Application of Strength-Based Social Vulnerability Index (SSVI) in Vulnerability Assessment: Bangladesh Perspective

Jinat Ara Nasrin[1]
Saadmaan Jubayer Khan[2]
Dr. Md. Mostafizur Rahman[3]

Abstract

Hazard and social vulnerability are closely related. The traditional approach for social vulnerability assessment is focused on a community's weakness and overlooked the community's resourcefulness to minimize their vulnerability. This study employs an improvised approach for determining the community's social vulnerability based on the Strength-based Social Vulnerability Index (SSVI). This approach considers the strength and resourcefulness of the community to assess their vulnerability. The purpose of the study is to determine the applicability of this approach in Bangladesh perspective. Two study areas were selected in Mirpur, Dhaka city. A Field survey was conducted to collect demographic and socio-economic information. SSVI was applied to compute and then compare the social vulnerability between these two areas. Once the index is constructed, aggregated and standardized properly, the result is visualized using the ArcGIS 10.3. The results confirm that the SSVI approach can be applicable in Bangladeshi environment. However, other aspects (education, social status) can be considered for better vulnerability assessment.

Keywords: Social vulnerability, Strength-based social vulnerability index, SSVI, Sense of community, Social support

1. Introduction

Hazards both natural and man-made, pose a significant threat to people around the world. About half of the population of the world is potentially exposed to natural hazards (CRED, 2018). When natural hazards turn into disaster, the negative impacts of the disaster can be seen through a significant increase in economic losses and fatalities (Ogie, Shukla et al. 2017). From 2013-2017, on average 10,846 deaths and 49,303 injuries were recorded worldwide for the most common natural hazards- floods, earthquakes, bushfires and storms (CRED, 2018). In 2018, the number of recorded disaster events around the world was 315, where death was 11,804 and economic loss was US$131.7 billion (CRED, 2018). However, the rate of fatalities and economic losses are not shared equally among and within the nations, regions, communities and individuals (Toeroek, 2017). In 2018, Asia encountered comparatively more disasters and faced the highest impact compared to the other continents and 40% of natural disaster events were recorded with 80% of death and

[1]MSS student, Batch -1 (2018-2019 Academic Year), Department of Disaster and Human Security Management, Bangladesh University of Professionals. E-mail: jinatbup@gmial.com
[2]Lecturer, Department of Disaster and Human Security Management, Bangladesh University of Professionals E-mail: sourovjubayer@gmail.com
[3]Assistant Professor, Department of Disaster and Human Security Management, Bangladesh University of Professionals E-mail: amimostafiz@gmail.com

76% of affected people. The data about disaster in 2018 across the world showed that the number of population potentially exposed (PPE) to storms was higher in Asia and it was 2.1 billion. Among the 19.4 million storm affected people, 17.1 million were from Asia (CRED, 2018). Bangladesh, ranked the fifth most vulnerable country in the 2016 Disaster Risk Index, is also recognized as one of the most affected countries in the world for extreme weather events (Dutta, 2018). Heavy rainfall, flood, cyclone, storm surges, drought, salinization are the more frequent natural hazards and in the urban context, earthquake, waterlogging, building collapse and fire are identified as the most common hazards. These extreme events claim thousands of lives, destroy property, livelihood and infrastructure and force people to leave their houses and land (Parvin and Johnson, 2015). However, the extent of exposure of the people not only rely upon their proximity to the source of risk, rather, is influenced by their housing condition, use of resources and opportunities, environmental degradation for livelihood and production, their ability to prepare for and act during natural hazard, which also determine their social vulnerability status (Ogie and Pradhan 2019; Pradhan 2010, Toeroek, 2017). Dhaka city, the capital of Bangladesh, is a fast growing urban center facing high population density due to rapid and unplanned urbanization. According to the report of the world air quality-2018, Dhaka is ranked as the second most polluted capital in the world (Khalequzzaman, 2019).

Social vulnerability is a multi-dynamic social issue and a product of social inequality (Chau, 2014); which, defines the socioeconomic and demographic characteristics of a person or group that influence their capacity to anticipate, ability to prepare for, respond to and recover from the impacts of hazards (Aksha et al., 2019; Ogie and Pradhan 2019). Thus, the social vulnerability assessment is recognized as a key component for identifying and limiting the root causes of vulnerability, in addition explaining how social differences within a community can influence the impact of disasters differently (Daddoust, 2018).

Ogie and Pradhan (2019) proposed an improvised new approach called “Strength-based Social Vulnerability Index (SSVI)” for social vulnerability assessment. This index is built on socio-psychological theories and considers how people act during the disaster and emergencies. While constructing the social vulnerability index, it is important to identify the existing resource and strength of a community, along with the people who are least prepared for an emergency in addition to more likely to be affected during the hazards.

1.1 Problem Statement

According to Solangaarachchi, 2012 (Mavhura, Manyena, and Collins, 2017), it is not entirely possible to eliminate or control hazard but people can lessen the risk associated with hazard occurrence through a shift from hazard to vulnerability paradigm in order to accomplish disaster risk reduction. Vulnerable people, disproportionately affected, should have the priority in disaster management phases (Garlick 2015, Ogie and Pradhan 2020, Paton and Johnston, 2001). Vulnerability assessment is required to identify the vulnerable people in a community. However, vulnerability assessment in the earlier studies typically focused on the biophysical and physical aspects of vulnerability that overlooked the social dimension of vulnerability (Flanaganet et al., 2011). Social vulnerability is a popular term to measure the community’s sensitivity to hazards with their coping capacity (Cutter and

Finch, 2008). The social vulnerability assessment is acknowledged as an effective and essential guiding tool to reduce risk and to promote disaster resilience (Siagian et al., 2014). It focuses on the issues of access to resources, socio-economic condition, how people act during a crisis, and the community's existing strength to minimize the disaster losses. Traditional social vulnerability assessment methods have limitations to consider only the weakness (old age, low income, children, disable people etc.) of the community (Ogie and Pradhan, 2020). Instead of considering only the weakness of the community people, the SSVI (Ogie and Pradhan, 2019) approach also acknowledges the strength and resources of the selected community. Significant differences were found when comparing traditional social vulnerability assessment method with the new SSVI method (Ogie and Pradhan, 2020). The purpose of this study is to employ SSVI method to determine and compare the social vulnerability between two Ward communities of Pallabi thana, Mirpur in Dhaka district.

1.2 Research Objectives

This study has an aim to understand the applicability of the SSVI method in Bangladesh perspective.

To achieve this aim, the specific objectives of the study are following -

i. To assess the perception of local people on the idea of community and social support;
ii. To apply SSVI to compare the social vulnerability of different areas in Bangladesh perspective.

1.3 Rationale of the Study

In 2013, a nine-storeyed building named Rana Plaza collapsed and killed about 1,115 people and injured many more (Biswas et al., 2015). This tragic disaster has been considered as the deadliest accidental structural failure in human history (Biswas et al., 2015). Evidence from the Rana Plaza tragedy shows, numerous community members and different sectors of the society helped to save thousands of lives and manage the situation well, otherwise, the death toll could have risen much more. Therefore, everybody is exposed to hazards, whether they are natural and/or man-made and has various degrees of vulnerability. People's ways of managing those crises and helping each other during the emergency situation assist to minimize the disaster loss. Failing to identify the unique strength and supports that exist within the different community increases the impact of the disaster on the people. Strength-based social vulnerability index is the combination of susceptibility, capacities and strength of a community. In this study, SSVI method (Ogie and Pradhan, 2019) is applied to determine social vulnerability at the community level in Bangladesh perspective. Besides, the outcomes of the vulnerability assessment can also influence critical decisions about where the limited resources should be allocated to support the communities in the mitigation, preparedness, response and recovery phase of disaster management (Ogie and Pradhan, 2019).

2. Literature Review

According to Emrich and Cutter (2011), the concept of vulnerability was first introduced in

1970 in hazard and disaster management literature. Vulnerability analysis tends to answer 'how do natural hazards affect the society?', yet it can be explored in detail 'what are the critical processes and outcomes of hazard risks and disasters in society?' (Collins et al., 2015). The concept of social vulnerability is dynamic and multi-dimensional because of the complex nature of the social system. Social vulnerability considers different aspects and features and explains why different social groups suffer from different extent of loss and impact. Besides, social vulnerability plays a crucial role from disaster response and recovery phase to whole disaster management cycle (Solangaarachchi et al. 2012 cited in Siagian, 2014). On the basis of existing literature review, the majority of it, has examined the role of vulnerability but the analysis of social vulnerability is comparatively low (Mavhura, Manyena and Collins, 2017). The researchers have investigated the major factors that influence social vulnerability; mostly have referred to: limited access to resources, power and representation, connectedness with supporting people, beliefs and customs, housing condition, density of infrastructure including energy supply and finally transportation routes (Siagian et al., 2014; Bergstrand et al., 2015; Mavhura, Manyena and Collins, 2017).

Several methodologies have been used by researchers for assessing the vulnerability - to natural hazards, of physical assets, life-line infrastructures and so on. The agent-based model is used for revealing the impacts of natural hazards on people, assets and economy. The input-output model is used to analyze the vulnerability across the several sectors of the economy when the interdependent network infrastructure is affected by disaster (Ogie and Pradhan, 2019).

Social vulnerability index is often used for assessing and comparing the vulnerabilities of different places. Mayhura et al. (2017) used principal component analysis (PCA) methods to develop a social vulnerability index (SoVI) for assessing the spatial variation of social vulnerability to flood hazards in the Muzarabani community of Zimbabwe.

Majority of the previous researches on social vulnerability assessment have emphasized on the weakness of the community structure such as age, income and their needs, therefore undermining the existing resources and the strength of the community and overlooking the resourcefulness of the people within the community ((Ogie and Pradhan, 2019). Besides, many regions in the hazard prone area are still struggling to profile social vulnerability to hazards at local level where poorer people live, as the profiling factor of vulnerability is influenced by the variation of hazards in different geographical and socio-political settings. Moreover, vulnerability studies are often conducted at national levels which overlook the context specific vulnerability at the local level (Mavhura, Manyena and Collins, 2017).

3. Theoretical Framework

Although a community may have different levels of vulnerabilities, it also has many underlying existing resources and strength that can help to cope with the aftermath of a disaster and to restore the community. In the modern human societies, 'the sense of community' (Ahmed, 2011),'spontaneous sense of communitas' (Jencson, 2001), the sense of 'we-ness' (Clarke, 2002), 'social utopias' (Bernardini and Hart, 2011) arise in human societies during the time of disaster and emergency; that allows not only the individuals to

be grouped together to confront the threat but also to help vulnerable community members (Ogie and Pradhan, 2019). This powerful sense of humanity and kindness during adversity allows people to interact and stimulate to appropriately carry out their responsibilities by providing social support, donation and strengthening their capacities to reduce the adverse impact of the disaster.

Social norms, values, beliefs, trusts, sense of apathy, relationship, obligation, information flows, participation in donation, volunteering, social work, etc. are some social capital indicators that often help to understand the willingness of people to cooperate each other. Social capital is defined as the quality of social interaction among the people who live in a particular society. The quality of interaction among the people can vary according the social, political, cultural and economic diversity of an area (Mpanje, Gibbons, et al., 2018).

Individuals' decision making process is often influenced by their behaviors under the risk. Risk perception influences people's behaviors and help to predict how people perceive and respond to the risk. It can be explained as an individual's assessment or evaluation of risk and the ability of the people's decision making under risk is often influenced by their understanding about the risk and how they feel about it. Literatures found that individual's values, beliefs, attitude, knowledge and attachment with environment and community are some important factors that influence people's behaviors. Some of the existing literature showed that households with stronger community ties were more prepared for a disaster and more embedded in the community (Xu, Peng, Liu et al., 2018).

In SSVI, the rest of the population (RoP) is considered as the strength of a community as this group consists of a smaller number of children, elderly and people with special needs. This RoP group can contribute their time, efforts, resources and moral support to reduce the loss and to restore the infrastructure and services. Impact of the impending disaster can be modified if the affected community has a high representation of the rest of the population (Ogie and Pradhan, 2019). The proposed method (Ogie and Pradhan, 2019) considered specific aspects of the strength-based social vulnerability for any given place and they are represented by the following equations-

(i) RoP = Tp – (Cp + Dp+ Ep – CDp – EDp)

(ii) Children-specific SSVI = (Cp / RoP) * (Cp / Ctp) * 1/Pc

(iii) Disability-specific SSVI = (Dp / RoP) * (Dp / Dtp) * 1/Pde

(iv) Elderly-specific SSVI = (Ep / RoP) * (Ep / Etp) * 1/Pde

(v) CALD-specific SSVI = (CALDp / Mp) * (CALDp / CALDtp)

(vi) Income-specific SSVI = (LIp / HIp) * (LIp / LItp) * 1/Ps

Here, Tp is total population, Cp is children population (0–4 years), Dp is population of individuals living with a or multiple forms of disability or needing assistance for daily living, Ep is elderly population (age => 65 years), CDp is children population (0–4 years) who are living with a or multiple forms of disability, EDp is elderly population (age => 65 years) who are also living with a or multiple forms of disability, Ctp is total children population in all places under comparative assessment, Pc is propensity to provide unpaid

care to another person's child, Dtp is the total population of individuals living with a disability or needing assistance for daily living in all places under comparative assessment, Pde is propensity to provide unpaid care to a person because of a disability or problems related to old age, Etp is the total elderly population in all places under comparative assessment, LIp is low-income population, HIp is high-income population, and, LItp is total low-income population in all places under comparative assessment. The culturally and linguistically diverse (CALD) population refers to the population in any given area who has very little competence or cannot speak dominant language. CALDp is the CALD population in a given place who cannot speak the dominant language, CALDtp is the total CALD population in all the places under comparative assessment and Mp is the multilingual population in the place who can speak the dominant language very well. Here dominant language indicates that the people have confidence in their language to communicate with the local disaster management facilities.

4. Research Methodology

4.1 Study Area

To understand the applicability a field survey was conducted in Ward-02 and Ward-05 (Figure 1) in Pallabi thana under Dhaka North City Corporation. This area has frequent water logging problems and it has a high risk of several urban hazards, i.e. fire, dengue etc. According to the Bangladesh Bureau of Statistics (2011), the area of Ward-02 is 3.55 square kilometer and the total number of male and female population is 67,972 and 59,879 respectively. The area of Ward-05 is 2.19 square kilometer and the total number of male and female population is correspondingly 46,507 and 40,608. The areas under Ward-02 are Bagun- bari-tek, Chakuli, Kalshi, Section -12 (Block – A, Block – B, Block – C, Block -D, Block – Ta Dakshin, DOHS, Block – E, Block – Ta uttar and Block – Pa). Ward-05 covers Section – 11 (Block – A, Block – B: part-1 and part-2, Block – D, Block – E, Block – F), Bauniabad Basti and Palashnagar.

Figure 1: Map of the study area.

4.2. Research Design

The study adopted SSVI method for assessing the social vulnerability. For this, a field survey was conducted. Primary data was collected through in-depth interview (IDI), semi-structured questionnaire survey, and participation observation. On the other hand, secondary data was also collected from existing census report, relevant articles and newspaper reports.

4.3. Data Collection and Variable Selection

For the SSVI calculation, the variables were selected according to the theoretical concepts of SSVI and the selected variables were – households' size, monthly income, children population (0-4years), elderly population (=> 65 years), population with special needs, access to emergency contact numbers, provide unpaid care work for other's children, elderly population, and the volunteers. Convenience sampling methods were used for selecting the sample households from the study area – Ward-02 and Ward-05. The sampling method was generated based on the condition that each street should be represented in the dataset at least once and only one household was selected from multiple-occupancy houses. Thus sampled households are representative for all areas; hence, the survey can cover all the areas under the study area. The total number of sampled households was eighty (80), and from each of the Ward forty (40) households were selected for demographic and socio-economic information.

4.4 Data Analysis

For this study, minimum-maximum standardization method Eq.vii was used for rescaling the computed value between zero and one. Here, zero (0) represents the smallest value of the dataset and one (1) represents the highest value of the dataset; the other values are scaled between these ranges. The minimum-maximum transformation is illustrated by the following equation -

(vii) $Vi = (Xi - Xmin) / (Xmax - Xmin)$

SSVI methods have been applied to compute social vulnerability index in the study area. Once the index has been constructed and standardized properly, the result is visualized using the ArcGIS 10.3 (ArcGIS Desktop, 2020). In the ArcGIS, computed SSVI values are classified using the equal interval classification algorithm, where, 0.00-0.20 = Very Low (VL) Vulnerability, 0.21-0.40 = Low (L) Vulnerability, 0.41-0.60 = Median (M) vulnerability, 0.61-0.80 = High (H) Vulnerability and 0.81-1.00 = Very High (VH) Vulnerability.

4.5 Method Development for SSVI

Rest of Population (RoP) was computed for both Ward-02 and Ward-05 separately from their own dataset using Eq. i. Based on the data children-specific SSVI, disability-specific SSVI and elderly specific SSVI, CALD-specific SSVI, income-specific SSVI were computed for both Ward-2 and 5using the Eq. ii, iii, iv, v and vi respectively. For CALD-specific SSVI, Ogie and Pradhan (2019) considered people who cannot speak in the dominant language (English), but in the study area, there was no respondent found, who could not speak the dominant language Bangla. So, the respondents who do not know

emergency contact number such as 999, mobile number of fire service station etc. are considered for CALD-specific SSVI (Eq.-v). CALDtp is the total population in all the places under comparative assessment, CALDp = population who do not know emergency contact number, Mp = population who know emergency contact number.

For calculating the income specific SSVI Eq. vi is used. The methodology used by OECD, 2019 (Organization for Economic Cooperation and Development) for computing the income diagrams, is adopted in this study for determining the lower income class and higher income class from the respondents. The actual distribution of the monthly income of each respondent is divided into two classes: low-income class and high-income class. The low-income range covers all the respondents with a net income below 50% of the median income of the total sampled population; while the high-income range covers income above 150% of the median income of the total respondents (OECD, 2019). Based on the data, a household's monthly income within or lower than BDT 14,000 is considered as lower income class, and greater than BDT 40,000 is considered as high-income class.

5. Discussion and Findings

5.1. Respondent's Profile

In each of households, a person who was the head of the house or the spouse aged within 20-58 years was identified as the respondent. In the SSVI methods, people within this age group were considered compared to the rest of the community population because they were more capable to withstand, respond to and recover from the impact of disasters. They were able to provide social support to others in the community. Monthly income for the respondent's household was ranged between BDT 10,000-200,000. All of the respondents were identified by marriage and belonged to different socio-economic status in the community. Table 1 presents the background information of the respondents and Table 2 contains the summary of the SSVI variables.

Table 1: Socio-demographic characteristics and socio-economic status of respondents.

Characteristics	Description	Percentage of respondents
Sex	Male	56%
	Female	44%
Residual duration of the respondents	>10 years	18%
	11-20 years	45%
	21-30 years	35%
Approximate monthly income	< 14,000	26%
	>40,000	37%

Table 2: Summary of the SSVI variables.

Variable of SSVI		Ward no-2	Ward no-5
Voluntary work	Participated in voluntary work	28%	15%
	Did not participate in voluntary work	72%	85%
Access to emergency contact number	Aware of emergency contact	60%	35%
	Unaware of emergency contact	40%	65%
Economic status	High income class	43%	33%
	Low income class	30%	23%
Children population	Households with children (0-4years)	40%	55%
	Households without children	60%	45%
Elderly population	Households with elderly person	20%	15%
	Households without elderly person	80%	85%
Education status	Illiterate	-	5%
	Primary school	-	18%
	High school	20%	34%
	College degree	24%	32%
	Graduation	23%	8%
	Post-graduation	33%	3%

5.2 Income-specific SSVI

Figure 2 presents the spatial distribution of the income specific SSVI for Ward-02 and Ward-05 in Pallabi thana. The result shows that Ward-05 was observed more vulnerable compared to the Ward-02 in case of financial capacity to prepare for, withstand or recover from the impacts of hazards. It can be explained by several underlying factors. Ward-02 had more representation of higher-income people who donate their money after the disaster to hasten the recovery of the affected community. The respondents, who experienced the losses from slum fire in 2018, are more interested in participating in social activities and fire drill. These high income-class people have better access to emergency information, emergency contact and they can interpret the disaster information and warning signals more appropriately during the emergency.

When the people of the developed residential areas enjoy all the facilities and services of city areas, a major portion of people who live in slums or in Bihari camps are often deprived of these facilities and service. Table 2 shows the concentration of the high-income community members' propensity to participate in social work is higher in Ward-02 compared to the Ward-05. The respondents who participated in social activity had better connections with their neighbors and they were more interested to donate resources (money) during disaster, emergency or crisis situation.

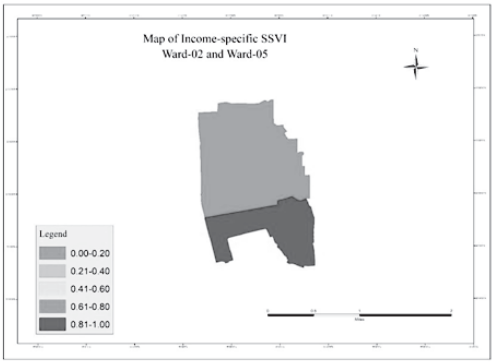

Figure 2: Map of the spatial distribution of income-specific SSVI in the Ward-02 and Ward-05 of Pallabi thana, Dhaka.

5.3 Children-specific SSVI

In terms of children-specific SSVI (Figure 3), Ward-05 was identified as a higher level of vulnerability and Ward-02 as a lower level of vulnerability; for this computation, the propensity to response provides unpaid care was not considered. This is because Ward-05 has more children from 0-4 years (Table 2) and there were no respondent who can potentially provide unpaid care to their neighbor's children. Map of children-specific SSVI (Figure 4) considers the perception of the people to look after their neighbor's children and it shows that the children-specific vulnerabilityfor Ward-05 ranked as a moderate level of vulnerability in the range of 0.41-0.60. It is because the rest of the population in the community who can potentially provide support to other people's children during the emergency situation has been taken into consideration. This social support and willingness to help each other during the disaster reduces the children-specific vulnerability in Ward-05.

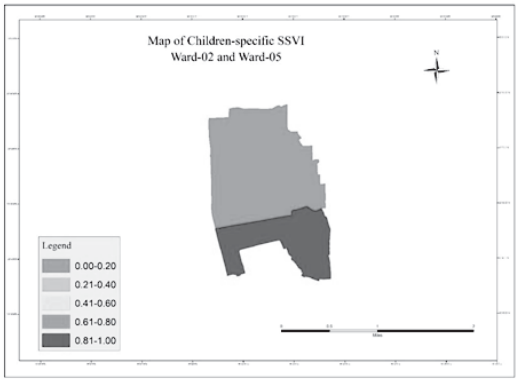

Figure 3: Map of Spatial distribution of children-specific SSVI in the Ward-02 and Ward-05 of Pallabi thana, Dhaka.

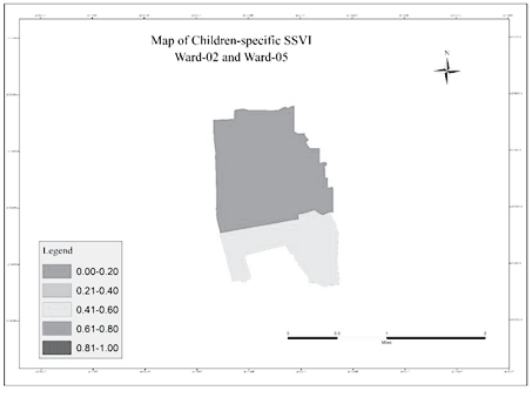

Figure 4: Spatial distribution of children-specific SSVI based on the perception of respondents to provide unpaid care.

5.4 Disability-specific SSVI

The number of households having one or multiple persons with special needs (disable) was very low relative to the rest of the population in both of the study areas. In terms of disability- specific SSVI, Ward-02 was observed as the moderate level of the vulnerable category, whereas Ward-05 was observed as a very low vulnerable category (Figure 5). As the number of respondents who provide long-term unpaid care work to other persons living with disability and needs assistance for daily living apart from their family members and relatives, Ward-02 shows vulnerable to the disability-specific SSVI. Majority of respondents showed interest in helping the disable person in their neighborhood during any emergency. They mentioned that for the sake of humanity, they should help individuals living with disability.

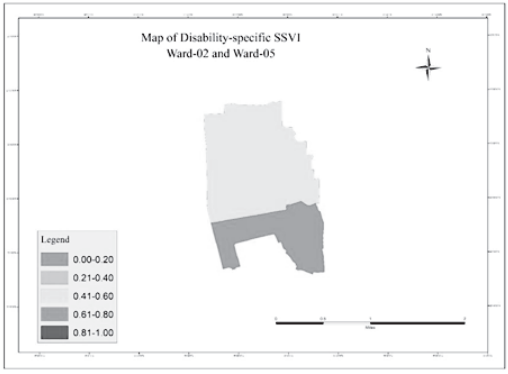

Figure 5: Spatial distribution of disability-specific SSVI based on the perception of respondents to provide unpaid care.

5.5 Elderly-specific SSVI

Majority of sampled households were identified as the nuclear family, only a few of them had elderly parents living with them. Table 2 represents that the respondents' households in Ward-02 (20%) had more elderly population compared to the respondents in Ward-05 (15%). Majority of households with elderly people have been found to be of medium to high-income class because almost all of the lower income-class respondents claimed that the living expense is very high in Dhaka city and they cannot afford to jointly live with their parents or other relatives. The map in Figure 6 illustrates the elderly specific vulnerability and Ward-02 is ranked as the median level of vulnerability after considering those respondents who showed interest in providing support to an elder person during the time of emergency. After ensuring their personal safety, the majority of the respondents showed their willingness to help the old aged individuals during the disaster. This supportive behavior reduces the community's social vulnerability due to the presence of an elderly person.

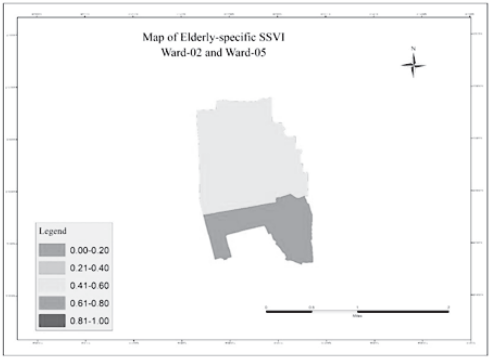

Figure 6: Spatial distribution of elderly-specific SSVI based on the perception of respondents to provide unpaid care.

5.6 CALD-specific SSVI

The equal development of industrial and residential establishments in the same place makes local people exposed to different urban hazards, especially fire. CALD-specific population refer to the respondents who do not know the national emergency contact number such as *999* or phone number of the adjacent fire service station. Majority of respondents were observed to get information about disasters or emergencies from social media. In terms of CALD-specific SSVI (Figure-7), Ward-05 is categorized as a higher level of vulnerability, whereas, Ward-02 as a lower level of vulnerability due to the community people's awareness about the disaster and their access to the information and knowledge such as where to contact during the crisis or emergency situation. One of the underlying reasons behind this situation could be the education status of the respondents, because, there are affirmations that the community with higher representation of low educational background has little access to the emergency information and often they ignore the critical emergency warning signals and they are also unaware of the concept of risk, vulnerability, exposure, environmental degradation and so on. All of these factors make them more vulnerable to different types of hazards and limit their ability to cope with, withstand or recover from the disaster loss effectively. Table-02 shows that the respondents from Ward-02 had better educational status compared to the response of the Ward-05, and it also presents that 60% of the respondents from Ward-02 know emergency contact number and where to inform during the crisis or emergency, but, in Ward-05 only 35% of the respondents know the emergency contact number.

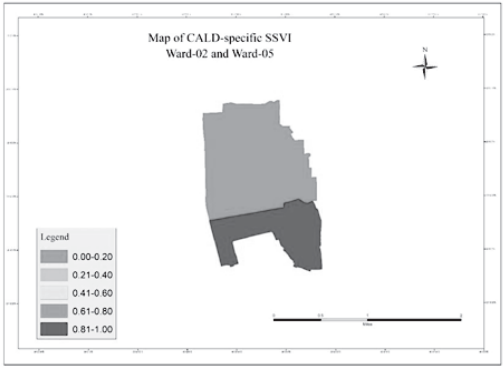

Figure 7: Spatial distribution of CALD-specific SSVI in Ward-02 and Ward-05 of Pallabi thana, Dhaka.

6. Conclusion

This study demonstrated an improvised and balanced SSVI approach for determining and comparing the social vulnerabilities of different places or communities. This assessment captures not only the susceptibility of a community but also their capacities and strength to mitigate and adapt to disaster. The results confirm the applicability of this method. The residents in Ward-02 and Ward-05 have different needs and capabilities; hence their ability to cope and recover from the impacts is different. Ward-02 has a moderate level of vulnerability due to elderly-specific SSVI and disability-specific SSVI. Ward-05 has a

moderate level of vulnerability due to children-specific SSVI and very high level of vulnerability due to income-specific SSVI and CALD-specific SSVI. The well-off community members can help them to reduce their social vulnerability by offering those different forms of assistance. The results of the SSVI show that if the vulnerable community receives support from the rest of the population (RoP) groups who have the capacity to do so, the social vulnerability can be reduced. The result of the study also shows the majority of respondents do not have clear ideas about their roles and responsibility during any emergency situations. As SSVI assessment acknowledged the role of community strength in reducing the social vulnerability of any given location, the policy makers and emergency planner can incorporate this method in vulnerability assessment. The policy makers need to consider not only the weakness features of the community, they also need to address the strength part of the community. This information can be applied in case of disaster risk reduction strategies and policies.This index could also help them to identify and better understand how the social vulnerability is unevenly and inversely distributed among the communities; as a community may have the most vulnerability for the disability-specific and elderly-specific vulnerability, whereas the other community may have the lowest vulnerability for these aspects. Therefore, when the communities are identified and ranked in the highest to the lowest category of vulnerability, according to the specific aspects of SSVI, it will play a vital role in determining the main direction of response during any emergency, disaster or crisis by the professional responders or volunteers. It will also ensure proper allocation of resources for disaster preparedness, response and recovery to reduce economic losses and threats to the population.

7. Limitation and Strength of the study

This study was conducted only on Bangladeshi urban environment to assess the applicability of SSVI method which may not be similar to other countries or in the context of rural areas. Due to the time limitation and small participants of this study, small sample size has been considered. Even with the small sample size, this study considers noble method through primary data collection as done in the context of different other disaster-affected countries.

References

ArcGIS, 2020. *What's new in ArcGIS for Desktop—Help | ArcGIS Desktop.* [online] Available at: <https://desktop.arcgis.com/en/arcmap/10.3/main/get-started/whats-new-in-arcgis.htm> [Accessed 25 Apr. 2020].

Aksha, S. K., Juran, L., Resler, L. M. and Zhang, Y., 2019. An Analysis of Social Vulnerability to Natural Hazards in Nepal Using a Modified Social Vulnerability Index. *International Journal of Disaster Risk Science,* 10(1), pp.103-116.

Bergstrand, K., Mayer, B., Brumback, B. and Zhang, Y., 2015. Assessing the relationship between social vulnerability and community resilience to hazards. *Social Indicators Research,* 122(2), pp.391-409.

Biswas, A., Rahman, A., Mashreky, S. R., Humaira, T. and Dalal, K., 2015. Rescue and emergency management of a man-made disaster: Lesson learnt from a collapse

factory building, Bangladesh. *The Scientific World Journal*.

Chau, P. H., Gusmano, M. K., Cheng, J. O., Cheung, S. H. and Woo, J., 2014. Social vulnerability index for the older people - Hong Kong and New York city as examples. *Journal of Urban Health.* 91(6), pp.1048- 64. [DOI:10.1007/s11524-014-9901-8] [PMID] [PMCID]

Collins, A. E., Jones, S., Manyena, B., Jayawickrama, J., 2015. Hazards, Risks and Disasters in Society. *Elsevier, Amsterdam.*

CRED, 2018. Emergency event Database. EM-DAT | *The international disasters database.* [online] Available at: https://www.emdat.be.

Cutter, S. L., and C. Finch. 2008. Temporal and spatial changes in social vulnerability to natural hazards. *Proceedings of the National Academy of Sciences.* 105(7): 2301–2306.

Daddoust, L., Khankeh, H., Ebadi, A., Sahaf, R., Nakhaei, M. and Asgary, A., 2018. The social vulnerability of older people to natural disasters: an integrative review. *Health in Emergencies and Disasters,* 4(1), pp.5-14.

Dutta, B., 2018. *Fire risk in slum areas.* The Independent. [online] Available at: http://www.theindependentbd.com/printversion/details/141175

Emrich, C.T. and Cutter, S. L., 2011. Social vulnerability to climate-sensitive hazards in the southern United States. *Weather, Climate, and Society,* 3(3), pp.193-208.

Flanagan, B. E., Gregory, E. W., Hallisey, E. J., Heitgerd, J. L. and Lewis, B., 2011. A social vulnerability index for disaster management. *Journal of homeland security and emergency management,* 8(1).

Garlick, D., 2015. The vulnerable people in emergencies policy: Hiding vulnerable people in plain sight. *Australian Journal of Emergency Management,* vol. 30, (1), pp.31–34.

Khalequzzaman, M. 2019. Dhaka's toxic air: A major public health concern. [online]. Available at https://www.thedailystar.net/opinion/environment/news/dhakas-toxic-air-major-public-health-concern-1713184 [Accessed 7 Dec. 2019].

Mavhura, E., Manyena, B. and Collins, A. E., 2017. An approach for measuring social vulnerability in context: The case of flood hazards in Muzarabani district, Zimbabwe. *Geoforum,* 86, pp.103-117.

Mpanje, D., Gibbons, P. and McDermott, R., 2018. Social capital in vulnerable urban settings: an analytical framework. *Journal of International Humanitarian Action,* 3(1), p.4.

OECD (Organization for Economic Cooperation and Development), 2019. Compare your income—Methodology and conceptual issues. https://www.oecd.org/statistics/Compare-your-incomemethodology. pdf. [Accessed 9 Dec. 2019].

Ogie, R. and Pradhan, B., 2020. Social vulnerability to natural hazards in Wollongong: Comparing strength-based and traditional methods. *Australian Journal of Emergency Management, The,* 35(1), p.60.

Ogie, R. I. and Pradhan, B., 2019. Natural Hazards and Social Vulnerability of Place: The Strength-Based Approach Applied to Wollongong, Australia. *International Journal of Disaster Risk Science,* pp.1-17.

Parvin, A. and Johnson, C., 2015. Disaster vulnerability in the policy context of Bangladesh: a critical review. *Handbook of Climate Change Adaptation,* pp.877-899.

Paton, D. and Johnston, D., 2001. Disasters and communities: vulnerability, resilience and preparedness, Disaster Prevention and Management: An International Journal, vol. 10 (4), pp.270–277.

Siagian, T. H., Purhadi, P., Suhartono, S. and Ritonga, H., 2014. Social vulnerability to natural hazards in Indonesia: driving factors and policy implications. *Natural hazards,* 70(2), pp.1603-1617.

Statistics, B. B. O., 2011. Statistical yearbook of Bangladesh. *Statistics Division, Ministry of Planning, Dhaka, Government of the People's Republic of Bangladesh.*

Toeroek, I., 2017. Assessment of social vulnerability to natural hazards in Romania. *Carpathian Journal of Earth and Environmental Sciences,* 12(2), pp.549-562.

Xu, D., Peng, L., Liu, S., and Wang, X., 2018. Influences of risk perpection and sense of place on landslide disaster preparedness in southwestern China. *International Journal of Disaster Risk Science,* 9(2), pp.167-180