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Human Response to Flood Disaster in Kandawalai: Kilinochchi District in Sri Lanka

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Abstract

The flood is one of the extreme weather events in the world. In Sri Lanka, it is a major natural disaster that mainly occurs in the South-West and the North-East monsoon seasons. The human response strategies are explained in the concepts of the disaster management cycle in the PRE and POST stages. People do not satisfactorily respond during these stages in the study area. There have been no systematic studies conducted on how people responded before, during, and after the floods in Kandawalai. The main objective of this study was to examine human responses to PRE flood situations (mitigation and preparedness). This study selected three GN divisions. Questionnaires, surveys, and interviews were carried out to collect primary data and information. The data was analyzed using both quantitative and qualitative methods. Some preparedness and mitigation were undertaken by the Disaster Management Centre (DMC) in Kilinochchi during the PRE flood stage. To reduce floods, the community has used very simple community-based mitigation measures. Only 43% of them took part in flood-awareness programs that taught them how to evacuate from flood-prone areas and how to respond to early warning systems.57% of respondents mentioned that the flood impact could be reduced through better structural mitigation strategies. 10% of the respondents recommended controlling the illegal activities of sewage disposal and soil mining in the Kanakarayan River. The PRE-flood activities should be considered by relevant stakeholders together with community participation, but the government has the main responsibility for mitigating the impacts of the floods in this particular area.

Keywords: human response; Kandawalai Division; mitigation; PRE-Flood disaster; preparedness

Introduction

A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, economic or environmental losses that exceed the community's or society's ability to cope with its resources (IFRC, 2021). WHO defined a disaster as an occurrence disrupting the normal conditions of existence and causing a level of suffering that exceeds the capacity for adjustment of the affected communities (WHO/EHA, 2002). A flood is the most common type of natural disaster, and it occurs when an overflow of water submerges land that is normally dry. Floods are frequently caused by heavy rainfall, rapid storm surges caused by a tropical cyclone, or a tsunami, particularly in coastal areas. Floods are the most destructive form of natural hazard in both local and global contexts. This is true in terms of both human lives lost and property damage. It is also the most prevalent form of natural hazard (Hydrometeorology) in the world. Herath, 2002 mentioned that the Asian continent is found to be one of the most flood-affected regions in the world (Disaster Management Centre). In Sri Lanka, too, the occurrence of floods is more common than any other natural hazard.

Sri Lanka's position across the path of two opposing monsoon systems causes heavy rainfall from the monsoons. In Sri Lanka, there are four types of floods: flash floods, coastal floods, urban floods, and river (or fluvial) floods. Major floods are associated with the two monsoon seasons. These are the South-West monsoon (May to September) and the North-East monsoon (December to February). Inter-monsoon rains also bring rain to the island. The first inter-monsoon primarily produces convectional rainfall, while the second inter-monsoon produces cyclonic storm rainfall as a result of depressions activated in the Indian Ocean's Bay of Bengal. During this second inter monsoon season, the periodic squalls occur and sometimes tropical cyclones bring overcast skies

and rains to the South, North east and Eastern parts of the island (Rekha Nianthi, K.W.G, 2012). From the records, it can be seen that floods have occurred over much of the year, except during the driest months.

The Northern and Eastern regions of Sri Lanka have suffered a lot due to droughts and floods. According to the disaster history of the Northern Region of Sri Lanka, except for the tsunami of 2004, all other disasters are related to the climate (Nagamuthu & Kandiah, 2015). Kilinochchi is one of the districts that is frequently flooded during the rainy season, affected by the North-East monsoon period. The main reason for this flooding was the seasonal heavy rainfall. When the spilling gates of the Iranamadu tank are opened during periods of heavy rainfall, the flood flow is accelerated. When the rainy season begins, heavy rainfall is the most important factor in raising the water level in the Iranamadu Tank. The total annual rainfall exceeds 1.800 mm in some years, high rainfall causes floods in the study area during specific seasons (Figure 1).

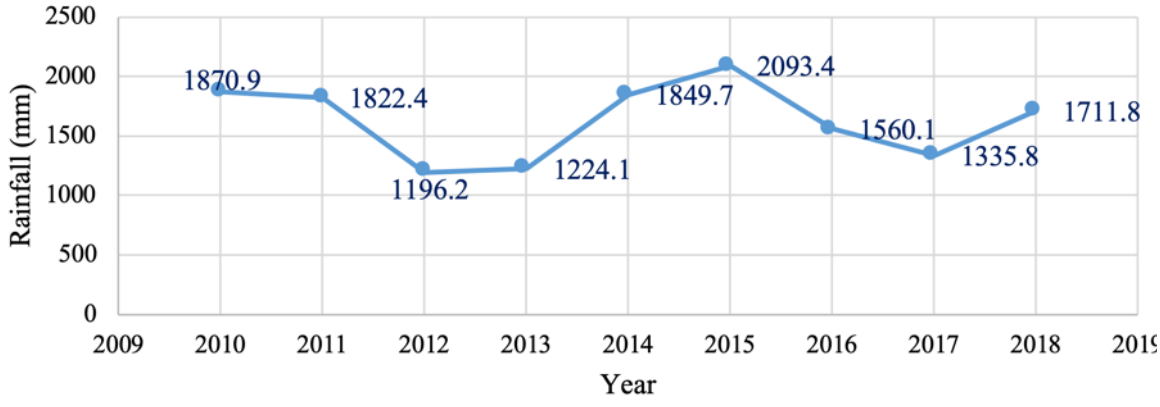

Figure 1. Annual total rainfall in Iranamadu dam. (Source: Department of Irrigation, Kilinochchi, 2019)

The Iranamadu Tank is located in the Kilinochi District, Northern Province, Sri Lanka, and it was built by King Dhatusena. Following the tank's renovation in 2018, the water level in Iranamadu Tank was 35.07 ft.[1] in 2010, 2014, 2012, 2014, the water level was above 30 ft. in the tank. Flood damage was very high in those years. The water reservoir capacity in this tank is 131.4 mcm. The Killinochi district people are facilitated by this tank with irrigation services for agricultural activities, the inland fishing industry, and sanitation services. This is one of the deepest tanks in Sri Lanka (Ceylon, 2017).

Many researchers have investigated various aspects of the damage and loss in flood-prone areas in Sri Lanka. Some researchers have evaluated the social and economic damage caused by the floods in the Batticaloa District in the Eastern Province (Prakashnie, Rekha Nianthi, & Wickramasooriya, 2020). Human response is very important during times of flooding. The human response can be defined as how victims, officers, authorities, and relevant stakeholders prepare to face the flood and its impacts before, after, and during the disaster. Responses to floods are mainly in two phases. The first phase is called the PRE-flood response; it includes mitigation and preparedness, and the second phase is called the POST-flood response, which includes emergency response and recovery. This response can also be called flood management. Flood management is the process of implementing a national policy, plan, relief, and action to protect human lives, public property, and the natural environment from flood risk, as well as carrying out long-term projects and plans to protect people and the environment from future risks and impacts.

[1] Construction on this tank began in 1902 and was completed in 1921 with a storage capacity of 26 feet. After the augmentation in 2018, it has a 36 ft. capacity, 14 radial gates and an ungated spill of 317 ft. (90.5 m) in length (Ministry of Agriculture, 2018)

Human response is very important in flood management. The human response is less considered when it comes to flood disasters when compared to other disasters in the country. A flood is associated with the PRE and POST disaster and response phases. Before the Tsunami in 2004, people had a lack of knowledge of how to manage the disaster situation in the country. Even in the case of flood disasters, the PRE and POST flood disaster response mechanisms are poorly structured and researched. Therefore, this study analyses how human responses are prepared for a flood situation before it occurs. According to the literature review and my personal experiences, human responses are not at a satisfactory level in the PRE-flood situation in the Kandawalai DS division of the Kilinochchi district.

The various institutions and stakeholders support reducing the negative impacts of floods. It is necessary to identify why human responses are not successful in the study areas. Some researchers have previously conducted flood studies in the study area, but no systematic studies have been conducted to answer the following research question: *"Why are people not responding to the floods (PRE flood situation) in the study area at a satisfactory level?"*

Data and Methods

The main objective of this study is to examine the human response to the flood disaster in the PRE flood disaster situation, focusing on the flood mitigation and flood preparedness phases.

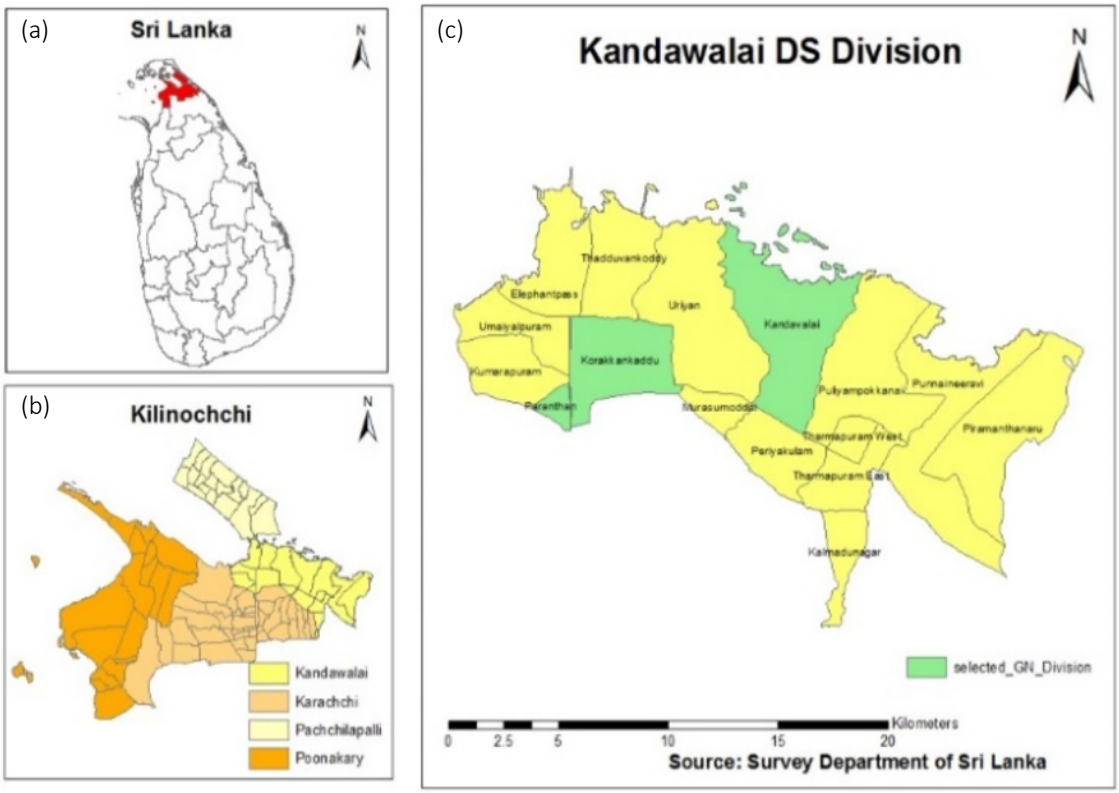

Figure 2. (a) The map of Sri Lanka with a solid black line indicates the district political boundary, and the red colored shape indicates the location of Kilinochchi district; (b) The sub district political boundary map of Kilinochchi district, is shown by different colors indicate different sub district (DS Division) as indicated by the text on the lower right panel; (c) The map of the study area.

This research used a questionnaire survey and interviews to analyze the human response and verify the answers addressed to the research question. Questionnaire surveys were conducted in the study area of the Kandawalai DS division as is shown in Figure 2c. The three (03) Grama Niladhari divisions were selected for the sample study, namely Paranthan, Kandawalai, and Korakkankattu. Those are the areas most affected by the GN Division's

involvement in the Kandawalai flood disaster. The samples are selected from the most affected areas of the GN division by both purposive and random methods.

A total of 30 samples have been selected, 10 samples from each GN Division. The primary data collection and the interviews were conducted with the support of various officers of the Disaster Management Centre, the District Secretariat office of Kilinochchi, the Disaster Management Centre of Kandawalai Divisional Secretariat, the Irrigation Department in Kilinochchi, and the Grama Niladhari officers of the Kandawalai, Paranthan, and Korrakkankattu. Interviews were conducted using open-ended questioners. The secondary data has been collected from statistical records, preparedness and awareness programs, reports, books, and maps.

The rainfall data and the water level of the Iranamadu Tank have been collected from the Disaster Management Unit, Kandawalai DS office, the Irrigation Department, the GN offices, web sources, etc. This data was analyzed using a mixed method of both quantitative and qualitative analysis methods. Secondary data, such as rainfall data, tank data, and the number of people affected and the number of people evacuated, have been analyzed using quantitative data analysis techniques. Flood situation reports have been examined to get a clear understanding of the flood incidents. Some secondary data was analyzed through narrative studies in this research. The research used data analysis tools such as Excel and SPSS. Descriptive statistics and GIS tools were used in this study to analyze land use patterns, road networks, water resources, and so on.

Results and Discussion

The mitigation measures available in the study area can be divided into two categories, such as structural and non-structural. UNESCO mentioned that human resources in the form of knowledge, skills and local cooperation in response to these events are extremely useful in minimizing economic losses. For this reason, non-structural measures embrace public education and training courses for the community (UNESCO, 2004). When it comes to structural mitigation at the household level (Figure 3), most people use a sandbag as a barrier to prevent floodwater from entering their homes and from constructing blockades between their homes and floodwater areas. Some of the damage caused by flooding can be mitigated by taking appropriate precautions to keep floodwater from entering various properties within the house.

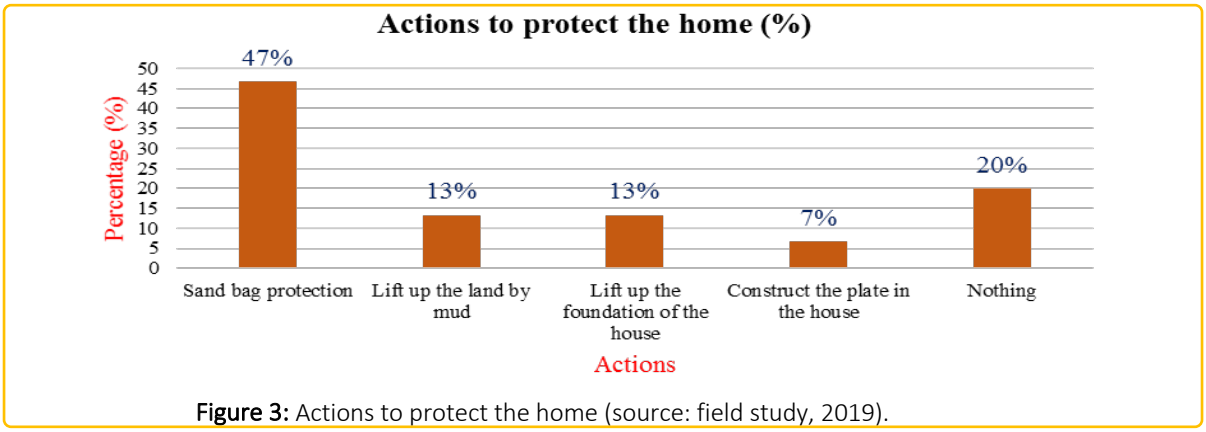

Figure 3: Actions to protect the home (source: field study, 2019).

Based on figure 3, 13% of the respondents mentioned that they lift or elevate their house-base with sand or mud since the houses are located in a very flat area adjacent to the paddy land. Paddy land has clay soil, which reduces infiltration and holds a lot of water. Therefore, people elevate the land and plinth by using sand[2]. 13% of respondents mentioned that this is one of the community-based structural techniques used in the Kandawalai

[2] A house requires approximately 50 loads of sand. One load of sand costs 1200 rupees. However, it must be elevated on sand every year.

area, according to their experience. The high-level foundation of houses reduces the amount of flood water that enters the houses (Figure 4 left).

The community has gradually understood the importance of elevated houses as a flood mitigation strategy in the study area. Effective structural mitigation at the DS and GN levels is required to prevent flood damage in the study area, depends on the incorporation of appropriate measures into national and regional development planning and policies. Development considerations play a key role in contributing to the mitigation and preparation of a community to effectively confront a disaster Invalid source specified. The Sri Lanka Disaster Management Act, No. 13 of 2005, mentioned capacity building among people living in disaster-prone areas in relation to risk management and disaster management and mitigation practices (Government of Sri Lanka, 2005).

The Kandawalai area has constructed small bridges, canals, concrete roads, and small ponds as structural mitigation to mitigate floods (Figure 5 left). These are mainly located on the A35 roads, but the villages of Paranthan, Pandisuttan South, Avaranchatti, Kudiyiruppu, and Velikkandal have only been given less concentration with very few construction methods. According to the existing poor-function structural measures, the structural mitigations in the study area are partially damaged when floods occur (Figure 4 right). Some of the physical structures are in good condition because they were constructed recently.

Figure 4. Left: Foundation of a house, Right: Temporary small bridge (source: field study, 2019).

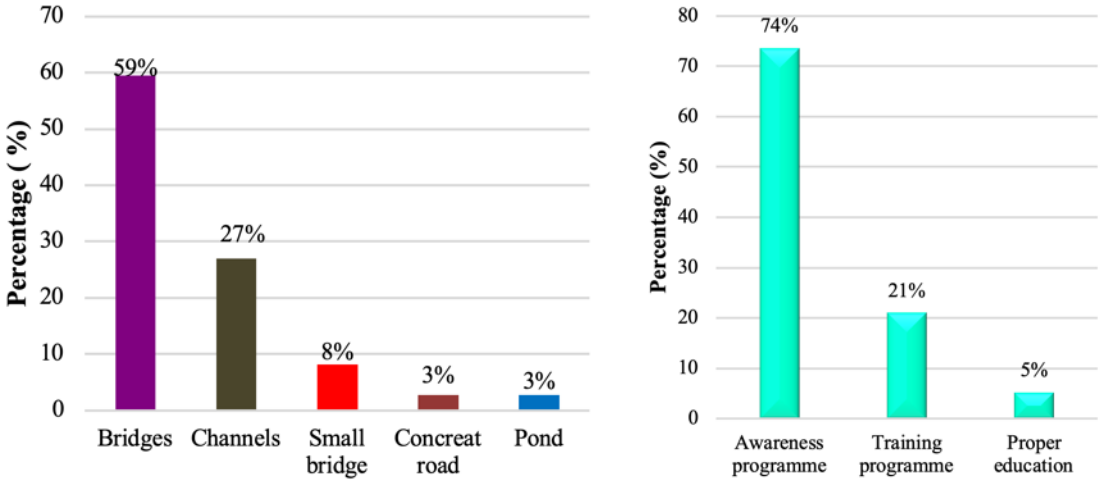

Figure 5. Left: Structural activities, Right: Non-structural activities (source: field study, 2019).

The roads are affected mostly in the study area by flooding due to improper structural conditions. The floodwater is not properly drained and therefore enters the water into the village areas and enters the houses. The main roads and the road paths in the study have no proper channels and bridges across the village. It increases the

amount of flood water entering people's residential areas. The minor-scale community-based improper bridges are maintained by the people of Kandawalai. Some of them are made by house owners using sandbags, tree parts, i.e. trunks, and using improper construction materials. Bridges generally constrict the flow of water, and they can act as artificial dams of debris jams in the structure. In all cases, their hydraulic characteristics must be considered at the design stage to prevent an unacceptable rise in water levels (UN, 2001). The study area contains some non-safe channel structures that overflow during the peak of the floods. Sound watershed management through extensive soil conservation, catchment area treatment, preservation of forests, increasing the forest area and the construction of check dams are reducing flood impacts (Sivakumar, 2015).

When considering the non-structural mitigation measures, some of the respondents confirmed that they had non-structural activities in the flood disaster in their villages. 74% said they have participated in some awareness programs (Figure 5 right). The DMC organized scenario-based contingency planning to prepare for the floods normally happening in the Northeast-Monsoon in 2018. This awareness program is mainly for different officers. NDRSC is also carrying out a specific preparedness planning process at the divisional level together with relevant stakeholders focusing on the North-East Monsoon floods. The Flood Mock Drill program is one of the training programs conducted by the DMC.

A flood mock drill is practice for how to save a life in a real-life flood situation. It will aid in the evacuation of people from flood-prone areas to safer areas. Government officers of the DMC organized the flood awareness programs at the school level. Non-structural approaches have recently come up as an effective method of risk management, but without developing structural measures, they would be less effective (Heidari, 2009). A mitigation plan is for the long term and it only becomes valuable or brings benefits when a disaster occurs (Tee & Abdul Nifa).

Another important activity to reduce the effects of flooding is preparation/preparedness. The Australian Government published a book titled "Flood Preparedness" in 2009. For example, the author discusses the importance of flood preparedness. Flooding is often caused deleterious impacts on human activities and assets, but the damage that floods cause can be reduced by careful planning and management of floodplain use (Australian Government, 2009).

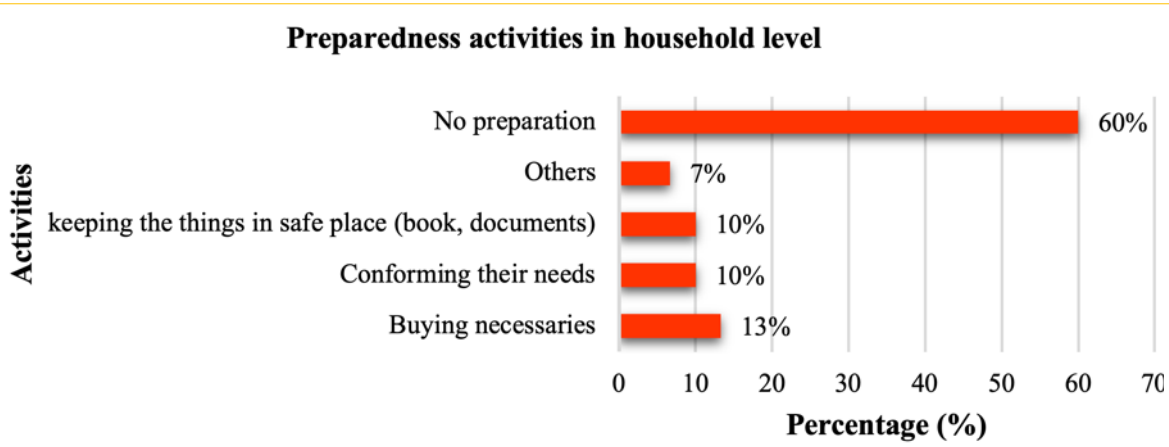

Figure 6. Preparedness activities in household level (source: field study, 2019).

The study area's household-level flood preparedness is deplorable. Because 60% of them have not participated in any awareness programs (Figure 6). Past experiences of flood events faced by the community are one of the most believable perceptions of the villagers. They are more dependable in identifying better preparedness activities based on their community experience. Some affected people who are in flood-prone areas do not consider the floods since most of them are situated in low-income groups.

According to the questionnaire surveys with multiple-choice responses, 13% of respondents stated that they used to buy necessary items before the flood event, such as food, torch lights, animal fodder, medicine, sandbags, and so on. 10% of respondents stated that they collect firewood, prepare for the homeland, remove dead or rotting trees, and secure or bring outside objects that have caused damage to the inside of their homes. 80% of respondents said that they had a flood emergency kit. They give priority to valuable documents rather than other mobile properties. But 20% of them did not have an emergency kit to protect their important documents.

In every flood event, the DMC organizes evacuation centres for flood-affected people. People stayed for more than 6-10 days in evacuation centres when a critical flood takes place. In Kandawalai GN division, people stay for more than 13 days because of heavy floods occurring due to the location of the village, which is close to the Kanakarayan River. Flood early warning is another preparedness activity mainly distributed at the district level in flood-prone areas. People take action only when they know what specific actions can be taken to reduce their flood risks. They are convinced that their flood preventive actions will be effective. They believe in their own ability to carry out the tasks against the flood. The early warning system is a critical component of flood preparedness (Red Cross, 2011). The flood warning is given by the DMC and Irrigation department using a sound system, i.e., speakers in the study area.

The GN Divisions have flood preparedness plans, flood hazard maps, and community groups for flood management. Cleaning activities are the most common form of community involvement in the study area. The research found that some of the preparedness practices at the DN level, i.e., establishment of a DMC unit at the village level, appointing an early warning team, an emergency relief team, and a search and rescue team. It aids in the improvement of disaster management knowledge among the general public. But some of the GN divisions do not have the DMC unit and such practices. One of the authors mentioned that sufficient flood protection Structural flood measures have not been introduced in many vulnerable areas. Further flood risk reduction via non-structural measures is often indispensable (Menzel & Kundzewicz, 2003). So, the preparedness activities also very important to reduce flood risks.

Conclusions

According to the findings of this study, communities place more trust in structural mitigation strategies than in non-structural mitigation strategies or preparedness. When the intensity of the flood is high in the study area, the property damage is still significant, i.e., loss of paddy, crops, and livestock, physical property damage, and so on. Moreover, most people are not willing to participate in the awareness and training programs organized by the DMC because they think the programs are useless and time-wasting activities. They also believe that the flood is a natural process. People's participation in flood mitigation and preparedness activities is extremely limited. People and the responsible stakeholders commonly take some actions after a flood disaster rather than before it happens. Moreover, in Kandawalai, disaster management activities take place after the disaster. PRE-flood preparedness and mitigation activities are more important than the POST-flood phases, because PRE flood activities can minimize damage and loss of life. PRE-flood human responses are very important in every flood-prone area in the country, not only for floods, but also for other disasters too. This study recommends improving the PRE-flood human response mechanism for Kilinochchi connected to the other GN divisions. For example, before opening the Iranamadu Tank spilling gates, a flood alert should be issued to the last mile people at the appropriate time and in real-time. The community should be encouraged to participate in awareness and training programs, like local service delivery mechanisms, to protect vulnerable people (elderly, people with disabilities/HIV/AIDS the landless or homeless, female-headed households) (UNDP). Research has stated that community-based disaster response works well because it responds quickly to urgent needs that achieve relief at the early stages (Zubir & Amirrol, 2011) . The majority of structural mitigation (bridges and road renovations) are

located on the main road (A-35), and they should be built to connect it to rural areas as well. The Paranthan area has many long roads which are not constructed properly and this has increased flooding in the adjacent areas. For development projects that cause some water to accumulate and overflow in flat areas, the government should consider EIA for development projects. For example, roads in the Northern Province cross the study area. Railway roads do not have enough bridges, which increases flooding in the Paranthan and Kumarapuram areas. Sand mining is also the main human activity responsible for inducing floods in the study area. People should be asked to stop sand mining and sewage disposal near the Kanakarayan River. Finally, flood mitigation and preparedness activities should be considered by relevant stakeholders together with community participation, but the government has the main responsibility for mitigating the impacts of floods in this particular area.

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