, Fire safety measures have to be installed, and collaboration with emergency services is crucial for a coordinated approach to risk reduction. Building codes are maintained to ensure structural integrity, fire resistance, and emergency egress. An early warning system is also in place to provide timely information to communities, emergency responders, and authorities. The strategies were ranked based on a pairwise comparison, as shown in Table 4.

**Table 3** Pair wise ranking for strategy

|                                   | Proper Building design | Train up volunteer | Fire hydrant | Better access to Road | Awareness Program | Early warning system | Collaboration with emergency service | Frequency | Rank |
|-----------------------------------|------------------------|--------------------|--------------|-----------------------|-------------------|----------------------|--------------------------------------|-----------|------|
| Proper Building code maintain (1) | x                      | 2                  | 3            | 4                     | 5                 | 1                    | 7                                    | 1         | 6th  |
| Train up volunteer (2)            | x                      | x                  | 2            | 2                     | 5                 | 2                    | 2                                    | 5         | 2nd  |
| Fire safety measures (3)          | x                      | x                  | x            | 4                     | 5                 | 3                    | 3                                    | 3         | 4th  |
| Better access to Road (4)         | x                      | x                  | x            | x                     | 5                 | 4                    | 4                                    | 4         | 3rd  |
| Awareness Program (5)             | x                      | x                  | x            | x                     | x                 | 5                    | 5                                    | 6         | 1st  |
| Early warning system (6)          | x                      | x                  | x            | x                     | x                 | x                    | 7                                    | 0         | 7th  |
| Collaboration with emergency (7)  | x                      | x                  | x            | x                     | x                 | x                    | x                                    | 2         | 5th  |

#### *3.4.4. Awareness Program*

Putting in place a comprehensive awareness program aimed at educating the people of Seroil Colony about fire risks, safety precautions, and emergency response procedures. Through informed decision-making, this effort seeks to improve community awareness and readiness while lowering the likelihood of fire occurrences.

#### *3.4.5. Volunteer Unit Training*

Creating a trained volunteer corps with the fundamental information and abilities needed to fight fires. These volunteers ensure a timely and well-organized response to fire emergencies by serving as the community's rapid response team. The community's total resilience against fire dangers is strengthened by this technique, which empowers residents.

#### *3.4.6. Increasing Road Accessibility*

Making Seroil Colony's roadways and sidewalks more accessible to allow emergency vehicles and workers to pass quickly. By ensuring that firefighting services can reach impacted regions right away, this infrastructure enhancement reduces reaction times and any damage brought on by delays in reaching the event site.

#### *3.4.7. Installing Fire Safety Measures*

Installation of fire safety measures like fire extinguishers, smoke detector, alarming system and others can mitigate the potentiality of fire hazard and considered as risk reduction strategies.

#### *3.4.8. Collaboration with Emergency Services*

Collaboration with emergency services is a key part of a comprehensive fire risk reduction strategy. It involves establishing partnerships and communication channels between stakeholders, such as fire departments and community organizations. By fostering strong collaboration, communities can establish a more robust and coordinated approach to fire risk reduction, enhancing safety and well-being, and mitigating the impact of fire incidents.

#### *3.4.9. Proper Building Code Maintenance*

Building codes are essential for ensuring the structural integrity, fire resistance, and emergency egress of buildings. They also mandate emergency egress and accessibility, with clear exit pathways and accessible routes. Fire detection and suppression systems are also required, ensuring early detection and suppression. Occupancy limits are established based on the building's type and intended use, facilitating evacuation and requiring safety measures like fire drills.

#### *3.4.10. Early Warning System*

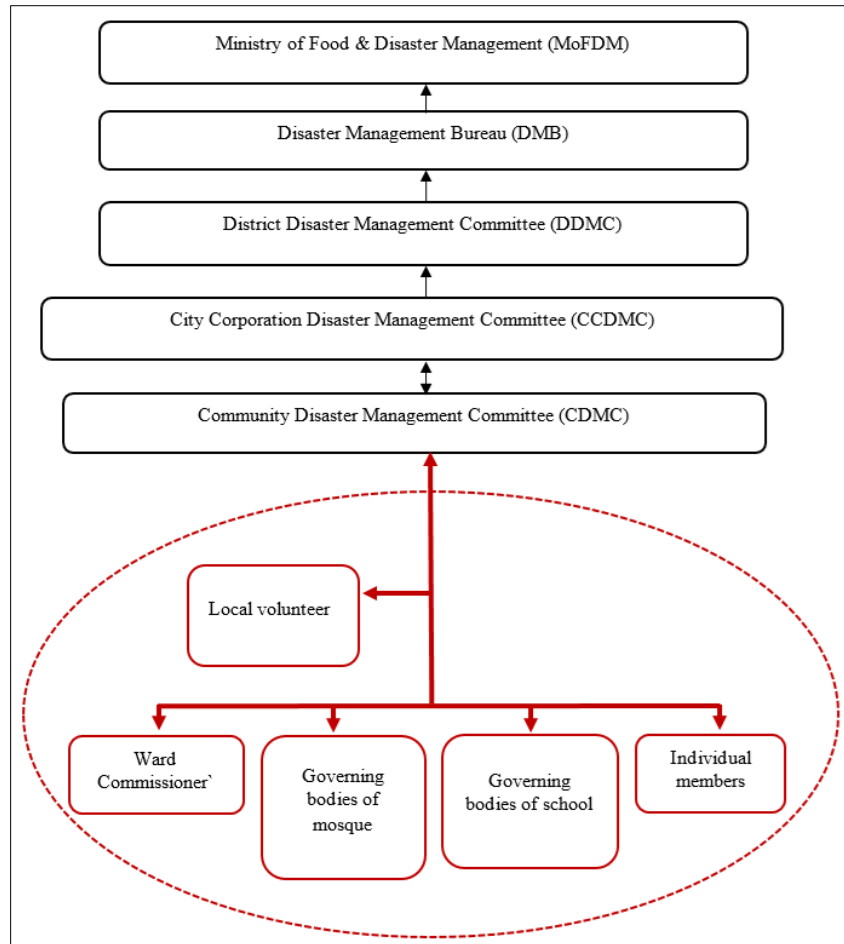
An early warning system is a crucial tool in reducing fire risk by providing timely and accurate information to communities, emergency responders, and authorities. It uses technology, monitoring tools, and communication networks to detect and alert people about potential fire threats before they escalate.

### *Recommendations*

- Explore incentives for building owners who voluntarily undertake fire safety improvements like fire extinguisher, smoke detector, fire safety alarm etc.
- Imposing penalties on individuals who unlawfully obtain electricity and gas services to mitigate the possible risk of fire.
- Installation of an artificial reservoir on the roof of public buildings or a mosque for emergency use.
- Awareness program and training local people at regular intervals so that they can handle fire situations with efficiency.
- Collaboration with local people, fire services, civil defense and other emergency services like civil defense, NFPA (National Fire Protection Agency), Red Crescent Society for a coordinated response.

### **3.5. Proposed Organizational Set Up for Disaster Management Committee**

The current disaster management structure in Bangladesh is limited to the City Corporation Disaster Management Committee, with no local-level organization in place. This gap between existing organizations and the community has resulted in a significant deficiency (Figure 6).

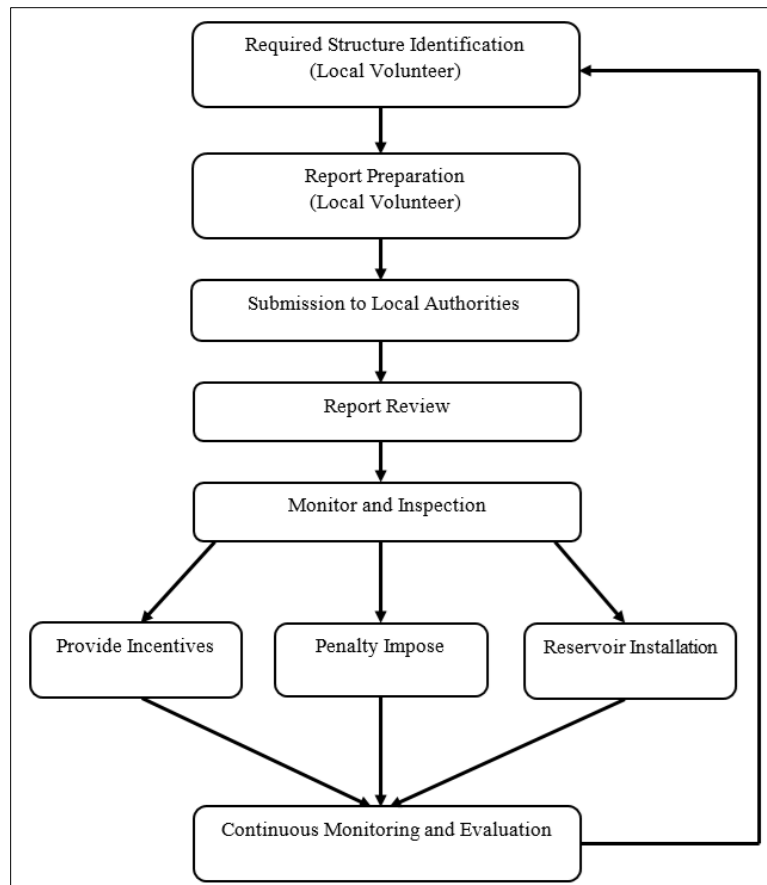


**Figure 6** Proposed organizational set up for disaster management committee flow chart (9)

### 3.6. Phase of Implementation

For providing incentives to building owners, firstly, the local volunteers will identify the vulnerable buildings. They will then inform the owner of that house. If they agree to undertake fire safety steps personally, the volunteers will send the report to the ward commissioner. They will then request Bangladesh Fire Service and Civil Defence (BFSCD) to inspect, and if they find it positive, the final report will be given to higher authorities (City Corporation), and then they will take necessary measures to meet the incentives for the specific person (Figure 7).

For the installation of an artificial reservoir, the local volunteers will look for a suitable structure where they can establish the reservoir. After being satisfied with the infrastructure, they will send the details to the local authorities through the Community Disaster Management Committee. The authority will inspect and, after monitoring, the foundation will be established with the help of a higher authority (City Corporation). In the same way, for imposing penalties, the local volunteers will first look for the suspected houses. After getting surety, they will send the report to the ward commissioner's office. The ward commissioner will send that to a designated authority like Northern Electricity Supply Company Limited (NESCO). They will inspect and take legal action if necessary. Besides, continuous monitoring and evaluation will be helpful for the community people to mitigate risk reduction strategies as well as to make the area more resilient.



**Figure 7** Implementation phase flow chart

#### 4. Conclusion

This area is one of the most congested in RCC with a large population. In this study, various types of PRA tools have been used for identifying the major causes of fire accidents and developing risk reduction strategies. This study examines the history of previous fire incidents in the area through a historical timeline, and their intensity was noticeable. In this study, we prepared a vulnerability map on the basis of the local people's opinion that indicates different vulnerable zones of the selected area and also identifies the major causes that are responsible for the fire hazard. Along with identifying the variables that could make a zone vulnerable to fire, the study also presents an exceptional chance to collaborate with the local population and involve them in developing methods to reduce the fire hazard. The community people also made a futuristic map of the area. The study also contains some adaptation strategies. The adaptation strategies will be easily accepted by all residents of the area because the community members themselves were involved in the development process. Therefore, adopting these techniques into practice will pay off in terms of helping the community's members become more adaptable and reducing risk and the effects of all hazards. The methodology can assist policymakers in choosing special consideration areas or hotspots for disaster management if it is implemented throughout the ward and other wards.

#### Compliance with ethical standards

##### *Acknowledgments*

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### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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