Flood Hazard and Risk Reduction Strategies in Homagama Divisional Secretariat Division: A Study of Pre and Post Intervention Mitigation Approaches

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DOI: https://doi.org/10.51584/IJRIAS.2025.10050008

Received: 23 April 2025; Accepted: 28 April 2025; Published: 28 May 2025

ABSTRACT

Flood hazard is one of the predominant hydro-meteorological disasters affecting the Homagama Divisional Secretariat Division (DSD), primarily driven by intense rainfall events. The main objective of this research is to examine the nature of the flood hazard and risk reduction strategies in Homagama DSD. Primary and secondary data were collected through official reports, institutional documents, scholarly articles, online sources, field observations, and informal discussions with local officials, residents, and experts. Among the 81 Grama Niladhari Divisions (GNDs) in Homagama, 22 have been identified as highly vulnerable to flooding, particularly during the south-west monsoon. In addition to heavy rainfall, topographical conditions, rapid development, and the presence of the Kelani River contribute to the area's flood risk. The consequences include significant damage to lives, property, and infrastructure. A structured response framework has been established to enhance community-based disaster preparedness and facilitate the delivery of relief services during flood events. Although relevant authorities have initiated multi-phase strategies for flood risk reduction, further development and integration are crucial to ensure effective and sustainable flood management. This study highlights the significance of both structural and non-structural flood mitigation measures in enhancing flood resilience and reducing disaster risk in Homagama DSD.

Keywords: Flood hazard, Risk reduction, Mitigation measures, Homagama Divisional Secretariat Division

INTRODUCTION

A disaster is a sudden and extreme event that causes significant harm to people, property, and the environment which can be either natural or man-made. In 1985, Enrico L. Quarantelli defined a disaster as 'a crisis situation that far exceeds the capabilities of the affected community or society to cope with, requiring external intervention.' These disasters can affect communities, cities, states, or entire countries, and in rare cases, the entire world, as seen with the COVID-19 pandemic (Goyal & Gupta, 2023; Khan et. al, 2008).

Disaster management refers to the actions and activities designed to control and mitigate the impact of disaster and emergency situations. Disaster management encompasses activities before, during, and after a disaster. Accordingly, disaster management aims to reduce or avoid potential losses from hazards and ensure prompt and appropriate assistance to disaster victims. Disaster management is a continuous, cyclic process in which each phase transitions into the next. It comprises the Disaster Phase, Response Phase, Recovery/Rehabilitation Phase, Risk Reduction/Mitigation Phase, and Preparedness Phase (ADRC, 2005). Preparedness involves planning for potential hazards, while the response phase focuses on immediate actions to safeguard lives and

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue V May 2025

property. Recovery aims to restore normalcy, and mitigation seeks to reduce the impact of future disasters through prevention and awareness efforts both before and after emergencies (Goyal & Gupta, 2023; Warfield, n.d.; Carter, 2008; Khan et al., 2008). This cyclical approach aligns closely with the priorities outlined in the Sendai Framework for Disaster Risk Reduction 2015-2030, which emphasises understanding disaster risk, strengthening disaster risk governance, investing in disaster risk reduction for resilience, and enhancing disaster preparedness for effective response and 'building back better' during recovery, rehabilitation, and reconstruction phases (UNDRR, 2015).

Among all hazards, flooding is one of the most widespread and common weather-related or hydro-meteorological natural disasters. Flooding occurs when water overflows onto normally dry land. While floods are natural events, human activities can intensify and even trigger them. Flooding causes widespread damage, including to infrastructure, displacement, food and water shortages, disease outbreaks, and harm to wildlife and aquatic ecosystems through habitat destruction and pollution (WHO, 2025; Goyal & Gupta, 2023; Carter, 2008).

Studies show that around 1.47 billion people, or 19% of the global population, face significant risks from one-in-100-year flood events, with 1.36 billion of them living in South and East Asia, primarily in China and India, which together account for over a third of global exposure (Rentschler & Salhab, 2020). Between 1995 and 2015, floods affected 2.3 billion people, with 95% of those in Asia (CRED & UNDRR, 2015). Globally, floods accounted for 44% of all disaster occurrences from 2000 to 2019, making them the most frequent type of disaster (Goyal & Gupta, 2023).

Sri Lanka is highly prone to natural disasters, particularly flooding, with 103 major river basins, 17 of which are in flood-prone areas. The Mahaweli, Kelani, Kalu, Walawe, Gin, and Nilwala river basins present the highest flood risks. The most vulnerable districts to flooding include Colombo, Ratnapura, Kalutara, Galle, Matara, Ampara, Anuradhapura, and Polonnaruwa. For further study, the Homagama Divisional Secretariat Division (DSD) in Colombo, one of the country's most urbanized areas was selected. Therefore, the primary objective of this research is to examine the nature of the flood hazard and risk reduction strategies in Homagama DSD.

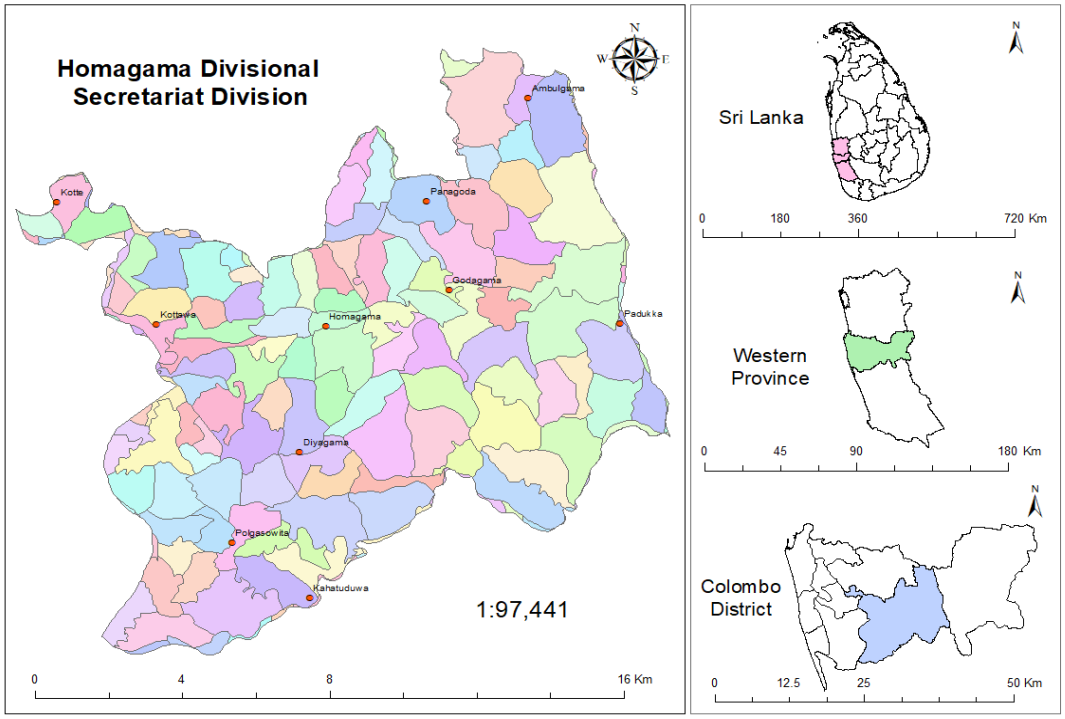
METHODOLOGY

The Homagama DSD, located southeast of Colombo, is bordered by Kalutara District to the south, Kelani River to the north (which forms the boundary with Gampaha District), Kaduwela DSD, Maharagama DSD and Kesbewa DSD to the west and Hanwella DSD and Padukka DSD to the east. The area covers 11,815.5 hectares and consists of 81 Grama Niladhari Divisions (GNDs), with a population of approximately 0.3 million (Figure 1). Situated in the coastal lowlands, the elevation ranges from 10 m near the Kelani River to 80 m inland. The topography is primarily semi-plains or alluvial valleys formed by sediment accumulation. Homagama has a population growth rate of 2.4%, making it the third most populated area in the region, with 11% of the population residing there (Sampath Pethikada - Homagama DSD, 2020; UDA, 2019).

To conduct this research, both primary and secondary data were collected. Secondary data were obtained from relevant government offices, online sources, books, and academic articles. The main sources of data included reports from the DSD office in Homagama, as well as other institutional reports and documents. Maps were created using digital data from the Survey Department of Sri Lanka, processed with ArcGIS software. Primary data collection involved field observations and informal interviews. Approximately 20 respondents, including DSD officers, scholars, and local residents, were randomly selected from various parts of the division to ensure a diverse range of perspectives. A semi-structured approach was adopted, using a set of guiding questions focused on flood impacts, community preparedness, traditional coping mechanisms, and perceptions of institutional response. To minimise potential biases, information obtained through interviews was triangulated with institutional records and field observations.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume X Issue V May 2025

Figure 1: Study area - Homagama DSD



Source: Created using 1 : 50,000 Digital Data, Survey Department of Sri Lanka

RESULTS AND DISCUSSION

Overview of the Flood Hazard

Factors Contributing to the Occurrence of Floods in Homagama DSD

The Homagama DSD, located in the Wet Zone of Sri Lanka, receives an annual average rainfall exceeding 2,500 mm. The precipitation pattern is shaped by both monsoonal and inter-monsoonal systems, creating distinct wet and dry seasons. Significant rainfall occurs during the south-west monsoon (May to September) and the second inter-monsoon period (October to November), with October typically recording the highest monthly total at around 350 mm. The first inter-monsoon period (March to April) also contributes notably to the annual rainfall. January marks the driest month, receiving approximately 85 mm, while May has the highest number of rainy days, averaging 29.8. This seasonal variability is further influenced by temperature fluctuations and climate change-related impacts, which continue to affect the region's rainfall patterns (Sampath Pethikada - Homagama DSD, 2020).

Heavy rainfall is the principal trigger for flood hazards in Homagama. An analysis of flood events indicates that the highest frequency of floods coincides with the region's peak rainfall periods, particularly during April, May, June, October, and November (Homagama DSD, 2022). This close alignment highlights a strong correlation between seasonal precipitation peaks and flood incidence, underscoring the importance of climate-informed disaster risk planning in the division.

Another important factor influencing flood hazards in Homagama DSD is the area's topography. Approximately 95.8% of the total land area (11,315.5 ha) consists of land with a slope of less than 8%. Only 3% of the area (351 ha) falls within the slope range of 8% to 30%, while only 1.2% of the area (149 ha), consists of steeper slopes ranging between 30% and 60% (Sampath Pethikada - Homagama DSD, 2020). This data indicates that the region is predominantly a low-lying plain with gentle slopes and mildly undulating terrain (Figure 2). Such low-lying areas are significantly more vulnerable to severe flooding compared to higher, more elevated terrain.

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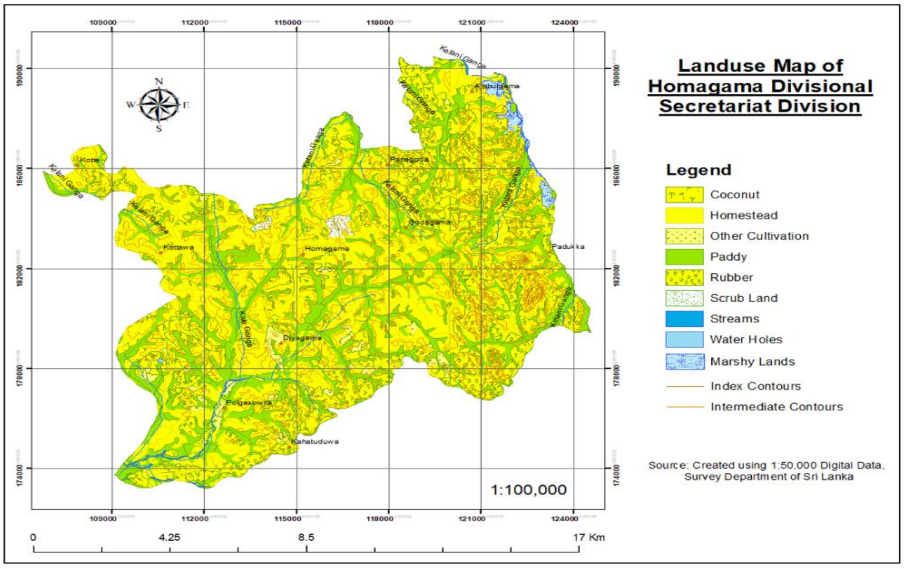
Figure 2: Land-use map of Homagama DSD (in 1989)



Source: Created using 1 : 50,000 Digital Data, Survey Department of Sri Lanka

Another contributing factor to flood hazards in the area is the presence of rivers, tributaries, and streams that flow through the region. Two primary drainage basins can be identified within Homagama DSD. The first is the Kelani Valley River Basin, which includes several medium and small-sized tributaries, streams, and brooks such as the Pusweli Oya, which runs along the northern boundary and joins the Kelani River, and the Hettige Ela. The second is the Bolgoda Lake sub-drainage system, a micro-drainage system of the Kalu Ganga River Basin. This system comprises smaller watercourses such as the Maha Oya and Nadun Ela, which eventually flow into Bolgoda Lake (Figure 2; Sampath Pethikada - Homagama DSD, 2020; UDA, 2019).

Although the upper reaches of these tributaries benefit from an effective drainage system, the lower areas are prone to unexpected minor flooding and often become swampy. This is primarily due to constructions, some of which are unauthorized, that obstruct natural water flow in and around the waterways (Sampath Pethikada - Homagama DSD, 2020). As a result, residential areas near the Kelani River and Pusweli Oya, including Artigala North, Panaluva, Nawala, Jalthara, Henpita, Watareka North, Walpita, and Nawalamulla face a constant risk of inundation. This risk is especially high for those living in zones that are frequently flooded. Notably, in 1989, the areas near the Kelani River experienced flooding only 3-4 times a year, with water levels rising up to 1 foot. However, 15 years later, flood levels increased significantly, reaching up to 5 feet (UDA, 2019).

Additionally, data related to the Pusweli Oya indicate that residences located on either side of its banks are subjected to inundation levels of up to 15 feet, occurring at least 2-3 times per year. This is primarily due to its lower elevation compared to the banks of the Kelani River. As a result, when floodwater rise to around 5 feet near the Kelani River, the adjacent areas along Pusweli Oya can experience flood levels as high as 15 feet (UDA, 2019).

The study on the distribution of development pressure areas in Homagama, along with an environmental sensitivity analysis, reveals that new physical developments are increasingly encroaching upon environmentally sensitive zones such as wetlands and paddy fields. Marshy and water retaining areas surrounding waterways, traditionally used by farmers for paddy cultivation are particularly affected. However, these farmlands are highly vulnerable to crop damage, especially during severe flood events (UDA, 2019).

In addition, topographical features combined with the presence of impermeable surfaces further contribute to flooding in the area. Similarly, localized flooding in several locations has been triggered by blocked drainage systems, often caused by construction activities, the extension of utility services, and the transformation of certain areas into marshlands.

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Nature and Spatial Distribution of the Flood Hazard in Homagama DSD

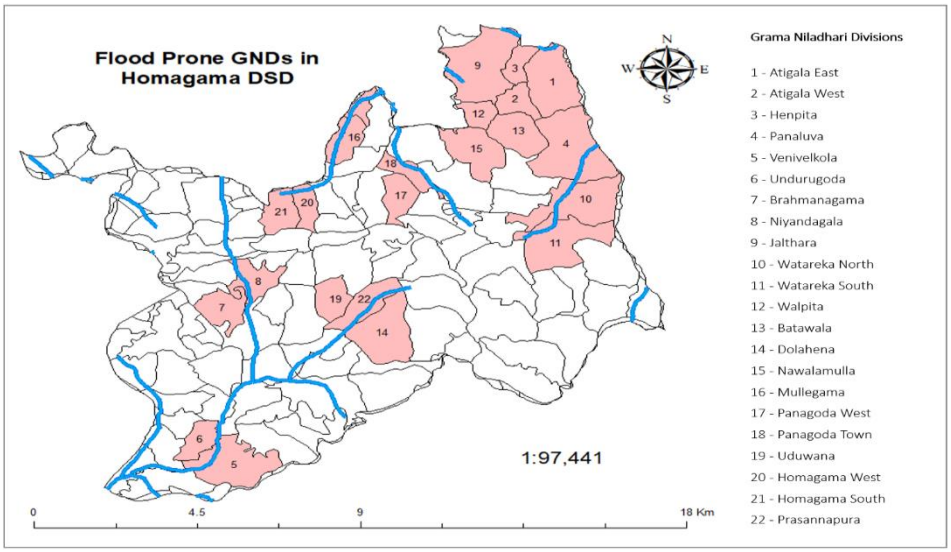
Table 1: GNDs most prone to flood hazards in Homagama DSD

No	GND	Number of affected families	No	GND	Number of affected families
1	446 - Atigala East	55	12	Walpita - 450 A	6
2	446 A - Atigala West	14	13	Batawala - 450	6
3	451 - Henpita	38	14	Dolahena - 484 C	2
4	447 B - Panaluva	19	15	Nawalamulla - 482 D	4
5	601 - Venivelkola	2	16	Mullegama	1
6	600 - Undurugoda	4	17	Panagoda West	2
7	500 - Brahmanagama	1	18	Panagoda Town	1
8	499 A - Niyandagala	4	19	Uduwana	1
9	449 - Jalthara	19	20	Homagama West	1
10	448 B - Watareka North	7	21	Homagama South	1
11	448 - Watareka South	2	22	Prasannapura	1

Source: Sampath Pethikada - Homagama DSD (2020)

The Homagama area is particularly prone to three types of natural disasters: floods, cyclones, and lightning. All of these are weather-related and primarily occur due to heavy rainfall. Situated within the Wet Zone of the country and lying above 10 m above mean sea level, Homagama is largely protected from direct water sources. However, flooding remains the most frequent natural hazard experienced in the region. As of 2020, out of the 81 GNDs within Homagama DSD, 22 have been identified as highly vulnerable to flooding. The table below (Table 1) presents the flood-prone GNDs along with the number of affected families in each area (Sampath Pethikada - Homagama DSD, 2020).

Figure 3: Flood-prone GNDs in Homagama DSD



Source: Created Using 1 : 50,000 Digital Data, Survey Department of Sri Lanka

Most of the aforementioned GNDs are located near waterways, including tributaries of the two main rivers, Kelani and Kalu, as well as marshy lands in the northeastern part of the division. GNDs situated on either side of the Kelani River are particularly vulnerable to flooding caused by river overflows. However, these overflows also enrich the surrounding soil with alluvial deposits, making it suitable for rice cultivation. Swamps, semi-swampy areas, and natural marshes found in other GNDs are ecologically important, functioning as floodplains or natural flood retention zones during flood events (Figure 3), with the Barawa Forest in the Panaluva GND serving as a notable example due to its key role in managing floodwater (Sampath Pethikada - Homagama DSD, 2020).

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According to the data from the Irrigation Department in 2016, the GNDs and the total area impacted by flooding that year include Artigala East (1.82 km²), Artigala West (0.13 km²), Habarakada North (0.39 km²), Habarakada South (0.21 km²), Henpita (0.58 km²), Jalthara (1.22 km²), Meegasmulla (0.08 km²), Meegoda North (0.08 km²), Mullegama North (0.17 km²), Mullegama South (0.22 km²), Panagoda East (0.08 km²), Panagoda Town (0.18 km²), Panaluva (1.48 km²), Walpita (0.3 km²), Watareka North (0.84 km²), and Watareka South (0.16 km²) and the total flood-affected area in Homagama was 7.94 km² (UDA, 2019).

History of the Flood Hazard and Probability of Occurrence

Flood hazards in Homagama DSD have been occurring since the 1950s. However, according to available data, the frequency and severity of these events have decreased in recent years due to improved flood management and planning measures. Despite these efforts, challenges remain. Rapid urbanization, unauthorized constructions, the clustering of buildings, and the reclamation of paddy fields and swampy lands have contributed to the re-emergence of flood-related issues in certain areas. The following table presents historical records of flood events in Homagama and their associated impacts, as compiled by the Disaster Management Centre, Sri Lanka, in 2017 (UDA, 2019).

Table 2: Flood affected houses and population in selected years in Homagama DSD

Date	Number of affected people	Number of deaths	Number of affected houses	Number of destroyed houses	Number of affected families
2008/06/01	1827	-	-	-	469
2010/05/18	139	-	13	3	41
2011/05/27	820	-	6	3	234
2012/05/27	842	-	6	3	240
2016/05/15	5266	3	7	16	1349

Source: Urban Development Authority (2019)

According to the data, the number of individuals affected by flooding in Homagama DSD increased notably between 2008 and 2016. In the 2016 floods, approximately 5,266 people residing near Pusweli Oya were impacted, with three reported deaths and 16 houses completely destroyed (UDA, 2019). The extent of flood-affected areas along the Kelani River also varied over the course of the event in 2016, measuring (7.3 km^2 - 16th May), (9.1 km^2 - 18th May), (8.6 km^2 - 19th May), (7 km^2 - 20th May), (4.1 km^2 - 21st May), (3.2 km^2 - 22nd May), (1.8 km^2 - 23rd May). In comparison, during the flood event of May 2008, around 1,827 people from 469 families were affected (Alahacoon et. al., 2016). This comparison highlights a significant increase in the severity and scale of flood impacts within the division over time.

Another significant factor is the increasing number of people choosing to settle in flood-prone zones over time. This trend can be attributed to factors such as population distribution and growth, rising land values, relatively low land prices, frequent land sales, and the area's close proximity to Colombo. The expansion of settlements in these zones has directly contributed to a rise in flood occurrences, primarily due to the obstruction of natural waterways, including streams and canals. Consequently, the number of people affected by floods has increased over the years. It is estimated that approximately 12% of the total population in Homagama DSD are affected by flooding (UDA, 2019).

Additional details regarding notable flood events that occurred in 2008, 2010, 2011, 2012, and 2014 in Homagama DSD are available in records maintained by the division. According to these records, a significant flood event took place on 29th of April, 2008, affecting several GNDs, including Atigala East, Atigala West, Henpita, Panaluva, Walpita, and Nawalamulla. A total of 133 families and 526 individuals across these 6 GNDs were impacted. Among them, Atigala East was the most severely affected, with 55 families and 210 individuals reported as victims of the flood. Another flood hazard occurred on 1st of June, 2008, affecting

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multiple GNDs within Homagama DSD. The impacted GNDs included Atigala East, Atigala West, Panaluva, Heraliyawala, Palagama, Nawalamulla, Watareka South, Watareka North, Walpita, Mullegama North, Kahathuduwa West, Henpita, Habarakada North, and Jalthara. In total, 478 families and 1,650 individuals across these 14 GNDs were affected. Among them, Atigala East GND experienced the highest impact, with 156 families and 608 individuals reported as flood victims (Homagama DSD, 2022).

A flood hazard on 14th of May, 2010, impacted several GNDs in Homagama DSD. The affected GNDs included Atigala East, Atigala West, Niyandagala, Mullegama North, Brahmanagama, Habarakada North, Diyagama West, Jalthara, Henpita, Palagama, Homagama West, Panaluva, Uduwana, and Kiriwaththuduwa South. A total of 85 families and 306 individuals across these 14 GNDs were affected, along with 15 houses damaged by flooding. Atigala East was once again the most severely affected GND, with 26 families, 88 individuals, and 3 houses impacted by the flood. On 10th of November, 2010, another flood hazard impacted several GNDs within Homagama DSD. The affected GNDs were Niyandagala, Brahmanagama, Kahathuduwa West, Palagama, Undurugoda, Venivelkola, Rilawala, Heraliyawala, and Ambalangoda. In total, 378 families and 1,652 individuals across these 9 GNDs were affected by the flood. Additionally, 10 houses in Brahmanagama sustained damage. The most severely affected GND was Kahathuduwa West, with 181 families and 900 individuals impacted (Homagama DSD, 2022).

A flood hazard occurred on 28th of May, 2011, affecting several GNDs in Homagama DSD. The impacted GNDs included Atigala East, Atigala West, Panaluva, Watareka North, Batawala, and Henpita. A total of 842 families across these 6 GNDs were affected. Among them, Atigala East was the most severely impacted, with 598 affected families (Homagama DSD, 2022).

A flood hazard on 31st of October, 2012, affected 13 GNDs within Homagama DSD. The impacted GNDs were Mullegama North, Watareka North, Kahathuduwa West, Panaluva, Atigala East, Watareka South, Habarakada North, Walpita, Nawalamulla, Henpita, Batawala, Jalthara, and Atigala West. A total of 255 families and 571 individuals were affected and Atigala East was once again the most severely impacted GND, with 59 affected families and 199 individuals (Homagama DSD, 2022).

A flood hazard occurred on 2nd of June, 2014, impacting 8 GNDs in Homagama DSD. The affected GNDs included Atigala East, Panaluva, Watareka North, Brahmanagama, Henpita, Niyandagala, Watareka South, and Jalthara. In total, 121 families and 438 individuals were affected by the flood. Panaluva GND experienced the highest impact, with 33 affected families and 126 individuals (Homagama DSD, 2022).

According to historical data, Atigala East GND, situated on the northeastern border of Homagama DSD, has consistently been the most severely affected by floods. While significant casualties have not been reported in recent years except during the 2016 floods, damage has been primarily limited to affected families, residents, and housing structures. It is also notable that since the year 2000, residents of Atigala North, Panaluva, Nawalamulla, Jalthara, Henpita, Watareka, and Walpita have been frequently impacted by recurring flood events (UDA, 2019).

Potential Impacts

The overflow of the Kelani River, Kalu River, and Pusweli Oya mainly caused by heavy rainfall leads to frequent flooding in the area. This results in the inundation and damage of a substantial number of houses and land plots. In some cases, prolonged rainfall also triggers minor landslides. The main impacts include damage to property such as houses, buildings, home gardens, paddy fields, and crop lands. Roads and other infrastructure are often affected as well. Although casualties have been relatively few, some have been reported in recent years.

Several areas within Homagama DSD are prone to flooding due to the overflow of nearby rivers and tributaries. In Atigala East, about three-fifths of the GND is inundated during floods, affecting areas like Atigala paddy fields, Colombo Road, and Liyanagegama. Atigala West experiences flooding along the Kelani River, the Old Colombo bus route, and near Henpita Canal, particularly when the Kelani River overflows. Habarakada North, including low-lying lands and several other lands in Welikadaowita, is also affected by

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flooding when the Kelani River overflows during heavy rainfall. In Rilawala, the tributary of the Kalu River (Athu Oya) floods during heavy rain, causing damage to nearly 15 houses. Watareka South and North, especially the Andadola Kanda area, sees landslides and flooding, affecting around 16 houses. In Gal Kandawatta and Galamedi Hena areas, flooding caused by the overflowing of the Pusweli Oya inundates nearly 10 houses. Mullegama North, including areas like Muthhettiyawatta, Kaluwalamulla, and Malwatta Road is prone to flooding, with approximately 14 houses affected. Siyambalagoda South, particularly around Polgasovita junction, suffers from drainage system overflows during the rainy season. Lastly, Diyagama, with low-lying lands near the Diyagama canal, sees flooding and inundation of houses when the canal overflows (Homagama DSD, 2022).

In the year 2012, flooding caused significant damage to paddy fields cultivated during the Maha season in the Kahathuduwa Agrarian Service Division. The affected areas included paddy fields in the Kahathuduwa East Division, such as Dummaleyaya, Godaporagahadeniya, and Dummale Ismaththa paddy fields. In the Kudamaduva Division, the paddy fields of Naya Kumbura, Medadenivala, Iriyagaha Kumbura, Delgahapitavala, and Vaha Kumbura were severely impacted by flooding. Additionally, in the Siddamulla North Division, paddy fields of Puwakgahadeniya, Galvaladeniya, and other related areas experienced extensive damage due to floodwater (Homagama DSD, 2022).

Multi-phase Flood Risk Reduction Strategies for Disaster Resilience in Homagama DSD

According to officials from the Homagama DSD, a structured response plan is in place to ensure effective community-based disaster preparedness and relief services, particularly during flood events. As part of this plan, the Disaster Management Centre (DMC) actively maintains a comprehensive database of contact details and essential information for key personnel across government agencies, non-governmental organizations, and the private sector. This network enables swift coordination and mobilization of relief efforts in the event of an emergency, ensuring timely support for affected communities.

As part of this plan, the DMC maintains updated contact information of officers and relevant personnel such as Engineers, Assistant Engineers, Divisional Engineers, Grama Niladhari (Village Officer), Technical Officers, and Branch Executive Officers. These contacts also extend to numerous governmental and non-governmental organizations including the Water Supply and Drainage Board (Homagama and Kesbewa), Police Stations in Homagama, Aturugiriya, Padukka, Kahathuduwa, and Hanwella, Department of Agrarian Development, Panagoda Army Cantonment, Homagama Pradeshiya Sabha, District Irrigation Office, Provincial Irrigation Office (Ratmalana), Ceylon Electricity Board (Homagama), Sri Lanka Red Cross Society (Kottawa), District Disaster Management Coordinating Unit, and Homagama DSD itself. This database is maintained to facilitate the provision of various relief services during emergency situations. These services include the supply of water in the event of shortages, removal of fallen trees or broken branches, clearing of blocked roads, deployment of boats and army troops, repair and maintenance of drainage systems and canals, restoration of power outages, response to fire and cyclone events, and the provision of first aid services, ambulances, trained volunteers, and overall disaster management and relief coordination.

The DSD also keeps detailed records of Grama Niladhari for each GN Division. This enables quick and effective communication with residents, efficient distribution of relief and aid, and proper management of hazardous situations. In addition, the DSD maintains information on nearly 80 village development societies, which can be mobilized to support relief work during hazardous events within Homagama DSD. Regarding non-governmental organizations, the DSD has documented details of those that actively participate in disaster response and management. These include Sarvodaya - Sri Lanka's Sarvodaya Shramadana Movement and the Sri Lanka Red Cross Society, both of which contribute significantly during emergencies.

The DMC in Homagama also maintains detailed records of privately-owned vehicles that can be utilized during emergencies. These include bicycles, motorcycles, three-wheelers, hand tractors, tractors, trucks, lorries, vans, buses, cars, carts, and gill. Furthermore, the DMC keeps an inventory of machinery and equipment that can be used for relief services during hazardous events. This includes information on quantities, owners, and charges per hour for items such as backhoes, JCBs, water bowsers, motor graders (grader machines), gully bowsers, bulldozers, boats, traditional *Agul* boats, stone roller machines, saucepan

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sets, lorries, and tippers. All the aforementioned information is thoroughly documented and regularly updated by the DMC - Homagama. Based on field survey data, the individuals and organizations listed above are contacted as needed to provide prompt assistance and support during emergency situations.

In addition, the National Disaster Relief Services Center, along with other coordinating agencies, has undertaken the necessary preparations to provide disaster relief services at the Divisional Secretariat level in anticipation of the adverse weather conditions typically caused by the south-west monsoon each year. In line with this, Homagama DSD is actively preparing for potential disaster situations, similar to other DSDs across the region. As part of this effort, the contact details of key officers directly involved in disaster relief operations have been compiled. These include the Divisional Secretary, Assistant Divisional Secretary, Assistant Director (Planning), Accountant, Administrative Officer, Administrative Village Officer, and others.

Table 3: Number of affected families and individuals, children under and above 5 years of age and people with special needs in flood vulnerable GNDs in Homagama DSD - 2022

GND	Number of vulnerable families	Number of vulnerable individuals	Number of children under age 5	Number of children above age 5		Female	Male	Number of people with special needs
				Female	Male			
Watareka North 448 B	32	105	6	12	11	50	55	-
Meegasmulla 482 E	39	145	14	13	20	50	48	3
Batawala 450	45	172	15	22	15	72	48	5
Walpita 450 A	65	260	5	8	7	126	114	6
Henpita 451	250	950	82	97	93	346	332	114
Atigala West 446 A	170	646	40	58	64	246	238	83
Jalthara 449	267	1068	32	76	69	451	440	44
Mullegama North	38	167	12	19	18	95	72	3
Atigala East 446	345	1386	38	87	92	581	570	27
Total	**1213**	**4732**	**232**	**373**	**371**	**1922**	**1845**	**282**

Source: Homagama DSD (2022)

Furthermore, the DSD has documented statistical information on vulnerable populations within flood-prone GNDs. This includes the number of affected families and individuals, as well as specific data on children under the age of five, children above five, and persons with special needs. The category of people with special needs comprises pregnant mothers, individuals with disabilities, those with mental health conditions, and senior citizens over 65 years of age. The following table (Table 3) presents the numerical data compiled for the year 2022.

Furthermore, they maintain information on evacuation camps where displaced people can be temporarily housed within the affected GNDs. This information includes the maximum number of people that each camp can accommodate, as well as the availability of essential services such as water, electricity, and sanitary facilities. It also covers the number of temporary toilets that can be constructed, the current condition of existing bathing facilities, any necessary improvements, and the estimated quantity of utensils and equipment required for cooking.

To ensure the effective management of these evacuation camps, a team of three coordinators is assigned to each camp. This team typically consists of the Grama Niladhari, a Development Officer, and a community representative from the respective GND, with their membership in the Village Disaster Relief Services Committee being a key consideration during their selection. In addition, the inclusion of a female officer, as well as representatives from both a non-governmental organization and a private organization, has been officially approved to support and strengthen camp operations. Officials at Homagama DSD also record information regarding alternative safe locations and the homes of relatives where displaced individuals can be

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accommodated if the designated evacuation camps lack sufficient space. This includes details on the number of people that can be housed in these alternative shelters, as well as the required quantity of tents.

Additionally, the DSD has documented the estimated quantities of essential food and non-food items required during the critical first 72 hours following a flood emergency. These essential food items include cooked food packets, bottled water, tea packets, milk powder, infant milk powder, biscuits, noodles, and sugar. Non-food items include sanitary towels, toothpaste, toothbrushes, soap, and disinfectant liquid. The documentation specifies the daily requirement per person, such as the number of cooked food packets and the minimum quantity of water (at least 3 liters per person per day). In the event that infant milk powder is urgently needed, arrangements have been established to coordinate with the Medical Officer of Health (MOH) of the DSD to supply it to those in need. Furthermore, the DSD maintains contact information for emergency service providers such as St. John Ambulance and the Red Cross, who can be called upon to provide first aid support when required.

They have also documented the details and estimated quantities of essential food items and other necessities that may be required during the first week of a flood emergency. The listed essential food items include dry rations such as rice, dhal, sugar, potatoes, onions, curry powder, chilli powder, and cereals. In addition, non-food essentials such as sanitary towels, toothpaste, toothbrushes, soap, face masks, hand gloves, and hand sanitizer are also included in the records. Furthermore, the DSD has documented the basic items needed during the rehabilitation phase following an emergency. These include necessities such as pillows, bed sheets, and mattresses to ensure the comfort and well-being of affected individuals during the recovery period.

In addition, the officers of Homagama DSD have systematically documented all necessary service provider contact details related to the operation and management of evacuation camps. These include services such as first aid, medical centers, nursing services, ambulances, and both government and private hospitals. Furthermore, the records include contacts for engineering services, the provision of heavy vehicles (such as Backhoes and JCBs), access to drinking and non-drinking water, electricity supply, and sanitary facilities. Additional services documented cover technical support for camp maintenance, vehicles and boats for emergency relief operations, basic infrastructure requirements for camp management (including electricity and fuel), and security services. Provision of solar-powered rechargeable torches, as well as access to psychological and social support services are also included. All these details have been compiled and organized separately for each evacuation camp to ensure an efficient and well-coordinated response during emergencies.

Details of food suppliers, providing cooked meals, dry rations, and drinking water are also documented for each evacuation camp. Preference is given to food suppliers located nearest to the respective camps to ensure timely delivery. In the selection process, the rate agreements with these service providers and the suitability certificates issued by the Public Health Inspector (PHI) are carefully reviewed and considered.

In addition, Homagama DSD maintains comprehensive records of essential non-food items required during an emergency. These records include both the quantities currently available, and the additional amounts needed, based on the number of families residing in flood-prone areas. The listed items include tents, mats, kitchen utensil sets, water tanks, buckets, cups, plates, Panadol, water purification tablets, mosquito nets and coils, towels, bed sheets, children's sanitary napkins, women's sanitary napkins, regular napkins, sarongs, milk bottles, candle packets, soap, toothpaste, toothbrushes, boots, raincoats, mammoties, coconut scrapers, traditional knives (*keththa*), and lanterns.

Besides, Homagama DSD has taken steps to establish Village Disaster Relief Service Committees in disaster-prone GNDs. These committees are intended to be formed either at the GN division level or at the area level, with a minimum of one committee per two to three GNDs. Each committee is expected to include representatives from the Women's Affairs and Child Development Officers of the respective DSD. Furthermore, the inclusion of members from local private institutions is encouraged to facilitate collaboration and support from non-governmental organizations and the private sector in disaster response and relief activities.

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Almost all of the procedures outlined above are consistently implemented by Homagama DSD during each instance of flood hazard. These activities are carried out both before and after flood events, and collectively, they contribute significantly to effective flood hazard management. Additionally, a Disaster Management Committee meeting is held every three months at the district level. This meeting is chaired by the District Secretary of Colombo and attended by other relevant officials. During these sessions, current disasters within the district and related disaster management matters are discussed in detail.

Typically, following a flood event, officers from Homagama DSD, in coordination with the DMC - Homagama, conduct post-disaster observations to evaluate the extent of damages and provide necessary support to affected individuals. In addition, they implement awareness programs before, during, and after flood hazards to educate the public on disaster preparedness and response. To further support these efforts, leaflets and booklets are distributed among the community to further raise awareness and provide practical guidance. These educational materials include information on how to remain safe in evacuation centers, how to prepare for and respond to a flood disaster, emergency contact numbers, and the essential items to include in a disaster or emergency supply kit. The materials are produced and distributed by several institutions, including the Ministry of Health and Indigenous Medicine, Disaster Management Centre, Health Promotion Bureau, National Disaster Relief Services Centre, Disaster Preparedness and Response Division, and the United Nations Development Programme (UNDP). Moreover, separate leaflets have also been prepared by these institutions to guide relevant officers on proper disaster management protocols and procedures.

The Homagama DSD provides compensation for damaged houses and properties in the event of natural disasters. Compensation is provided based on requests and case reports submitted by Homagama DSD. Initially, a form and progress report must be filled out by Homagama DSD and forwarded to the Colombo District Secretariat to request compensation. Following this, an advance payment of up to Rs. 10,000 is made by the National Disaster Relief Services Centre (NDRSC) under the Ministry of Disaster Management, with the involvement of the Colombo District Secretariat. The amount of Rs. 10,000 should be disbursed to displaced persons within seven days of receiving the requested compensation funds.

For property damage estimated at up to Rs. 25,000, the amount should be requested from the NDRSC and provided to the affected individuals within one month after the disaster. In cases where property damage exceeds Rs. 25,000, certified copies of the application form must be submitted to the NDRSC within one month of the disaster. In addition, Homagama DSD also offers compensation to micro, small, and medium-scale enterprises that have suffered property damage exceeding Rs. 25,000 due to natural calamities. The procedure for compensation follows the same process outlined for residential property damage.

Table 4: The amount of disaster relief compensation in 2018

No	GND	Number of families affected	Disaster Relief Compensation - Rs (2018)	No	GND	Number of families affected	Disaster Relief Compensation - Rs (2018)
1	446 - Atigala East	55	508500.00	12	Walpita - 450 A	6	57000.00
2	446 A - Atigala West	14	133000.00	13	Batawala - 450	6	54000.00
3	451 - Henpita	38	361300.00	14	Dolahena - 484 C	2	20000.00
4	447 B - Panaluva	19	185300.00	15	Nawalamulla - 482 D	4	38000.00
5	601 - Venivelkola	2	20000.00	16	Mullegama	1	10000.00
6	600 - Undurugoda	4	40000.00	17	Panagoda West	2	20000.00
7	500 - Brahmanagama	1	8000.00	18	Panagoda Town	1	10000.00
8	499 A - Niyandagala	4	20000.00	19	Uduwana	1	10000.00
9	449 - Jalthara	19	171000.00	20	Homagama West	1	10000.00
10	448 B - Watareka North	7	35000.00	21	Homagama South	1	10000.00
11	448 - Watareka South	2	1000000.00	22	Prasannapura	1	10000.00

Source: Sampath Pethikada - Homagama DSD, (2020)

The majority of investments allocated for disaster risk reduction in the Homagama area have been directed towards mitigating flood and cyclone hazards. During the 2018 flood event, the government granted Rs. 10,000 for each affected family. At that time, 191 families across 22 GNDs were impacted. In total, the

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government allocated Rs. 1,910,000 which was distributed among the affected families (Table 4). In addition to government funds, private organizations, donors, NGOs, and TV channels also contributed essential items such as food, clothing, sanitary products, and medicines. The responsibility and accountability for managing the distribution of government funds were undertaken by the Disaster Management Center, in collaboration with Homagama DSD.

In addition to government agencies, non-governmental organizations such as the Sri Lanka Red Cross Society (SLRCS) and the International Federation of Red Cross and Red Crescent Societies (IFRC) are actively involved in the response and recovery efforts within Homagama DSD. Their recovery programs focus on addressing critical needs in shelter, health, water and sanitation, livelihoods, and enhancing the capacity to manage future emergencies.

Strengthening Disaster Resilience: Structural and Non-structural Change Recommendations

Structural and non-structural flood mitigation measures work together to manage flood risks and reduce the impact of floods on communities. Structural measures include physical interventions such as levees, dams, flood barriers, and improved drainage systems that control the flow of water and protect vulnerable areas. Non-structural measures, on the other hand, focus on policies, regulations, and community-based strategies like floodplain zoning, early warning systems, public education, and land-use planning. While structural measures provide physical protection, non-structural measures emphasize preparedness, risk reduction, and the sustainable management of flood-prone areas, creating a comprehensive approach to flood risk management.

When addressing the challenges of disaster prevention, especially in relation to flooding, a range of proactive activities and measures can be implemented. One key measure is to provide clear guidelines and instructions for the proper management of drainage systems and waterways within the area. The water bodies in Homagama including rivers, tributaries, streams, brooks, and tanks play a crucial role in managing excess water during heavy rainfall. Particularly in densely populated areas, tanks such as Maththegoda Tank, Olupattawa Tank, and Kuda Tank are significant. These tanks should be treated as environmentally protected ecosystems and must be conserved accordingly. The Homagama development plan 2019-2030, highlights the dual importance of these tanks, not only as vital components for disaster risk reduction but also as key elements in enhancing the natural beauty of the urban landscape. The creation of conservation zones along tank reservations is a valuable strategy for flood risk mitigation, as these buffer zones can enhance the land's ability to absorb excess rainfall, reducing flood impacts during monsoon seasons (UDA, 2019).

Other important water bodies in the area include rivers, tributaries, streams, and brooks. To effectively minimize flood-related hazards, several key strategies should be adopted. It is essential to closely monitor the natural flow and any changes occurring in the two main drainage basins: Kelani and Kalu. In addition, regular cleaning, desilting, and maintenance of all canal networks in the region are vital. Improving the existing drainage infrastructure and ensuring its proper and consistent upkeep are also critical measures to reduce the risk and impact of future flood events (UDA, 2019).

When examining the Kelani River, its embankments are particularly significant in relation to the Homagama area. The river is connected to a network of small streams and both minor and major canals that flow from the northern part of the region. However, the current landscape around the Kelani River has drastically changed, with a dense concentration of large concrete buildings, roadways, and other impermeable surfaces. This urbanization has significantly contributed to the increased risk of flooding. In response, the Irrigation Department has declared a 50-foot-wide flood protection zone on either side of a 6-kilometer stretch of the Kelani River within Homagama. This zone, measured from the riverbank's edge, is recognized as an environmentally sustainable measure. It will receive legal protection to prevent unregulated construction and ensure the conservation of the river's natural flow and surroundings (UDA, 2019).

The streams and canal networks in the Homagama area have significantly deteriorated due to the lack of regular maintenance. According to the 2012 flood profile of Sri Lanka prepared by the UNDP, one of the major issues contributing to flooding is the narrowing of these canal networks, which hampers the efficient drainage of floodwater and ultimately increases river flooding. When canals are left unattended, they tend to

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silt up and gradually convert into terrestrial land, leading to the degradation of local ecosystems. Recognizing this issue, the Homagama Development Plan 2008-2020 proposed designated reservation zones around canals to support flood mitigation efforts. For instance, the plan recommends a 10 m reservation for Pusweli Oya, 8 m for Henpita Canal and Maha Oya, 5 m for Nadun Ela and Panaluva Ela, and 1 m for other canals. These measures aim to restore and protect the canal network, ensuring its functionality and ecological value (UDA, 2019).

Another significant consideration in flood mitigation is the establishment of flood control zones or water retention areas such as wetlands and small forest patches. In this regard, two major wetlands located within the Western Province hold particular importance for the Homagama area. One of these is the Barawa Wetland, situated along the banks of Pusweli Oya, while the other is the Baduwila Wetland, located near the Bolgoda water retention area. These wetlands play a crucial role in absorbing excess rainwater and acting as natural buffers during flood events. By serving as water retention zones, they help reduce the severity and frequency of floods, thereby minimizing the damage to surrounding communities and ecosystems. Protecting and restoring these natural flood control systems is essential for sustainable disaster risk reduction in the region (Sampath Pethikada - Homagama DSD, 2020; UDA, 2019).

The aforementioned wetlands play a crucial role in flood control within the Homagama area. Due to their environmental significance, a substantial portion of lowlands, approximately 10% of the wetlands in Homagama have been designated as wetland conservation areas under the Wetland Master Plan of the Western Province. Similarly, the zoning plan implemented as part of the Urban Development Authority's Development Plan (2008-2020) recognized nearly 200 acres of wetlands as designated conservation zones. Notably, this includes a 400-acre stretch of wetland along both sides of the Pusweli Oya, encompassing the Barawa wetland park (UDA, 2019).

Another critical aspect of flood risk reduction in the Homagama area is the protection of paddy fields and other low-lying lands from reclamation. These lands include not only actively cultivated paddy fields but also abandoned ones and wetland agricultural areas such as *owita*, *deniya*, *pillewa*, *godawala* and other similar types, form an interconnected network that is integrated with the region's surface water systems. They play a vital role in absorbing excess rainwater and regulating surface drainage. However, ongoing reclamation continues at an alarming rate, disrupting natural water flow and significantly increasing flood risk. Therefore, establishing clear guidelines and enforcing legal measures to prevent further land conversion is essential. Conservation of these lands is not only an environmental priority but also a key strategy for sustainable flood management in Homagama (UDA, 2019).

In addition to the previously mentioned measures, several other activities can be implemented to prevent flood hazards in the area. Attention must also be given to the proper regulation and monitoring of abandoned pottery pits, quarry mines, and other disturbed lands such as shallow brackish water wetlands and minor waterways. These areas, if neglected or improperly repurposed, can further exacerbate flood hazards. Preserving and rehabilitating them is crucial for maintaining the region's resilience to natural disasters. Zonation for low-density housing should be prioritized to avoid overcrowding in flood-prone regions. Any construction work that leads to land-use changes in flood-affected areas should undergo detailed studies to assess its impact. Furthermore, the expansion of the population into environmentally sensitive areas, such as Barawa, Pusweli Oya, and Kelani River, should be minimized to reduce exposure to flood risks. Slope studies should be conducted to identify low-lying areas that are particularly vulnerable to flooding (UDA, 2019; Homagama DSD, 2022).

Engaging local communities through group discussions is also essential to raise awareness and minimize future hazards. A strong link should be maintained between the local people and relevant authorities to ensure effective disaster management. Additionally, educating the public about the hazards and the areas that require special attention such as environmentally sensitive zones like water retention areas, watercourses, paddy fields, wetlands, scrub jungles, and flood-affected areas is crucial. Other measures include minimizing sand mining in rivers, prohibiting the destruction of bamboo thickets along riverbanks, such as in the Kelani River, and constructing stone ridges and embankments on both sides of rivers to provide additional flood protection

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(UDA, 2019; Homagama DSD, 2022). Some of these mitigation measures are already being implemented in the area, contributing to better flood risk management.

In regard to flood hazard mitigation, indigenous practices should also be taken into consideration. Discussing these forms of traditional knowledge is valuable for gaining a better understanding of how local communities, particularly peasants, have historically coped with flood situations. In the past, villagers living in flood-prone areas of Homagama implemented several traditional practices to protect their homes and livelihoods from flood hazards. One such practice was the cultivation of a special rice variety called '*Maa vee*', which is known for its flood resistance. This rice variety grows taller than usual, reaching a height of around 140 to 170 cm (about 4.5 to 5.5 feet), and is unaffected by floodwater. Even if submerged, the plant would not be destroyed, making it a suitable crop for flood-prone areas. However, due to frequent flooding, both the Yala and Maha seasons could not be cultivated, and only the Maha season was utilized for farming. Sowing typically began by the end of December, with harvesting around April. This method of farming, known as '*Muththes govithena*' was common in areas such as Tunnana, Atigala, Aluth Para Meegoda, Barawa, and Manungala. Farmers in these regions believed that the silt deposited by floods contributed to better crop growth.

Additionally, in the past, villagers built a bund or small flood wall, called '*Kayyoruwa*', around the foundation of their houses. This bund, typically 4-5 feet high, was constructed to control the flow of floodwater towards the house, offering some protection during floods. During flood events, villagers would also seek refuge in higher areas of the village, such as the village temple or school, which served as safe places during floods. Moreover, it is reported that about 30 years ago, a large stone at the mouth of the Kelani River estuary was destroyed to reduce the risk of flooding in the area. These practices were part of the community's traditional methods of coping with flood risks, showcasing the resilience of the local population in the face of frequent natural disasters.

CONCLUSION

Flooding remains a significant hazard within Homagama DSD, driven by both natural and human-induced factors. This study underscores the importance of a comprehensive understanding of local vulnerabilities and the application of both structural and non-structural mitigation measures for effective flood risk management. Key steps toward building sustainable flood resilience include strengthening institutional coordination, preserving natural drainage systems, and integrating traditional knowledge with modern practices. Enhancing data-driven planning and promoting community-based preparedness will further improve the region's capacity to mitigate flood-related impacts. While local disaster management strategies partially align with the priorities of the Sendai Framework for Disaster Risk Reduction 2015-2030 particularly in areas such as community preparedness and early response, greater efforts are required to fully embed its principles into long-term risk reduction, governance, and recovery initiatives.

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