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Small and Medium-Sized Entrepreneurs' Perceptions of Flood Loss and Damage in Sri Lanka

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Abstract: As climate change has intensified flood risk and damage in many low-lying areas of the world, small and medium-sized enterprises (SMEs), which typically exist in developing countries, have endured high flood risks without much support for relief. This study investigates how SMEs in flood-prone areas of Colombo, Sri Lanka, the largest business hub in the country, have perceived and dealt with flood loss and damage in the past ten years. We conducted field surveys and a questionnaire survey among 60 SME owners in two flood-prone administrative units from March to June 2020. The results show that informal businesses experienced more flood loss and damage than other community members. Also, the community dominated by informal businesses tended to be located closer to potential flood sources. Ownership and awareness about flood insurance were very low in our study areas. Temporary business closure was the most serious loss experienced by informal business communities. These communities depended on personal savings to recover from floods. Our multiple regression analysis found that age, education, and experience significantly influenced SME owners' perceptions and experiences about floods. After discussing these findings, this paper offers recommendations to mitigate disaster loss and damage to SMEs. In particular, it highlights the importance of community-level awareness and mitigation efforts rather than administrative unit-level mitigation plans. Also, the government needs to register informal businesses by providing a more flexible business registration mechanism.

Keywords: loss and damage; floods; small and medium-sized entrepreneurs; Colombo; Sri Lanka

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1. Introduction

COP27 of the United Nations Convention on Climate Change (UNFCCC), which was held in Egypt in 2022, highlighted the urgency of addressing disaster loss and damage to climate-vulnerable and poor regions of the world [1,2]. This was partly in response to the 2021 Glasgow Climate Pact, in which developed country parties to the UNFCCC agreed to enhance support for climate-induced disaster loss and damage in developing countries (Article VI, 64). Past studies identified that climate-change-induced disasters like floods caused business interruptions, property damage, loss of customers, infrastructure damage, and business closure [3–8]. Small and medium-sized enterprises (SMEs) in developing countries are particularly vulnerable to floods [9]. For example, the 2010 flood in Pakistan affected 300,000 SMEs, of which 74.5% never reopened [10]. India's Chennai flood in 2015 recorded INR 17 billion in losses to the SME sector [11]. Malaysia's Kelantan flood in 2014 affected 13,337 SMEs or 37.7% of all SMEs in the state [12]. In Thailand, the 2011 flood caused USD 45.7 billion in losses and damage to 57,637 businesses, of which 90% were SMEs. About 2.3 million workers lost jobs [12].

These problems were attributed to the fact that SMEs are located in sub-optimal locations with weak financial stability, limited market accessibility, and insufficient localized disaster risk reduction measures [13]. Within a specific administrative area, especially urban centers, sub-optimal locations and newly developed/gentrified neighborhoods coexist, making administrative boundary-based assessment less accurate. SME

vulnerabilities largely stem from poor risk management and adaptation strategies [3,5,14]. Poor risk management can lead to SME failures that, in turn, affect the survivability and resilience of local communities as local businesses sustain livelihoods and create local employment opportunities [15,16].

Putting these findings in Sri Lanka's context, floods similarly caused heavy loss and damage. Sri Lanka experienced more than USD 2 billion in loss and damage between 1990 and 2018 [17], whereas its GDP in 2019 was about USD 84 billion [18]. From 1980 to 2019, 1.52 million people in Colombo district alone were affected by floods. More than half of these floods (52.75%) occurred in the last 10 years. Within the district, Kaduwela and Kolonnawa divisional secretariat divisions (DSDs) were affected most [19]. However, there were those heavily affected and those less affected within a DSD. Sri Lanka's SMEs are often located in congested and flood-prone low-lying areas without disaster-resilient infrastructures. In 2016, the amount of loss and damage from flood disasters reached LKR 31 billion (USD 214 million) [20]. In the same year, disasters damaged 5207 SMEs in Colombo District alone [3]. If one considers SMEs and informal businesses alone, we may gain a better understanding of the scale of the disaster loss and damage to Sri Lanka's socio-economic conditions as SMEs contribute to 52% of its GDP, 45% of the total employment, and more than 75% of the establishments [21].

Since 2016, Sri Lanka has adopted international risk reduction measures, such as the Paris Agreement, Sendai Framework for Disaster Risk Reduction, and the Warsaw International Mechanism for Loss and Damage. It also has incorporated a loss and damage concept into its National Determinant Contributions (NDCs) for 2030 [22]. However, for some reason, this document left out SME's loss and damage. The available disaster database does not have information about SMEs [19]. Furthermore, only a few studies have been conducted on Sri Lanka's SME sector in connection to flood loss and damage [3,23].

After examining a number of studies on loss and damage in developing countries, we found that a predominant focus was placed on local loss and damage information with the intention to improve policy and practice [3,5,12,24,25]. As a result, these papers did not include theoretical contributions to scholarship in vulnerability, risk, and urban/development studies. This said, Lebel et al. [26] made an important point about the limit of a governance unit (e.g., city, municipality) to effectively manage water-related disasters like floods because rivers and other flood sources extend beyond jurisdictional boundaries (e.g., agencies, stakeholders). This point is quite relevant to understanding flood loss and damage among informal SMEs in Sri Lanka. As we have already pointed out in our previous paper [27], Sri Lanka's flood vulnerability maps identify flood risks by administrative units (e.g., DSD, GND) rather than geographical or hydrological characteristics. Here we also should point out the fluid and complex nature of vulnerability that Weichselgartner [28] aptly discussed. As the concept of vulnerability is largely a social construct, an intended universal theoretical approach may not sit well in understanding localized and uninformed areas like the informal settlements of Sri Lanka. It is important to pay much more attention to community perceptions about vulnerability than focusing on policy and practice improvement within an administrative unit in Sri Lanka. Considering this trend and the salience of understanding more about flood impacts on SMEs within a community-based context, this paper examines how SMEs in flood-vulnerable areas have perceived and dealt with floods in the past. Much of the discussion below is based on our fieldwork and questionnaire survey. Before discussing the methodologies and results, we elaborate on the significant aspects of these study areas.

2. Methodology

2.1. Study Location

Colombo District, the study area, has experienced floods as it is located in the flood plain of the Kelani River [29–31]. The Kelani River Basin has been recognized as the most flood-prone region in Sri Lanka. Since the early 1830s, the basin has experienced 27 devastating floods, causing extensive damage to Colombo residents [32–35]. In partic-

ular, the floods in 2010 and 2016 were the worst flood events in the district. It cost USD 10 million in 2010 and USD 277 million in 2016 [20]. According to the flood vulnerability profile the Ministry of Environment developed, among Colombo District's 13 DSDs, Kolonnawa and Kaduwela DSDs were the most flood-affected areas in the last 10 years [20,29]. Based on insights from officials from the Disaster Management Center, past literature, and field visits, we selected these DSDs as our study areas in this paper based on the purposive sampling method (Figure 1).

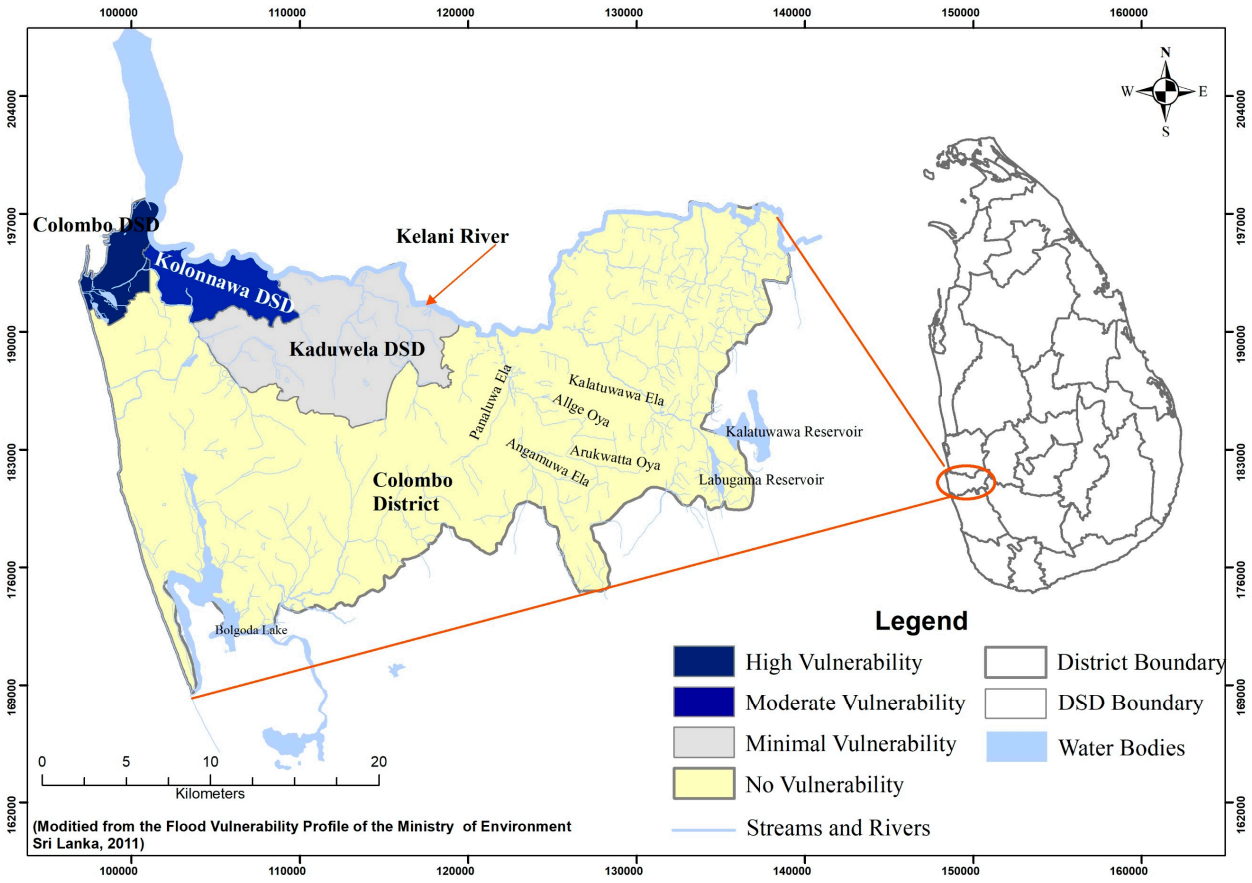

Figure 1. Study Locations.

These DSDs also have a high concentration of SMEs. Kolonnawa DSD has been developed as a commercial hub as it is located close to the Port of Colombo. There are wholesale store complexes, food granaries, container yards, electrical substations, a petroleum oil storage complex, and a government industrial goods manufacturing factory. Residents here work primarily in port-related industries. About 70% of this area is below the sea level [36]. Its population density is 7183 persons per km^2 [37] with scattered informal settlements and semi-permanent buildings along the Kelani River [20].

Kaduwela DSD became urbanized after the 1980s. After the Colombo Administrative Capital was established in 1985, the population of Kaduwela doubled from 126,053 in 1981 to 252,041 in 2011 [38]. Government ministerial complexes were developed during this period. The proportion of the built-up area increased from 14.6% in 1980 to 22.9% in 2016. Its landscapes were largely transformed from paddy and marshy lands to urban complexes [39]. From 1956 to 2016, the wetland area in Kaduwela and the surrounding Administrative Capital decreased by 47% [40]. When the 2016 flood affected this area, the SME sector endured the most severe damage, amounting to LKR 600 million in losses (USD 4.1 million) [20].

2.2. Data Collection and Analysis

To understand how SMEs have dealt with flood loss and damage, we conducted a questionnaire survey from March to June 2020 among 60 SMEs or 30 each from Kaduwela and Kolonnawa DSDs. As Figure 1 shows, the Sri Lankan government carried out a disaster risk assessment on the basis of district and DSDs. There is no community-based loss/damage assessment. Therefore, we designed a questionnaire by largely referring to the Warsaw International Mechanism for Loss and Damage [41]. This mechanism identifies disaster risk by focusing on risk reduction, risk retention, and risk transfer. We examined these components [41]. Following the mechanism, we also considered both economic and non-economic losses [42]. In our questionnaire design, we incorporated the Community Resilience Framework of Sri Lanka, which emphasizes the need for local community participation in disaster risk management [43].

The paper-based questionnaire had 42 questions. It was divided into five sections. Section 1 dealt with the socio-demographic information of SME owners. Section 2 asked about the vulnerability and flood exposure of the respondents. Section 3 attempted to identify SME's past risk reduction and risk transfer approaches. Section 4 attempted to understand SME owners' awareness of flood warnings and evacuation. The final section focused on assessing flood loss and damage and recovery methods of the respondents. The questions were both open-ended and close-ended. Close-ended questions included multiple choice options and the five-point Likert-scale. With the help of Disaster Management Centre (DMC) officials, we identified the most vulnerable locations in the study areas. A random sampling technique was used to select SME owners. All respondents returned valid answers. Using Microsoft Excel, the collected data were analyzed and the results are presented in the form of tables and figures.

In addition, we conducted a multiple regression analysis to find the significant correlations between socio-demographic characteristics and flood experience perceptions. We selected the following as independent variables: age, gender, marital status, household size, education, the physical structure of business entity, the number of employees, annual turnover, property/asset/equipment value, stock/good/raw material value, the number of daily customers, monthly work days, and business experience. Flood experience was selected as a dependent variable. In the multiple regression analysis, it was necessary to code categories to explain variations in the dependent variables. Here we used dummy variables as a numerical representation (Table 1). The equation of the multiple regression is as below:

$$Y = B_o + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + B_8X_8 + B_9X_9 + B_{10}X_{10} + B_{11}X_{11} + B_{12}X_{12} + B_{13}X_{13} + e$$

where:

Y = Respondents perceptions about flood experiences
B_o = Intercept
X_1 = Age
X_2 = Gender
X_3 = Marital status
X_{13} = Years of business experience in the locality
e = Error term

To formulate this questionnaire and better understand the results, we collected government documents and secondary sources. Our main information sources are the National Census Reports for 2012 and 2020, Post-Disaster Needs Assessment Report of Floods (2016) [20], the Desinventar database of the Disaster Management Centre (DMC), and DSD reports of the study locations. We reviewed United Nations documents on loss and damage that are pertinent to the Warsaw International Mechanism for Loss and Damage. We interviewed disaster management regional officers from the National Disaster Relief Services Centre, DMC, and the Kaduwela Municipal Council to understand the current flood management practices.

Table 1. The coded data and descriptive statistical analysis.

Independent Variables	Coding and Descriptive Statistics
Age	Measured in years
Gender	1 if male, 0 for female
Marital status	1 if married, 0 for single
Household size	Number of household members
Education	Years of formal education
Physical structure of business entity	1 if single floor, 2 for two or more floors, 3 for store house, and 4 for others
Number of employees	Number of employees
Estimated annual turnover	Measured in Sri Lankan Rupees (LKR)
Estimated value of property, assets, and equipment	Measured in Sri Lankan Rupees (LKR)
Estimated value of stocks/goods/raw materials	Measured in Sri Lankan Rupees (LKR)
Number of daily customers	Number of customers
Number of working days per month	Number of days
Years of business experience in the locality	Number of years spent in the business

3. Results and Discussion

3.1. Socio-Demographic Characteristics

The first section of the questionnaire survey discussed the socio-demographic characteristics of SME owners (Table 2). The results showed that 75% belonged to the age group of 20–49. Based on the national average, 43% belonged to this age group [38], meaning that our study area, overall, had relatively young SME owners. In Kaduwela, half of the respondents belonged to the age category of 20–39, whereas 70% were above 40 years old in Kolonnawa. Also, it is important to note that our respondents were mostly males (72%) and married (93% in Kolonnawa and 73% in Kaduwela). About 69% of the respondents had 3–4 household members. This is similar to the national average of 3.6 persons per household [44].

Education is often regarded as a social asset that improves coping capacity against floods [45]. In our survey, those respondents who had completed secondary and higher education consisted of 86%. Regarding tertiary education, 67% of those in Kaduwela had completed it at an advanced level or above, whereas only 30% in Kolonnawa had done so. In 2012, the national tertiary education completion rate was 18.2% and Colombo District's average was 29.4% in 2012 [38]. This means that the respondents in both DSDs, especially Kaduwela, had higher education levels than the national average.

Business activities of the respondents showed somewhat different profiles between the two DSDs. The respondents in Kolonnawa DSD were mainly engaged in miscellaneous business activities (47%) and retail shops (40%). In Kaduwela, the respondents were engaged in miscellaneous business activities (40%), restaurant/catering (20%), and retail shops (17%). The miscellaneous category refers to informal micro-scale businesses. The informal sector is defined on the basis of registration status, account keeping practices, and the total number of regular employees of a given entity [20]. A business entity is not registered in the Employment Provident Fund or Department of Inland Revenue if it does not maintain formal accounts, and its number of regular employees is less than 10 [20].

In our field survey of 2020, we observed that Kolonnawa's informal businesses typically included fruit stalls, timber shops, iron recycling centers, book shops, tailoring shops, repair centers, cloth shops, vegetable farms, digital printing shops, and shoe shops. In Kaduwela, the informal category represented beauty salons, fruit stalls, tuition classes, bicycle/vehicle repair centers, tire shops, industrial goods manufacturing, grass and organic fertilizer shops, betel shops, and telephone repair centers.

Another point we investigated was the types of buildings in which SMEs operated their businesses. Here we considered the study by Wedawatta and Bingunath [5]. It found that properly built business buildings with flood resilience infrastructure could minimize flood loss and damage. Our survey result showed that about 78% of our respondents had single-floor business buildings. Another 12% had multiple floors that are flood resistant to

some extent. About 9% had temporary huts and mobile structures for daily business along the roads (14% in Kaduwela and 4% in Kolonnawa).

During floods, the unavailability of employees significantly impacts business continuation [3,5]. On this point, we asked how many employees the respondents had. Among the Kolonnawa respondents, 67% had one to two employees. In Kaduwela, 40% had three to five employees, and 30% had one to two employees. The percentage of employees between 6 and 20 persons was 30% in Kaduwela and that in Kolonnawa was 16%. The respondents who had one to two employees were likely family business owners. The SMEs in Kaduwela had more employees than those in Kolonnawa.

According to the National Policy Framework for SME Development in Sri Lanka, an annual turnover of less than LKR 15 million is considered a micro enterprise [21]. About 40% of SME owners in Kolonnawa had an annual estimated turnover of about LKR 100,000–200,000 (USD 556–1111). Another 37% had an annual turnover of LKR 200,001–500,000 (USD 1111–2778). In Kaduwela, 33% of the respondents had an annual turnover of LKR 200,001–500,000 (USD 1111–2778). Another 27% had an annual turnover of LKR 5,000,001–10,000,000 (USD 27,778–55,556). Also, 10% earned more than LKR 10 million (USD 55,556) per year.

On average, the estimated value of property, asset, and equipment of SMEs in both DSDs were low as 82% had value at or below LKR 1,000,000 (USD 5556). Kolonnawa SMEs had a higher property value than Kaduwela SMEs. About 73% of the respondents in Kaduwela had less than LKR 500,000 worth of property, asset, and equipment (USD 2778). Another 10% had LKR 2,000,001–5,000,000 (USD 11,111–27,778) worth of property, asset, and equipment. In Kolonnawa, 50% had property, asset, and equipment that were worth LKR 500,000–1,000,000 (USD 2778–5556). Another 23% had a value below LKR 100,000 (USD 556). Those who owned assets worth LKR 5,000,001–10,000,000 (USD 27,778–55,556) constituted 7% of the respondents.

In general, the respondents' estimated value of stocks/goods/raw materials was low. Among 80% of all respondents, the value was at or below LKR 1,000,000 (USD 5556). About 70% in Kaduwela had a value below LKR 100,000 (USD 556) and 10% had a value of LKR 1,000,001–2,000,000 (USD 5556–11,111). More than half of the Kolonnawa SMEs (57%) had materials worth LKR 100,000–500,000 (USD 556–2778) and 7% had materials worth LKR 5,000,001–10,000,000 (USD 27,778–55,556).

Another question in the survey attempted to identify business operation scale and capacity. Regarding the number of daily customers, we found that the Kaduwela respondents had more customers as 60% had 20 to 50 or more per day. In Kolonnawa, 70% had 1 to 20 customers. In terms of working days, the respondents in both DSDs worked for more than 20 days per month. The number of working days was high in Kolonnawa as 70% worked for 26 to 31 days and 20% for 21 to 25 days. In Kaduwela, 43% worked for 26 to 31 days and 40% for 21 to 25 days. Another notable point is that 40% of the Kaduwela SMEs had joined business associations, whereas none had done so in Kolonnawa. Overall, the Kaduwela SMEs had larger scale business operations than those in Kolonnawa.

Flood experience is one of the factors for SMEs to prepare for possible flood damage [5,10]. About 74% in Kaduwela and 73% in Kolonnawa had 6 to 20 years of business experience in the same DSD. On average, the Kaduwela respondents had longer business experience than those in Kolonnawa.

Table 2. Socio-demographic characteristics of SME owners.

Demographics		Respondents (%)		
		Kaduwela DSD	**Kolonnawa DSD**	**DSD Average**
Age	20–29	20%	7%	13%
	30–39	30%	23%	27%
	40–49	27%	43%	35%
	50–59	10%	13%	12%
	60–69	10%	7%	8%
	Above 70	3%	7%	5%
Gender	Male	73%	70%	72%
	Female	27%	30%	28%
Marital status	Single	27%	7%	17%
	Married	73%	93%	83%
Household size (persons)	2	7%	3%	5%
	3–4	70%	67%	69%
	5	20%	17%	18%
	More than 5	3%	13%	8%
Highest education	No education	3%	0%	1%
	Primary	13%	13%	13%
	Ordinary level (O/L)	17%	57%	37%
	Advanced level (A/L)	47%	27%	37%
	Technical collage	7%	3%	5%
	University	13%	0%	7%
Business type	Retail shop	17%	40%	28%
	Mobile shop	0%	7%	3%
	Restaurant and catering	20%	3%	12%
	Supermarket	10%	0%	5%
	Manufacturing	3%	3%	3%
	Other service	10%	0%	5%
	Miscellaneous	40%	47%	44%
Physical structure of the business entity	Single floor	63%	93%	78%
	Two or more floors	20%	3%	12%
	Store house	3%	0%	1%
	Other	14%	4%	9%
Number of employees	1–2	30%	67%	49%
	3–5	40%	17%	28%
	6–10	17%	10%	13%
	11–20	13%	6%	10%
Estimated annual turnover	Not given	13%	3%	8%
	Below 100,000	7%	7%	7%
	100,001–200,000	3%	40%	22%
	200,001–500,000	33%	37%	35%
	500,001–1,000,000	0%	10%	5%
	1,000,001–2,000,000	0%	3%	1%
	2,000,001–5,000,000	4%	0%	2%
	5,000,001–10,000,000	27%	0%	13%
	Above 10,000,000	13%	0%	7%
Estimated value of your property, asset, and equipment (LKR)	Below 500,000	73%	23%	48%
	500,001–1,000,000	17%	50%	34%
	1,000,001–2,000,000	0%	17%	8%
	2,000,001–5,000,000	10%	3%	7%
	5,000,001–10,000,000	0%	7%	3%

Table 2. *Cont.*

Demographics		Respondents (%)		
		Kaduwela DSD	Kolonnawa DSD	DSD Average
Estimated value of your stock/good/raw material (LKR)	Below 100,000	70%	17%	43%
	100,001–500,000	17%	57%	37%
	500,001–1,000,000	3%	10%	7%
	1,000,001–2,000,000	10%	6%	8%
	2,000,001–5,000,000	0%	3%	2%
	5,000,001–10,000,000	0%	7%	3%
Number of daily customers	1–10	13%	40%	27%
	11–20	27%	30%	29%
	20–50	43%	20%	31%
	Above 50	17%	10%	13%
Number of working days per month	10–15	0%	3%	1%
	16–20	17%	7%	12%
	21–25	40%	20%	30%
	26–31	43%	70%	57%
Years of business experience in this locality	1–5	13%	17%	15%
	6–10	37%	50%	43%
	11–20	37%	23%	30%
	21–30	10%	3%	7%
	31–50	3%	7%	5%
Do you belong to a business association?	Yes	40%	0%	20%
	No	60%	100%	80%

3.2. Flood Exposure and Vulnerability

The questions in this section attempted to understand respondents' flood exposure and vulnerability. The past studies showed that the location of SMEs determines flood exposure and vulnerability [5,45]. First, we asked the respondents what motivated them to live in these localities by providing the following seven options to choose: (1) affordable land price, (2) inherited land, (3) close to home, (4) good accessibility, (5) availability of customers/laborers, (6) resource availability, and (7) other reasons. The availability of customers/laborers (60%) and inherited land (20%) were the main factors that led the respondents to establish businesses in Kaduwela. For the respondents in Kolonnawa, the main factors were close location to home (53%), availability of customers/laborers (23%), and inherited land (17%). A study conducted in Malaysia similarly showed that SMEs tend to locate in flood-prone coastal areas and deltas due to easy access to services, logistics, and infrastructure [12].

Proximity to a river, canal, or water body is one of the most important factors in determining flood vulnerability [45,46]. We asked the respondents about the distance from flood sources to their business entity (Figure 2). The respondents in Kolonnawa lived closer to flood sources as 70% lived within 100 m to 499 m and 23% within 100 m of the main river. In Kaduwela, 60% of the respondents lived more than 500 m or 1 km away from the flood source. The percentage of SMEs established within less than 100 m in Kaduwela was 10%. A study conducted by Asgary et al. [10] showed that about 76% of flood-affected SMEs were located in the immediate flood path in Pakistan.

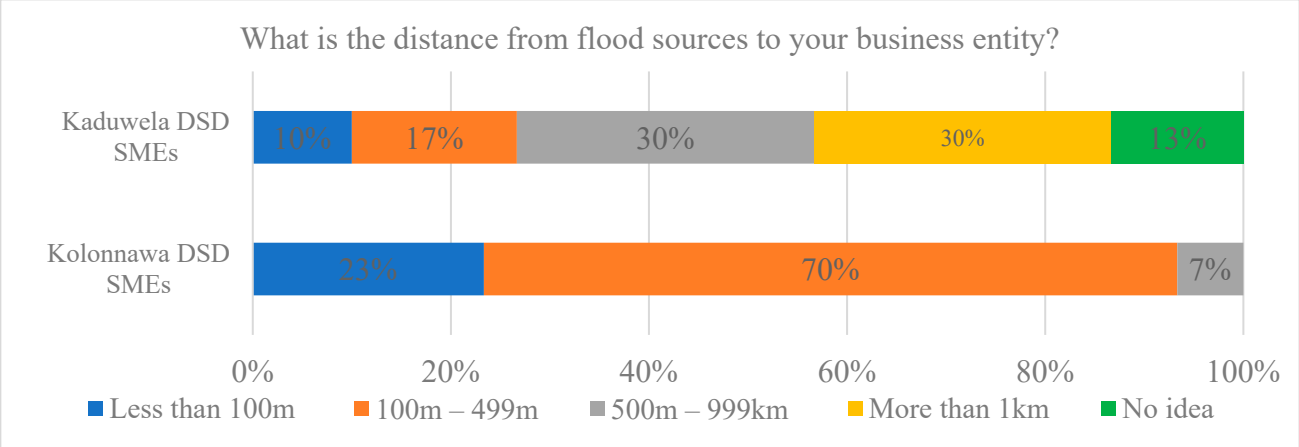

Figure 2. Distance from flood sources to business entity.

To identify flood frequency, we asked how often the respondents experienced floods (Figure 3). In Kolonnawa, 73% of the respondents experienced floods once a year and the rest once every two years. In Kaduwela, 77% experienced floods once a year and 10% after every heavy rain. About 7% of the Kaduwela respondents never experienced floods. All the respondents in Kolonnawa believed that flood frequency and intensity had increased in the last 10 years. However, only 33% of the Kaduwela respondents believed the same. We found that the respondents were adversely affected by the 2016 flood, and 97% in Kolonnawa and 80% in Kaduwela confirmed that it was the worst flood they had ever experienced.

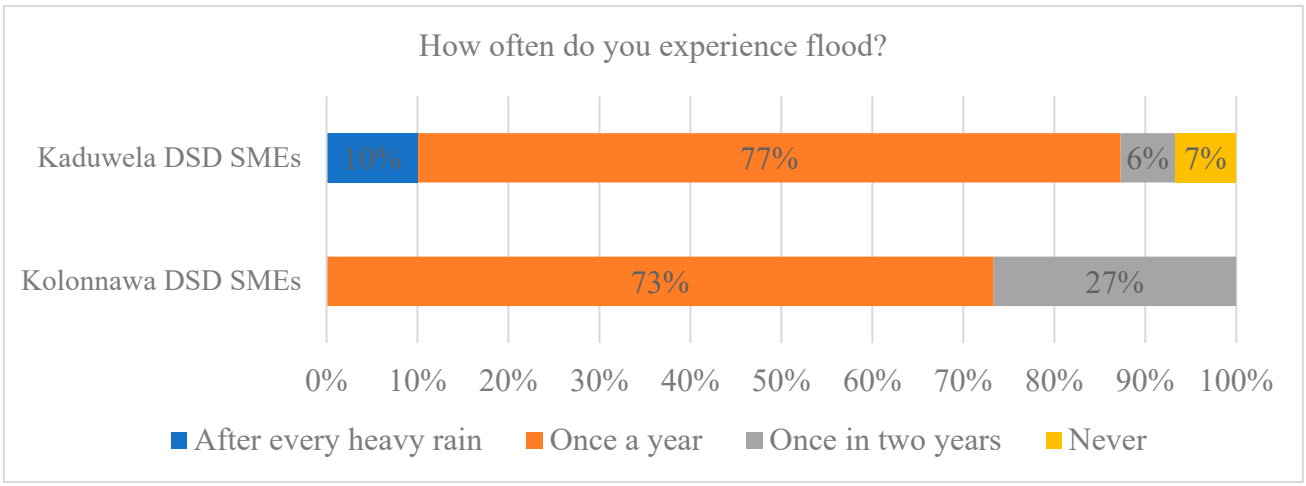

Figure 3. Frequency of floods experienced by the respondents.

3.3. Risk Reduction and Risk Transfer Approaches to Flood

In the next section of the survey, we focused on risk reduction and risk transfer. Past studies highlighted the importance of community-level risk reduction measures to minimize loss and damage [41,47]. Heeding to this study, we asked whether the respondents had taken any measures to minimize flood losses and damages to their business properties by providing multiple choice options. The options were as follows: (1) elevated my building, (2) constructed walls, (3) cleaned drains around the property, (4) installed a flood-resistant storage facility, (5) bought an insurance plan, (6) moved business to a safer area, and (7) other. About 53% of respondents in Kolonnawa and 47% in Kaduwela had taken measures to minimize flood damage. In Kolonnawa, the respondents installed flood-resistant storage facilities (63%), elevated buildings (19%), and purchased insurance plans (19%). The Kaduwela respondents focused on elevating buildings (63%), cleaning

drains (13%), and moving their businesses to safer areas (13%). De Oca [48] found that small businesses were less likely to take costly mitigation measures for floods. Also, he found that past flood experience enhanced preparedness. Another study conducted in Sri Lanka showed that SMEs did not invest in flood protection measures due to insufficient technical know-how, limited finances, and lack of government support [23].

As insurance is one of the most important risk transfer approaches [42], we asked what kind of insurance policy the respondents had (Figure 4). About 91% of the respondents in Kolonnawa and 63% in Kaduwela did not have any insurance plan. Though we found some life insurance (17%) and business property insurance (17%) holders in Kaduwela, none of the respondents in both DSDs had disaster insurance. Then, we asked what would prompt them to buy flood insurance. About 97% in Kolonnawa and 87% in Kaduwela had no idea about disaster insurance. The rest would consider premium affordability, plan's reliability and credibility, and high flood risk. Past studies show that flood insurance adoption is relatively low among SMEs. For example, out of half a million SMEs affected by the Bangkok flood in 2011, only 14% of them had flood insurance [12]. De Oca [48] showed that only 12% of SMEs had flood insurance in Mexico. When Pakistan faced a major flood incident in 2010, less than 1% of SMEs had flood insurance [10].

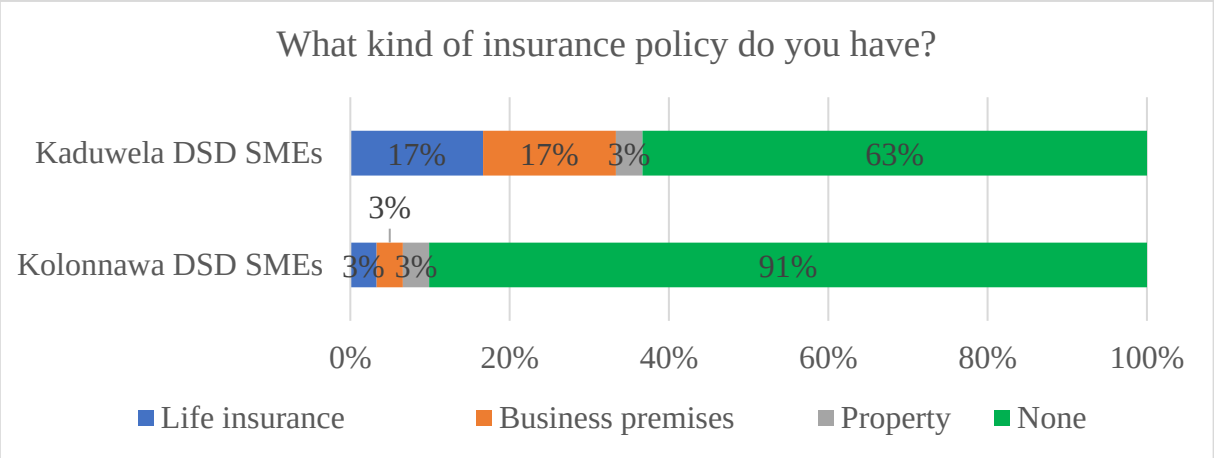

Figure 4. Insurance policies of the respondents.

In general, the insurance penetration rate of Sri Lanka is very low compared with other countries in the world. In 2016, it was about 0.67% of the GDP. Major industrial and commercial properties had natural disaster insurance coverage, but the number of SMEs with insurance coverage remains very low [49]. In 2016, the National Insurance Trust Fund of Sri Lanka established its Natural Disaster Insurance Scheme with support from the International Insurance Development Forum and the German Development Bank. Under the scheme, it covers the lives and properties of all households and SMEs up to LKR 2.5 million (USD 13,889) for damages. Death compensation was LKR 100,000 (USD 556) [50]. The total insurance value of this scheme per year was LKR 10 billion. LKR 8.5 billion was earmarked for property damages. The balance of LKR 1.5 billion covered immediate emergency relief for the affected people. However, the losses were not covered under the scheme [20]. We found that none of the respondents knew about the insurance scheme.

3.4. SME Owners' Awareness of Flood Early Warnings and Evacuation

As flood early warnings and evacuation centers and routes can reduce loss and damage [41], this section of the survey focused on SME owner's awareness of flood early warning and evacuation information. The reliability of the information source is vital for SMEs to decide on evacuation. Accordingly, we asked the respondents about the extent to which they rely on different sources of information by using a five-point Likert-scale

(1 = not reliable; 5 = very much reliable). The following information sources were presented to the respondents as options to choose from: grama niladari officer, television, short message service through mobile phone, business association/chamber/society, neighbor/friend/relative, an official government website, internet/social media, newspaper, and radio. More than 80% of the respondents would rely on almost all the sources. In particular, those in Kaduwela would use information from television (83%) and grama niladari officers (83%). A grama niladari officer is a government-appointed head of a cluster of villages.

Then, we asked the respondents whether they knew about a designated flood evacuation center and the evacuation route to it in their locality; more than half of the Kolonnawa (57%) and Kaduwela (53%) respondents answered no to this question. About 67% in Kolonnawa and 63% in Kaduwela were not willing to use evacuation centers during floods. We also found that 13% of the respondents in Kolonnawa and 10% in Kaduwela had used evacuation centers more than once during recent floods. In our in-person interview, DSD officials said that evacuation centers and routes were all designated in each DSD [51], but the survey results show that more than half of the respondents were not aware of these places. Moreover, in our field observations we did not find any signs indicating evacuation routes in the study areas.

The Warsaw International Mechanism for Loss and Damage identified that evacuation drills, practices, and disaster awareness are important to respond effectively in order to minimize loss and damage during flood events [41]. Evacuation orders and flood early warnings need to be provided with enough time to react. Accordingly, we asked the respondents whether they had received evacuation orders and flood early warnings with sufficient time to react. Most respondents in Kaduwela (80%) and Kolonnawa (67%) received evacuation orders on time. However, their participation in evacuation drills and flood awareness programs was very low as 80% in Kolonnawa and 70% in Kaduwela had never participated in these activities. A study conducted in Pakistan showed that most SME owners do not receive evacuation orders on time. For example, 58% of the SMEs evacuated on the same day when the flood reached their towns in the 2010 floods. The reasons included delayed evacuation orders, distrust of the evacuation system, serious security concerns, a lack of transportation, unavailability of accessible shelters, and a lack of risk perception among SMEs [10].

Regarding evacuation drills and other preparedness measures, we asked the respondents about their knowledge of responsible parties to provide drills. The respondents in Kolonnawa believed that government officials were responsible. In Kaduwela, 14% of the respondents had no idea about who conducts evacuation drills and flood awareness programs, while others chose government officials (43%) and private organizations (43%). The interviews with the officials in the Disaster Management Centre (DMC) revealed that only one disaster drill was conducted in Kolonnawa in 2016 and two drills were conducted in Kaduwela in 2015 and 2016 [52].

3.5. Loss and Damage and Recovery from Flood

The final section of the survey focused on loss and damage assessments and the flood recovery methods of the respondents. Loss and damage assessments include both economic and non-economic aspects, but these assessments can miss some locally valued items [42]. In this section, we attempted to analyze both economic and non-economic losses and damages for SMEs.

First, we asked the respondents about the seriousness of their losses and damages from floods with five-point Likert-scale options to choose from (1 = not serious; 5 = very serious). The respondents in Kaduwela (Figure 5) identified that the loss of income due to temporary business closure (80%) was the most significant loss and very serious. Another option, poor hygiene conditions, was chosen by 70% of the Kaduwela respondents. Moving to temporary premises (80%), structural damage to the business entity (73%), and a lack of access to basic utilities (70%) were among other serious losses and damages

reported. However, a considerable number of the respondents did not find the following options serious: high insurance premium (37%), loss/damage to business record (27%), loss/damage to stocks/goods/raw materials (27%), absence of laborers/employees (23%), and loss/damage to business equipment (20%).

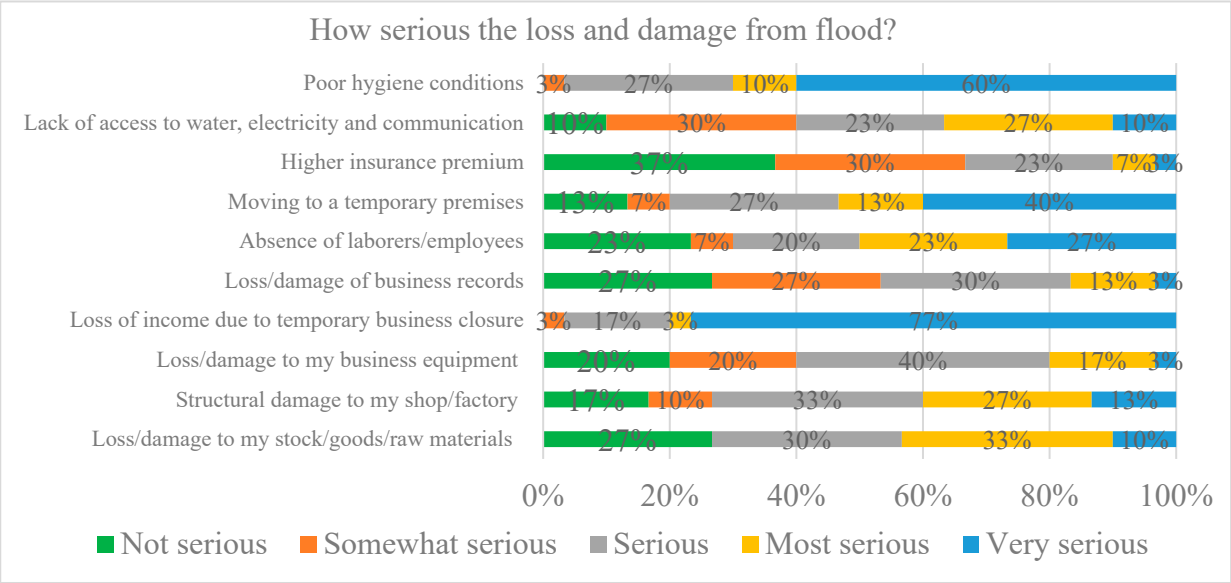

Figure 5. Seriousness of the effects of floods to SMEs in Kaduwela.

In Kolonnawa (Figure 6), the respondents chose income loss caused by temporary business closure (93%) as the most serious impact. Another option, loss/damage to stocks/goods/raw materials, was chosen by 74% of the respondents. Loss/damage to stocks/goods/raw materials (100%) and loss/damage to business equipment (77%) were also serious problems. On the contrary, most of the respondents did not indicate the following options as serious: higher insurance premium (93%), loss/damage to business record (93%), absence of laborers/employees (80%), and moving to a temporary premise (77%). Gunathilaka [3] similarly found that income loss due to business closure, loss/damage to stocks and raw materials, and inability to conduct business were the main impacts of floods on SMEs in Sri Lanka. In Malaysia, the loss of trade and production, absence of employees, property damage, stock and equipment loss, and profit decrease were identified as the main losses and damages among SMEs [12]. A U.K. study [53] found that stock and product damage, income loss, travel difficulties, additional costs to run the business, flooded premises, and trade and production decline were the main aspects of loss and damage.

Unlike other developed countries [5], the higher insurance premium is not a serious issue for SMEs in Colombo as many of them do not possess insurance plans. The absence of laborers or employees is one of the main issues for flood loss and damage in many parts of the world [54]. However, the respondents did not face this issue. Our analysis showed that SMEs faced more losses than damages.

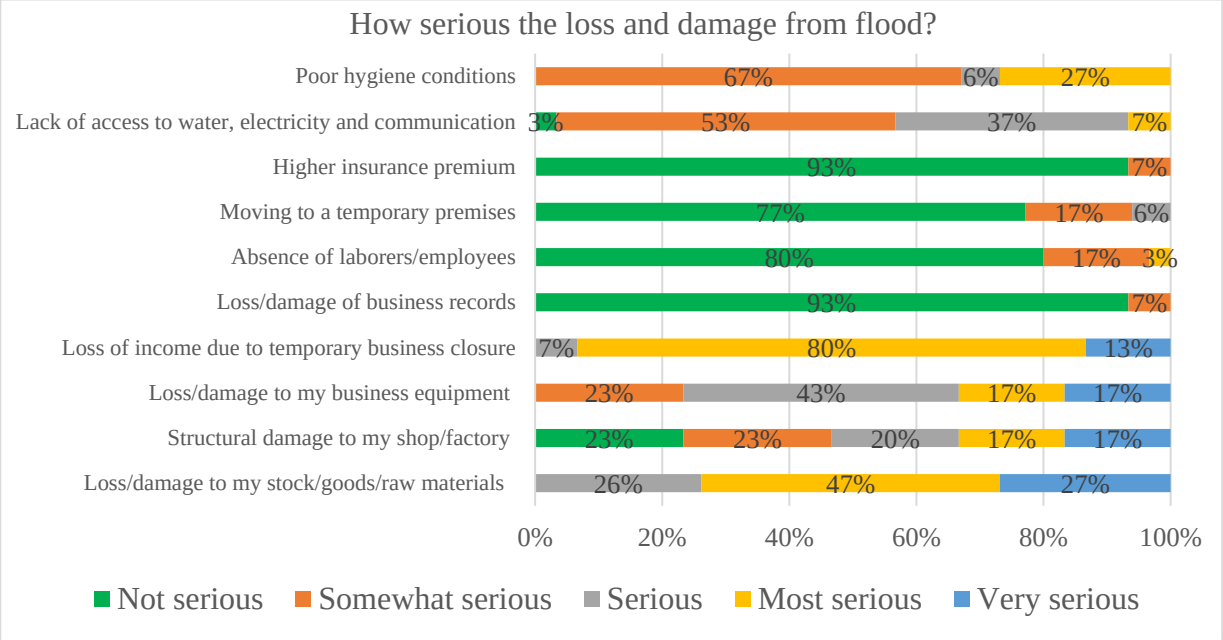

Figure 6. Seriousness of the effects of floods to SMEs in Kolonnawa.

Floods create physical and psychological health effects including injuries and stress [53]. Also, waterborne diseases such as diarrhea and cholera are the most common epidemics after floods [3]. To identify health and sanitary issues, we asked the respondents whether they experienced health or sanitation issues after floods. In Kaduwela, 80% said yes, whereas only 47% in Kolonnawa did so. The Kolonnawa respondents suffered from an epidemic (79%), waterborne diseases (29%), and other diseases (7%). Many Kaduwela respondents similarly suffered from an epidemic (88%) and waterborne diseases (12%). Dengue fever was the epidemic they highlighted.

In order to determine the loss of working days due to floods, we asked how many days the respondents lost due to the recent floods. In Kolonnawa, 27% lost two weeks. Others lost one week (23%) or one month (23%). In Kaduwela, 33% lost two weeks and another 33% lost three weeks. Those who lost one month consisted of 7%. The rest or 23% had no flood impacts. Overall, the Kolonnawa respondents lost more days due to floods. These business closure numbers are relatively shorter than cases reported in other countries. The 2007 U.K. flood, for example, resulted in SMEs losing 50 working days on average [55]. It took 6 to 9 weeks to resume business operations. In Pakistan, the 2010 flood led to the closure of about 64% of SMEs for 3 months [10].

Then, we asked the respondents whether any organizations had conducted flood loss and damage assessments for them. In response, 73% in Kolonnawa answered yes. However, 70% of the respondents in Kaduwela mentioned that no organization had conducted a loss and damage assessment for them.

We calculated the cost of loss and damag from the recent flood (Figure 7). Here the respondents were asked to choose one of the following options: (1) below LKR 100,000, (2) LKR 100,000–500,000, (3) LKR 500,001–1,000,000, (4) LKR 1,000,001–2,000,000, (5) 2,000,001–5,000,000, (6) 5,000,001–10,000,000, and (7) no damage. The results showed that 54% of the respondents in Kolonnawa indicated that they had sustained LKR 100,000–500,000 (USD 556–2778) in damages, and another 40% reported below LKR 100,000 in damages (USD 556). In Kaduwela, 60% had below LKR 100,000 (USD 556) in damages, and another 20% reported LKR 100,000–500,000 (USD 556–2778) in damages.

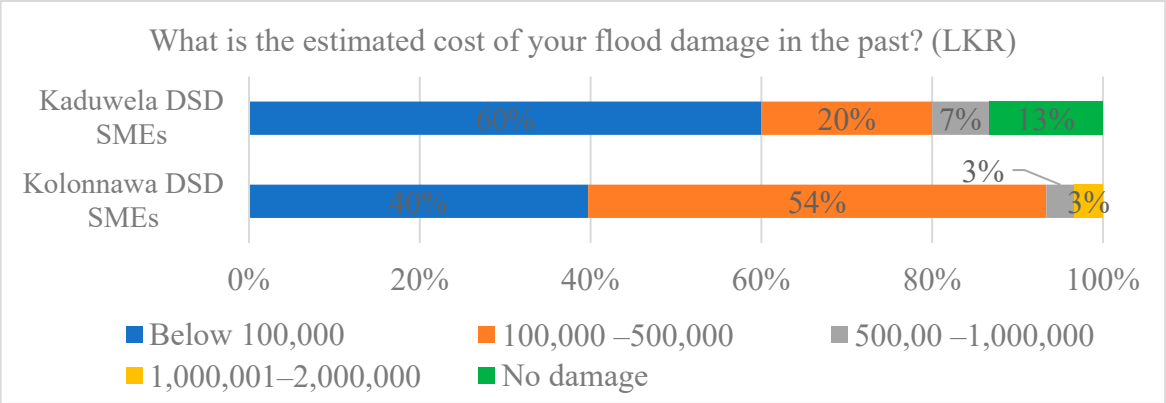

Figure 7. Past loss and damage costs from floods.

Finally, we asked the respondents how they recovered from flood loss and damage. We presented them with multiple choice answers. The choices were (1) insurance coverage, (2) a loan from a financial institution, (3) a loan from a friend/relative, (4) savings, (5) government compensation, (6) assistance from a business association, (7) other, (8) unable to recover, and (9) no damage. The result showed that the respondents in Kolonnawa largely depended on personal savings (27%), government compensation (20%), and loans from financial institutions (17%). However, 30% was unable to recover from the damage. In Kaduwela, personal savings (47%) was the main source of recovery followed by government compensation (20%) and insurance (13%). About 3% was unable to recover from their damage and 13% had no damage. Overall, personal saving was the most relied upon flood recovery source in both DSDs. This finding is similar to a few past studies. De Mel et al. [56] found that a large part of disaster damage recovery of a community and SMEs in Sri Lanka came from personal savings. Asgary et al. [10] found that SME flood recovery in Pakistan came from personal savings (37%).

Then, we asked whether the respondents received government compensation or relief for damage recovery. The majority of the respondents in Kolonnawa (67%) collectively received the total sum of LKR 1,099,000 (USD 6106) for damage recovery. The respondents in Kaduwela did not receive any compensation. Instead, a few respondents (13%) in Kaduwela collectively received a lump sum payment of LKR 40,000 (USD 222) to buy essentials for flood relief. The respondents complained that compensation and relief were barely enough to cover their losses and damages.

Past disaster recovery data from the Natural Disaster Insurance Scheme show that disaster claims from the SME sector were relatively low compared with community claims in Sri Lanka. For example, the Post Disaster Recovery Plan of 2017 showed that the collective flood claims from SMEs totaled LKR 228.46 million (USD 1.58 million), whereas the collective community claims totaled LKR 2.542 billion (USD 17.53 million) from the Natural Disaster Insurance Scheme. None of the losses are covered by this scheme [57].

3.6. Factors Influencing Respondents' Perceptions about Flood Experience

After obtaining these results, we attempted to identify factors that influenced respondents' perceptions of their flood experience by conducting multiple regression analyses (Table 3). We paired respondents' perceptions with age, gender, marital status, household size, education, physical structure of the business entity, number of employees, estimated annual turnover, estimated value of property/assets/equipment, estimated value of stocks/goods/raw materials, number of daily customers, monthly work days, and business experience.

We found that in Kolonnawa, age (p-value < 0.05), education (p-value < 0.05), and business experience in the community (p-value < 0.05) influenced perceptions of flood experience. These respondents were relatively aged entrepreneurs as 70% of them were

above 40 years old. But 87% of them had secondary and tertiary education. Also, 73% had 6 to 20 years of business experience.

Among the Kaduwela respondents, education (p-value < 0.05) and business experience in the locality (p-value < 0.05) had a significant influence on their flood perceptions. Compared with the Kolonnawa respondents, the Kaduwela respondents had higher education (67%). In addition, 74% of the Kolonnawa respondents had 6 to 20 years of business experience.

Table 3. Factors that determine SME owners' perceptions of flood experience.

	Kolonnawa DSD		**Kaduwela DSD**	
Variables	**Coefficients**	***p*-Value**	**Coefficients**	***p*-Value**
Intercept	1.530	0.002	0.980	0.228
Age	0.057	0.037 *	−0.245	0.508
Gender	−0.988	0.094	−1.145	0.182
Marital status	−0.589	0.639	0.086	0.879
Household size	0.068	0.786	1.038	0.130
Education	0.162	0.024 *	0.418	0.005 *
Physical structure of business entity	−0.225	0.456	−0.008	0.982
Number of employees	−0.048	0.863	−0.408	0.421
Estimated annual turnover	0.172	0.286	0.140	0.552
Estimated value of property, assets, and equipment	0.203	0.199	−0.199	0.838
Estimated value of stocks/goods/raw materials	0.265	0.059	0.326	0.679
Number of daily customers	−0.089	0.363	−0.060	0.853
Number of working days per month	−0.445	0.101	−0.229	0.550
Years of business experience in the locality	0.115	0.014 *	0.347	0.014 *

* p-value < 0.05.

4. Conclusions

This study investigated how small and medium-sized entrepreneurs faced, perceived, and dealt with flood loss and damage in flood-prone areas in Kolonnawa and Kaduwela DSDs of Colombo. We found that SME owners in Kolonnawa reported higher losses and damages than those in Kaduwela, partly because 93% of the Kolonnawa respondents lived within 500 m of flood sources. However, other factors like higher education, insurance, participation in evacuation drills, family businesses, and business organization membership also determined their vulnerability. For example, only 30% of the SME owners in Kolonnawa had tertiary education, about 91% had no insurance plan, and 80% had never received evacuation drills. Also, 67% of the respondents in Kolonnawa had a family business with 1 to 2 employees and none of them belonged to business organizations.

Regarding the motivation to live in these localities, the respondents in Kaduwela looked at the availability of customers and laborers (60%) and inherited land (20%). The respondents in Kolonnawa were motivated by proximity to their homes (53%) and the availability of customers and laborers (23%). In response to the floods, 53% in Kolonnawa and 47% in Kaduwela (47%) took flood mitigation measures, including flood-resistant storage facility installation (63%) in Kolonnawa and elevation of buildings (63%) in Kaduwela.

Our survey on evacuation found that 80% of the respondents in Kaduwela and 67% in Kolonnawa received evacuation orders on time. However, more than half of the Kolonnawa (57%) and Kaduwela (53%) respondents were not aware of evacuation centers and routes. This was basically due to their insufficient participation in evacuation drills and flood awareness programs as 80% of respondents in Kolonnawa and 70% in Kaduwela never received such programs.

We found that informal businesses were predominant in these two DSDs as 87% of the Kolonnawa respondents and 67% of the Kaduwela respondents were engaged in informal businesses. Also, all SMEs were engaged in micro-businesses with less than LKR 15 million in annual turnover. As informal businesses do not keep formal accounts, these businesses

cannot claim insurance and government compensation. We found that their losses and damages were underestimated and they had largely depended on personal savings and other external sources for disaster recovery. The respondents found temporary business closure as the most serious flood loss in Kolonnawa (93%) and Kaduwela (80%). Also, they lost one to two months of business due to floods. In addition, 80% in Kaduwela and 47% in Kolonnawa experienced health and sanitation issues after the floods. On average, an SME owner in Kolonnawa reported LKR 255,000 (USD 1417) in loss and damage. In Kaduwela, it was LKR 140,000 (USD 778) per person. This highlights the need for the government authority to register informal businesses and help them adopt insurance and business continuity plans. Our multiple regression analyses showed that age, education, and business experience significantly influenced Kolonnawa SMEs' perceptions, whereas education and experience significantly influenced Kaduwela SMEs' perceptions.

Considering these results, we recommend that flood disaster adaptation measures require mid- to long-term plans to improve disaster training and education quality in general for Sri Lankan residents. Disaster prevention and mitigation actions can be enhanced with more community-level involvement in training and evacuation drills. Also, some form of government incentive may expedite informal businesses to be registered and institutionally protected. In addition, the relocation of businesses and residences to higher ground, creation of levees, and wetland/flood plain preservation in less-populated areas can minimize flood loss and damage.

This study also has some limitations. We only collected survey data from 60 SMEs in the highly flood-affected areas within the DSDs. However, our previous study showed that within the same DSD, some communities are more vulnerable than others. Therefore, it is difficult to generalize the findings to all flood-affected communities in the country. A further expansive study is needed to identify the resilience levels of communities in different locations.

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