Evaluation of the Impact of Community-Based Disaster Risk Management Applied in Landslide Prone Area; A Case Study in Badulla District

SBD Samarasinghe[1] Malani Herath[2]

Abstract

Participatory planning is a very important process for decision-making and choosing the best alternative options for community welfare, the development of society, and its interactions among the community and professionals. People's involvement is considered the key guidance in participatory planning. Presently, Participatory planning is being used in many fields. It is not only limited to planning but also to disaster management, poverty, housing, etc. In the past, Disaster management practice was a top-down approach, but it raised many issues as it was converted to a bottom-up approach. There are several approaches to disaster management. Community-Based Disaster Risk Management (CBDRM) is a very successful participatory approach to risk management which is often successfully applied by other disaster-prone countries. It is a new concept for Sri Lanka, and the community faces difficulties' The CBDRM has applied to mitigate disasters such as landslides, tsunami, and floods as a preparedness mechanism. In 2015, Sri Lanka initiated the CBDRM approach to minimize landslide vulnerability. Hence, this study

[1]*Manager, Higher Education Institute Society Linkages Cell, SANASA Campus, Sri Lanka;* *bhagyadil007@gmail.com*

[2] *Lecturer, Department of Town and Country Planning, Faculty of Architecture, University of Moratuwa, Sri Lanka;* *malaniherath@yahoo.com*

mainly focuses on the impact of CBDRM approaches on landslide hazards. Also, to identify flourishing Community Based Disaster Risk Management practices in the world, to examine and analyze the approaches used in prevailing CBDRM programmes in the local context and to identify the factors of failures/success of CBDRM programmes in Sri Lanka concerning successful CBDRM planning approaches. Their successes and failures from both implementing parties and the community. This research is based on a qualitative method combined with a descriptive research approach.

A successful framework was prepared via a literature review. Case studies were selected considering the landslide CBDRM programs implemented by the Disaster Management Center and National Building Research Organization in Badulla. Their processes were evaluated. Data collection is done through interviews and informal discussions. Then their ideas were undefined by the Relative Effectiveness index. As a result, the overall effectiveness of the community's perception of CBDRM is 0.40, and the officers' perception of CBDRM is 0.59. According to the officers, it means low effectiveness related to the community and effectiveness. The resulting numerical value was used to rank the program's effectiveness and its success, failures, and impacting factors. Results show several reasons for failures among implementing parties and the community.

Keywords: Community-Based Disaster Risk Management, Disaster Management, Landslides

Introduction

Participatory planning has been a successful approach in the world practised by the United States, France, and Europe. According to Sharma, participatory planning is formulating a development plan and choosing the best alternative options for community welfare and the development of society with adjoining activities among the community and professionals. (Sharma, 2014)

As mentioned, participatory planning has been practised worldwide as Disaster Risk Management. Community-based disaster risk management is one of the important pillars in the participatory planning approach in Disaster Risk Management, which has been practised by the Philippines, Indonesia, Japan, Nepal, etc. (Center, 2008), (Development) "successful CBDRM can reduce social and economic costs in middle-income countries and developing

countries." (Anthony Zwi, Kim Spurway, Geetha Banmuthugala, Lisa Thompson, 2013)

As a developing country, Sri Lanka should be focused on Disaster Risk Management due to the increment of loss and damages due to disasters. Damage caused reduced social and economic costs in Sri Lanka. Present records show a sudden increase in occurrences

 of Natural Disasters from 2013 to 2018. Disaster Information Center Statistics (1974-2018) shows that from 2013 to 2015, around 89 people died, nearly 1,219,639 people were affected, and 18442 houses were partially damaged due to disasters. Considering the 2016 to 2018 duration, 220 people died, 1,270,475 people were affected, and 22277 houses were partially damaged. Comparatively, losses and damages have increased in this demarcated period. As stated by different scholars, developing and undeveloped countries are more vulnerable to disasters due to not having enough resilient capacity. So governments are trying to subdue disasters by improving the resilient capacity of both the government and the community.

In Sri Lanka, the Disaster Management Act, No. 13 of 2005, provides the legal framework for Disaster Risk Management by the government. The Disaster Management cycle is a circular process that leads to effective Disaster Risk Management by connecting a series of interlinked activities of mitigation, preparedness, response, and recovery. Mitigation and preparedness phases occur before a disaster, and recovery and response phases after a disaster. Preparing long-term and short-term strategies, Public Education, Hazard mapping, and building early warning systems in pre-disaster is considered an essential phase to the success of the disaster management strategy. (PHI Manual Chapter 5 Disaster Management)

Sri Lanka is a developing country which experiences severe natural calamities throughout the year. A significant amount of funds is allocated annually for disaster response and recovery. The government has allocated nearly Rs: 35 billion from 2006 to 2013 for Disaster Mitigation (Development, 2016),

Over the past few decades, the impacts of natural disasters have increased substantially. The country is more susceptible to floods, landslides, cyclones, drought, and coastal erosion due to increased environmental pollution and improper land use. Moreover, as the Report (Fund, 2019) states, developing

and undeveloped countries are more vulnerable to disasters due to the lack of resilient capacity. Hence, governments are trying to decrease the impact of hazards and disasters by improving the resilient capacity of the government and the community.

"Disaster Management "reduces disasters' impact in most countries. Programs such as hazard mapping, disaster risk reduction, early warning systems, and public awareness are some of the major disaster management techniques practised worldwide. (Reduction, 2004)

Community-Based Disaster Risk Management (CBDRM) is a process of disaster risk management in which at-risk communities actively engage in identifying, analyzing, treating, monitoring, and evaluating disaster risks. Their primary focus is reducing vulnerabilities and enhancing their capacities. A successful CBDRM can reduce social and economic costs in middle-income and developing countries. (Anthony Zwl, Kim Spurway, Geetha Ranmuthugala, Lisa Thompson, 2013) It is one of the important efforts in disaster risk management, which is being practised in countries such as the Philippines, Indonesia, Japan, Nepal etc. (Pérard, 2008)

As a country, Sri Lanka is also applying the CBDRM approach in managing disasters on the island. Disaster Management Center, the Sri Lanka Red Cross Society, and National Building Research Organization are the critical actors in implementing CBDRM in the government. Although the above institutions have used the CMDRM to reduce the disaster impacts, present records show a sudden increase in natural disasters from 1974 to 2016, especially Landslides. According to National Disaster Relief Centre, during 2014-2017, more than 160,000 people were affected by the Landslides, but during 1974 – 2014 only 46,719 were affected. The recent landslides occurred in 2003,2007,2010,2011,2012,2014,2015, and 2016. The government had to spend LKR 257.4 billion for the recovery process from 2016 to 2017. (Bandara, Jayasingha, 2018).

However, some other countries in the world have applied this approach successfully. They have received positive responses and benefits from these mitigation initiatives. (Institute, 2020) As mentioned, Sri Lanka is also a country that initiated CBDRM as disaster risk management. It is one of the finest approaches to delivering early warning up to the last mile. However,

current statistics do not show any reduction in losses or damages even with implementing the CBDRM programme in disaster management. Thus, whether the locally implemented CBDRM programmes accomplish the expected outcomes is questionable. Therefore, this research evaluates the CBDRM programmes implemented locally and identifies impacts on Disaster Management in Sri Lanka. The main objectives of this research were to identify thriving Community Based Disaster Risk Management practices in the world, to examine and analyze the approaches used in prevailing CBDRM programmes in the local context and to identify the factors of failures/success of Landslide CBDRM programmes in Sri Lanka concerning successful CBDRM planning approaches.

Literature Review

The participatory planning process is the enhancement of giving reasons for problems in the real world and providing appropriate solutions (Gallacher).according to Robert Chambers, "From 1950 through the 1960 and 1970, in the prevailing orthodoxies of development. It was to be solved by education and the transfer of Technology. Increasingly, that ideology has been questioned and undermined the balance has shifted; Development imposed from the top down was often not sustained—their participation is the key to sustainability and many solutions. The typology of participation can be mentioned according to a modified scholar by Pretty in 1994 1. Passive participation 2. Participation in The participatory planning process is the enhancement of giving reasons for problems in the real world and providing appropriate solutions (Gallacher).according to Robert Chambers "From 1950 through the 1960 and 1970, in the prevailing orthodoxies of development. It was to be solved by education and the transfer of Technology. Increasingly, that ideology has been questioned and undermined the balance has shifted; Development imposed from the top down was often not sustained. Their participation is the key to sustainability and many of the solutions. The typology of participation can be mentioned according to a modified scholar by Pretty in 1994 1. Passive participation 2. Participation in information: (no follow-up) 3. Participation by consultation 4. Participation in incentives 5. Functional participation 6. Interactive participation: 7. Self-mobilization. Successful Participatory planning should be comprised of good timing and clear need, strong stakeholder groups, Broad-Based involvement, credibility

and opens of process, commitment, support of established policies or authorities, overcoming mistrust and scepticism, strong leadership of the process, interim success, and a shift to broader concepts. (Building bridges through participatory planning-part 1, 2001)

Disaster Management Cycle represents all the aspects that have been explained above. It is an ongoing cycling process by which administration and community prepare plans, and it causes to reduce the impact of disasters. The following concluded its main components.

- Mitigation - Reducing effects from Disasters such as community education, Risk Analysis and Building Zoning.
- Preparedness - It is planning how to respond to pre-disaster, such as an Early warning system, Emergency training programme and preparedness plan.
- Response - It is a step to minimize hazards caused by a disaster, such as Search and rescue, evacuation place, etc.
- Recovery - Can say recovery means getting the community normal according to their livelihoods, such as temporary housing, sharing medicines and foods like community basic requirements (Himayatullah Khan ,Laura Giurca Vasilescu , Asmatullah Khan)

The community becomes first responders during and after a Disaster. (Ainuddin, 2012; Bornstein, 2013; Chandrasekhar, 2012; Crawford, 2013) Community empowerment is very important to the affected community because their power and involvement are very low (San Francisco) Philippines is a country that has applied the CBDRM program initiated by the government and NGOs. (International, 2007) Community participation is the key success of Disaster Risk Reduction, initiated before or after a disaster. (Murshed). There is a number of Participatory tools under CBDRM Programmes, such as participatory risk assessment, participatory identification, managing community by Risk Reduction Measures, and participatory monitoring and evaluation. (Glen Fernandez, 2012)

CBDRM consists of several steps, each to be followed by community involvement. CBDRM) is a process in which the community diligently participates in Disaster Identification, Disaster Analysis, and how to treat and monitor and finally give a kind of evaluation on disaster risk. So it is caused

to reduce community vulnerabilities and enhance their capacity. (HANDBOOK on CBDRM for Sindh Province, Pakistan, 2014) CBDRM is the most important process using participatory planning in Disaster Risk management as established by Sendai Framework for Disaster Risk Reduction 2015-2030.according to that, and their expected outcome was implementing Local Disaster Risk Reduction by 2020. This should be done through CBDRM and CBDRO. (Tanwattana, 2018)

Landslide CBDRM is conducted in high landslide-risk areas worldwide, such as Nepal, India, Sri Lanka, etc. Nepal has initiated the CBDRM approach to increase the resilience of livelihoods by preventing landslide disasters and establishing safer agricultural livelihood strategies. Some projects were carried out. Developing user-friendly agricultural hazard and vulnerability mapping and conducting detailed surveys etc. There were regular ongoing activities, such as landslide treatment and mitigation using a suitable bioengineering approach, supporting local agriculture-based livelihood activities, developing community-level watershed management plans, and early warning systems at the local level. Community-based Landslide risk management can be done by applying available knowledge, expertise, and resource customized to suit site-specific situations. (Parkash S., 2011)

Abarquez and Murshed stated that the CBDRM process "should lead to progressive improvement in public safety and community disaster resilience" The CBDRM process consists of seven or six stages. (Kafle and Murshed, 2006; UNDP, 2016) Those steps are Selecting the Vulnerability community, Rapport building and the understanding of the community with Capacity Building, Participatory Disaster Risk Assessment (PDRA), Community-based participatory disaster risk management planning, Building and training a DRMC, Community-managed implementation and Monitoring and Evaluation. to evaluate factors of success or failure of the CBDRM process, there need to be considered best practices of CBDRM programs in the world using Case of Urban Flood-Prone Community in Thailand Upstream area, Nan province, Community Based Disaster Risk Management in Vietnam and Community Based Disaster Risk Management Experience philippine.

Material and Methods

The main aim of the research was to analyze whether locally implemented CBDRM programs accomplish the expected outcomes by the program and the factors that caused the success or failure of the CBDRM process in landslide-prone areas. Also, to review the success of CBDRM practices in the world and interpret the factors that could lead to the success and failure of the program. Therefore, 03 case studies were studied on Urban Flood-Prone Communities in Thailand's Upstream area, Nan province, Community Based Disaster Risk Management in Vietnam and Community Based Disaster Risk Management Experience in the Philippines.

The research objectives were to identify successful Community Based Disaster Risk Management practices worldwide, examine and analyze the approaches used in prevailing CBDRM programs in the local context, and identify factors of failures /Successes of CBDRM Programmes in Sri Lanka concerning successful Planning approaches.

By considering Disaster Management Centre (DMC) and National Building Research Organization (NBRO) Programs, four case studies were selected in the Badulla area, namely Sirimalgoda, Balagala, Beragala and Mahawaththegama in Badulla, Uva Paranagama Haldomulla, and Haliela, Divisional Secretariat Divisions (DSD).

A random sampling method was selected from a probability method. The population size was decided based on a sampling calculator at a 90% confidence level with a 10% marginal error. The total population size was taken as the number of total participants in four programs. In order to do that, 100 persons were selected to evaluate based on the proportion of each program, and each sample size was calculated. All officers who participated in the CBDRM were interviewed for the research.

The primary data collection was conducted through interviews. The Likert scale questionnaire survey was facilitated for the study. The community and the officers are actively participating in the CBDRM process. Data was collected from both parties, and the survey data was gathered through informal discussions to gain in-depth insight into the research.

The Relative Importance Index (RII) was important in this study since the value of the index specifies the ranked degree of importance. It is beneficial for questionnaires that use a Likert scale. The RII formula was introduced into Microsoft Excel 2016 to determine the index for sets of objects. Here RII was used to calculate the satisfaction of the CBDRM Programmes conducted by NBRO and DMC. Responses from Government officers and participants of each program were collected and analyzed. Therefore, This RII was used as the Relative satisfaction Index in this study.

Variables of the Study; Factors of Effectiveness of the CBDRM (Center, 2006)

- Availability of Community-Based Organizations
- Availability of Community Fund
- Usage of Ground Walk map, disaster risk map, community vulnerable map, disaster risk warning sign
- Methods for Capacity Building
- Evacuation drill plan
- Early warning committee
- Community response plan

Results and Discussion

After analyzing all data could get each and every programme effectiveness level. The effectiveness value has got by using the Relative Important Index formula. Here it has named as "Relative Effectiveness Index". The primary purpose of this study is to evaluate the impact of CBDRM programmes and present their success or failure. Data was analyzed based on officers and community perceptions using the Likert scale and got the overall effectiveness level of each programme. According to people's point of view, they have an effective idea of CBDRM and officers have moderate effectiveness. When getting results, could identify comparatively opposing ideas of community and officers. That gap is marked as conflict level. It got from the substrate from officers (+) and community (-). So + value represents the level of enforcement of officers is higher than community perception (by officers) - Value says the effectiveness of enforcement actions of officers is higher than officers' perception (by the community). Mainly considered their absolute value of final results.

When considering Sirimalgoda and Balagala CBDRM Programme, which NBRO initiates, there is a low number of equal effectiveness levels and a high number of effectiveness levels at considerable conflict levels with officers and the community. However, Mahawaththegama and Beragla CBDRM programmes which DMC initiates, have become considerably effectiveness level.

Table 01: Relative Important Index

Effective Value	
0.0- 0.20	Very low effective
0.21 - 0.40	Low effective
0.41 - 0.60	Effective
0.61 - 0.80	Moderate effective
0.81 – 1	High Effective

0.1-0.20	Equal effectiveness idea
0.21-0.40	Considerable conflict-level idea
0.41<	High conflicted ideas

The relative important index was calculated for each CBDRM program in selected DSDs. The effective values according to the community and the officials are shown in Table 02.

Table 02: Effectiveness values of landslide-prone area CBDRM

CBDRM	**Overall Effectiveness**	
	Community	Officer
Sirimalgoda	0.29 (Low effective)	0.55 (Effective)
Mahawaththegama	0.47 (Effective)	0.65

		(Moderate effective)
Balagala	0.42 (Effective)	0.55 (Effective)
Beragala	0.46 (Effective)	0.61 (Moderate effective)

Overall Effectiveness from community perception = 0.41 (Effective)

Overall Effectiveness from officer's perception   = 0.59 (Effective)

Then their success and failure factors were considered using collected primary data.

Overall factors affected to the success of CBDRM programs were found as a good awareness of landslide hazards, early warning systems, mitigation practices and rain gauge reading, giving practical knowledge before a disaster and sufficient enforcement of officers,

Lack of Involvement from the community to continue the given tasks after CBDRM, technical errors in produced maps, lack of Supervision from officers after conducting the CBDRM programme, insufficient safe places and safe evacuation routes, participation errors and lack of community funding were identified as reasons the affect towards failures in CBDRM programs.

According to the present conflict level, says its success and failure. When effectiveness has a high value with a low conflict level, which is considered success outcome of the CBDRM, that means community involvement and officers' enforcement at a better level. At the same time, effectiveness is considerably low with a high conflict level, which is considered a failure outcome. That means both officers and the community have low commitment and enforcement.

Figure 03: Factors affected by success or failure

Main outcome	Measure of Indicator	Success or Failure	The factor for success or failure
Community Based organization	Structure of organization	Success	• Familiarization structure (Chairman, Secretary, Advisors, Zone leaders) • Easy to convey messages with less number of Committee
	Manage community resources	Failure	• No Active involvement in the community • Backward ideas of getting the community responsible for leaders (Issue of Leadership) • Lack of commitment
	Update Data Base by Zone leaders	Failure	
	Responsible for sharing medicine and food in emergency	Failure	
Community Fund	Fund generation from different sources	Failure	• Not initiated
	Account handled by CBO-trained officers	Failure	• Not initiated

Ground walk map, Disaster risk map, Community vulnerable map	Hazard map	Failure	• Less legibility to local community Prepared Hazard map shows streams, roads (without labelling), village boundary, buildings and hazard layers only. • Lack of familiarization with places on the produced map • Inconvenience to identify their experienced hazard areas. • No Social Map
	Household survey	Failure	• To be surveyed buildings did not match with real ground • Not conducted proper household survey by GN officers
	Mind mapping	Failure	• No clear understanding of the importance of mind mapping in the community • lack of commitment to drawing
	Oral History of Disaster	Success	• Low time consumes • Aware of every person's idea • The not present same incident • Actively participated • Conducted good discussions with themselves
	Seasonal Calendar	Success	• Showing their different events, experience, and disaster throughout the year • Easy to understand stress period of the year • Identify activities with disasters

Capacity Building	Rescue after hearing warning	Failure	• Lack of active involvement in getting readings by rain gauge and awareness by using a siren • No supervision of officers after conducting CBDRM • Ex: Sirimalgoda distributed Siren used as private requirements
	Agreed routes	failure	• Agreed routes going through hazard-prone areas
	Reaching the agreed evacuation place	failure	• It is a common evacuation place, but 100% has not confidently said its safety. • Ex: Sirimalgoda Temple is an agreed evacuation place in a sloppy area.
Community Drill	Assistance with neighbours	Success	• Each part of the villages participated in training at one place throughout the day. • Doing different teamwork • Ex: cooking, helping each other in an emergency, communicating with relevant officers
	Practice preparedness for disaster	Success	• Instructions to prepare "Disaster Bag." • How to rescue after hearing a warning and reaching to evacuate the place • More memorable steps to be followed
	Programme conducted	Success	• Drill programmes are conducted by DMC officers,

	by professionals		Scientists (Trained by ADPC) and geologists (NBRO)
	Training among a different social group	Failure	• Not all social groups consider women, elders, disabled, children and pregnant women.
Early warning committee	Committee activities	Failure	• Not initiated. Zone leaders do it.
Disaster response plan	Environmental friendly practices	Success	• Giving proper guidelines for best practices • Planting *Sawandara plants in* Soil erosion places • Trees border to prevent rocks from falling • Ex: Bathgala estate community • Maintenance of proper drainage network • The community actively engaged in environmentally friendly activities with community leaders to prevent disasters.
	Community stress levels decreased.	Success	• Harmony between each person • Aware and practised how to behave

Scholars Astrid Carrapatoso & Edith Kurzinger have mentioned top dawn nature, Issue of leadership and issue of participation are some of the failure factors of CBDRM. The above chart illustrates those issues also. Considering referred best practices in the world initiated an absolute bottom-up approach from beginning to end. Their Hazard map is produced by a community with

the support of expertise. First, they have combined community hazard experience knowledge with their technical knowledge. Studied Thailand case human three community have produced their map with university support. They have participated in all special groups of vulnerable communities in their programmes.at the same time there is less enforcement of government and community involvement, commitment very highlighted. For example, in Thailand, they bought rain gauges, medicines and food from their collected fund.no anything expects from others. They survive themselves. That means there were active participation and strong leadership. The heighlighted point of locally implemented CBDRM is less commitment of community participation to Disaster Risk Management than in Thailand, Vietnam and the Philippine countries.

Conclusion and Recommendation

According to studied DSDs, landslide CBDRM programs initiated by DMC and NBRO accomplish most of the expected outcomes of the programs. However, the level of effectiveness differs from the view of the community and the officials. Several failures among implementing parties and the community should be considered in the future. Overcoming those factors can make way for better conduction of future CBDRM programs and reduce the impact of hazards on the population of Sri Lanka.

Considering literature findings, evidence showed there were several CBDRM programs in the world for different purposes. Further referring to literature able to find successful CBDRM to disasters in developing and developed countries. As experienced, locally implemented landslide CBDRM which DMC and NBRO initiate, accomplishes the programs' expected outcomes.

The study aimed to analyze current practices of CBDRM and identify the factors of failure or success. So three objectives were formulated. The first objective was to identify successful CBDRM practices in the world. The literature review chapter was carried out by referring to journals, articles, books, and reports. Terms of participatory planning, Disaster Management, CBDRM concepts and tools, and Community-based landslide Risk Management got through referred knowledge. Finally, the best process and outcomes were extracted as a main result of the literature review.

The following objectives were carried out through an empirical study conducted under a literature review. An empirical study was conducted through four multiple cases evaluated based on one prepared framework. Data collection was conducted through semi-structural interviews and questionnaires with CBDRM participants and relevant officers.

The third objective was to examine and analyze the local approaches used in prevailing landslide CBDRM. So prepared a framework applied and got the effectiveness of locally implemented Landslide CBDRM. The third objective was to identify factors to the success or failure of CBDRM.to achieve this objective, repaired successful outcomes framework was used, and based on that developed framework, locally implemented community-based Landslide risk management programmes were examined. Based on the results, it was founded factors to success or failure. According to the results, some recommendations exist to improve landslide CBDRM programmes further.

1. Conducting CBDRM with a combination of awareness and practical Training
2. Supervision after implanted programs.
3. Community participation, including all social groups
4. Using Hazard Map with the Social Map

References

Tanwattana, P. (2018). Systematizing Community-Based Disaster Risk Management (CBDRM): Case of urban flood-prone community in Thailand upstream area. *International Journal of Disaster Risk Reduction*, *28*, 798-812.

Bandara, R. M. S., & Jayasingha, P. (2018). Landslide disaster risk reduction strategies and present achievements in Sri Lanka. *Geosciences Research*, *3*(3), 21-27.

Siriwardana, C. S., Jayasiri, G. P., & Hettiarachchi, S. S. L. (2018). Investigation of efficiency and effectiveness of the existing disaster management frameworks in Sri Lanka. *Procedia engineering*, *212*, 1091-1098.

Ibrahim, M., & Fernando, K. (2010). Climate Smart Disaster Risk Management in Conflict Affected Areas: the case of Trincomalee District, Sri Lanka.

Khan, H., Vasilescu, L. G., & Khan, A. (2008). Disaster management cycle-a theoretical approach. *Journal of Management and Marketing*, *6*(1), 43-50.

Pineda, M. V. G. (2015). Redefining community based disaster risk management (CBDRM) through enhanced early warning processes. *International Journal of Information and Education Technology*, *5*(7), 543.

Gupta, R., & Barman, A. Asian Community Based Disaster Risk Management-A Bi-Decadal Review.

Ruiz-Cortés, N. S., & Alcántara-Ayala, I. (2020). Landslide exposure awareness: a community-based approach towards the engagement of children. *Landslides*, *17*(6), 1501-1514.

Katan, R. (2014). *Building Together: Case Studies in Participatory Planning and Community Building*. New Village Press.

Tanwattana, P. (2018). Systematizing Community-Based Disaster Risk Management (CBDRM): Case of urban flood-prone community in Thailand upstream area. *International Journal of Disaster Risk Reduction*, *28*, 798-812.

Sharma, S. N. (2014). *Participatory Planning in Plan Preparation*. BookCountry.

Djalante, R., & Thomalla, F. (2012). Disaster risk reduction and climate change adaptation in Indonesia: Institutional challenges and opportunities for integration. *International Journal of Disaster Resilience in the Built Environment*.

Horney, J., Dwyer, C., Aminto, M., Berke, P., & Smith, G. (2017). Developing indicators to measure post-disaster community recovery in the United States. *Disasters*, *41*(1), 124-149.

Glen Fernandez, N. U. (2012). Community based disaster risk management experince of philipenes. *Community Environment and Disasater Risk Management* , 205-231.

Iftikar Hussan,Mushammad Asad Salim. (n.d.). Community Based Disaster Risk Management savings lives.

Abarquez, I., & Murshed, Z. (2004). *Field Practitioners' Handbook*. Bangkok: Asian Disaster Preparedness Center.

Zulch, H. (2019). Psychological preparedness for natural hazards–improving disaster preparedness policy and practice. *United Nations Off Disaster Risk Reduct*, 1-43.

Kko Teguh Paripurno,Ninil Mitahul Jannaj,Jonantan A.Lassa. (2017). *Community based disaster risk management Guidelines.* Masyarakat penanggulagan bencana Indunisia.

Horney, J., Dwyer, C., Aminto, M., Berke, P., & Smith, G. (2017). Developing indicators to measure post-disaster community recovery in the United States. *Disasters*, *41*(1), 124-149.

M.M.Sulphy. (2016). *Disasater Management.* kerala: PHI Learning PLT.

Murshed, S. K. (n.d.). *COMMUNITY-BASED DISASTER RISK MANAGEMENT.* Asian Disaster Preparedness Center.

2001). Building bridges through participatory planning-part 1. UN HABITAT

Abeynayake, M. D. T. E. (2012). An Analysis of construction law and disaster management law relating to sustainable development in Sri Lanka

Acknowledgements

Appendix

Effectiveness values of Sirimalgoda CBDRM

Measure of Indicators	Structure of organization	Manage community resources	Update Database by Zone leaders	Share medicine & foods in emergency	Fund Generation from different sources	Account handled by trained CBO officers	Hazard map	Effectiveness of Household Survey	Effectiveness of map	Effectiveness of Mind map	Oral History of Disaster	Effectiveness of Seasonal Calendar	Rescue After hearing warning	Agreed Routes	Agreed Evacuation place	Assistance with neighbors	Get ready to emergency	Programme conducted by professionals	Trainings among different social groups	Early Warning committee activities	Environmental friendly practices	Community Stress level
alMain Outcome	Community Based Organization				Community Fund		Ground Walk map, disaster risk map, community vulnerable map						Capacity Building			Evacuation Drill Plan				Early warning g g committee	Community response plan	
Community	0.4	0.2	0.2	0.2	0.2	0.2	0.3	0.17	0.74	0.37	0.68		0.21	0.25	0.27	0.23	0.2	0.34	0.32	0.24	0.27	0.22
Officers	0.57	0.46	0.46	0.42	0.2	0.2	0.7	0.86	0.38	0.57	0.48		0.68	0.74	0.91	0.74	0.26	0.5	0.86	0.46	0.6	0.58
Conflict level of ideas	0.17	0.26	0.26	0.22	0	0	0.4	0.69	-0.36	0.2	-0.2		0.47	0.49	0.64	0.51	0.06	0.16	0.54	0.22	0.33	0.36

Overall Effectiveness: Community 0.29(Low effective), Officers 0.55(Effective)

Effectiveness value of Mahawaththegama CBDRM

Measure of indicators	Structure of organization	Manage community resources	Update Database by Zone leaders	Share medicine & foods in emergency	Fund Generation from different sources	Account handled by trained CBO officers	Effectiveness of Hazard map	Effectiveness of Household Survey	Effectiveness of Mind map	Oral History of Disaster	Effectiveness of Seasonal Calendar	Rescue After hearing warning	Agreed Routes	Agreed Evacuation place	Assistance with neighbors	Get ready to emergency	Programme conducted by professionals	Trainings among different social groups	Early Warning committee activities	Environmental friendly practices	Community Stress level
	Community Based Organization				Community Fund		Ground Walk map, disaster risk map, community vulnerable map					Capacity Building			Evacuation Drill Plan				Early warning committee	Community response plan	
Community	0.49	0.37	0.29	0.24	0.2	0.2	0.4	0.52	0.49	0.78	0.38	0.44	0.41	0.51	0.44	0.78	0.64	0.7	0.44	0.58	0.63
Officers	0.65	0.53	0.58	0.45	0.2	0.2	0.9	0.83	0.65	0.58	0.58	0.75	0.7	0.73	0.66	0.8	0.83	0.78	0.75	0.68	0.73
Conflict level of ideas	0.16	0.16	0.29	0.21	0	0	0.5	0.31	0.16	-0.2	0.2	0.31	0.29	0.22	-0.1	0.02	0.19	0.08	0.31	0.1	0.1

Overall Effectiveness: Community 0.47((Effective), Officers 0.65(Moderate effective)

Effectiveness of Balagala CBDRM

Measure of indicators	Structure of organization	Manage community resources	Update Database by Zone leader	Share medicine & foods in emergency	Fund Generation from different sources	Account handled by trained CBO officers	Effectiveness of Hazard map	Effectiveness of Household Survey	Effectiveness of Mind map	Oral History of Disaster	Effectiveness of Seasonal Calendar	Rescue After hearing warning	Agreed Routes	Agreed Evacuation place	Assistance with neighbors	Get ready to emergency	Programme conducted by professionals	Trainings among different social groups	Early Warning committee activities	Environmental friendly practices	Community Stress level
Community	0.54	0.21	0.31	0.29	0.31	0.25	0.5	0.6	0.75	0.61	0.39	0.44	0.53	0.45	0.4	0.25	0.46	0.39	0.43	0.34	0.48
Officers	0.6	0.45	0.4	0.2	0.23	0.2	0.7	0.88	0.41	0.41	0.58	0.68	0.73	0.9	0.73	0.28	0.65	0.83	0.45	0.58	0.7
Conflict level of ideas	0.06	0.24	0.09	-0.1	-0.1	-0.1	0.2	0.28	-0.34	-0.2	0.19	0.24	0.2	0.45	0.33	0.03	0.19	0.44	0.02	0.24	0.22

Overall Effectiveness: Community - 0.42 (Effective), Officers 0.55(Effective)

Effectiveness of Beragala CBDRM

Measure of indicator	Structure of organization	Manage community resources	Update Database by Zone leaders	Share medicine & foods in emergency	Fund Generation from different	Account handled by trained CBO officers	Effectiveness of Hazard map	Effectiveness of Household Survey	Effectiveness of Mind map	Oral History of Disaster	Effectiveness of Seasonal Calendar	Rescue After hearing	Agreed Routes	Agreed Evacuation place	Assistance with neighbors	Get ready to emergency	Programme conducted by	Trainings among different social	Early Warning committee	Environmental friendly practices	Community Stress level
Community	0.49	0.29	0.27	0.24	0.2	0.2	0.4	0.52	0.52	0.73	0.38	0.64	0.32	0.3	0.66	0.73	0.63	0.67	0.42	0.58	0.66
Officers	0.65	0.53	0.55	0.45	0.2	0.2	0.8	0.83	0.25	0.56	0.58	0.73	0.6	0.7	0.55	0.78	0.8	0.73	0.65	0.63	0.75
Conflict level of ideas	0.16	0.24	0.28	0.21	0	0	0.4	0.31	-0.27	-0.17	0.2	0.09	0.28	0.4	-0.1	0.05	0.17	0.06	0.23	0.05	0.09

Overall Effectiveness: Community - 0.46(Effective), Officers 0.61(Moderate effective)