

Community Participatory Tools for Water Logging Vulnerability Assessment in Chittagong City Corporation Area

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Abstract

Chittagong city is the second largest metropolitan city of Bangladesh comprising hills with natural landscape on the Bay of Bengal. Water logging is one of the most prominent natural hazards for the city. Heavier than usual rains at the time of May to August results in water logging in many areas of Chittagong. Water logging has been disrupting livelihoods of thousands of people in Chittagong during past two decades. Badurtola is one of the places that is faced with water logging almost every year. Badurtola is prone to water logging due to the vulnerable geographical settings, mismanagement of waste and improper drainage. This research tried to identify the social, physical, and economic vulnerabilities that are causing adverse environmental condition. Necessary data has been collected through different participatory tools, which includes social map, resource map, cause effect diagram, daily activity schedule, process map, Venn diagram, service opportunity map etc. The target groups of this research are the persons, who live in the slums as they are the mostly affected and also the other groups in the society. Major findings revealed the causes of water logging are due to the dumping of waste in the drain, mismanagement of drain and also for the narrow drainage due to encroachment of drain for construction. The study found that most vulnerable groups due to the water logging are children and office going people. Some recommendations are made in the paper on the basis of the opinion of the local people, such as facilitating drainage, provision of dustbins and waste collection system, cleaning of drains and widening of drains and proper management of the drains.

Introduction

Natural hazard is one of the burning issue as 75% of the world's population lives in the areas that were affected by at least once by earthquake, tropical cyclone, flood, drought, water logging between 1980 and 2000 (UNDP, 2004). While Bangladesh is currently ranked as one of the world's most disaster-prone countries, with 97.1 % of its total area and 97.7 % of the total population at risk of multiple hazards (World Bank, 2005). Bangladesh is characterized by a tropical monsoon climate which receives seasonal rainfall every year that causes sometimes water logging in some cities. Water logging has been affecting about one million people in Bangladesh during the past two decades leading to large scale damages to crop, employment, livelihoods, and national economy (Papry and Ahmed, 2015). Every year the heavy rains make some parts of the city to suffer from water logging and most surprisingly there are areas in south west coastal region where people are compelled to live in waterlogged condition for nine

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months in a year (Awal, 2014). Chittagong is the second largest urban area as well as coastal area of Bangladesh surrounded by hill tracts. Majority of the population along coastal area living between 0 to 5 meter elevations from sea level (Hoque et al., 1996). Water logging which is not a new problem for the port city but the frequency of this problem is increasing day by day. Excessive urbanization rate and poor condition of city drainage system makes the city paralyzed during erratic rainfall. About twenty lakh city people in 2012 have been affected directly by water logging problem (The Daily Star, 2012). The stagnant water, full of foul smell, becomes a hazard to health. Water logging is the long-term inundation of areas as a result of inadequate drainage (Awal, 2014). From the beginning of 21st century this "water logging" problem arises in Bangladesh (Awal, 2014). It has become an increasing problem in recent years due to natural changes in river flow; increased deposition of sediment on floodplains; and a lack of proper operation and maintenance of drainage (Awal, 2014). Water logging problem also causes road block which leads to traffic jams, especially the urban poor who live in the slum or squatters have their home often damaged by water. But it is happening everywhere; weather in rich or in poor neighborhood.

The problem of water logging is even bigger in the case of Chittagong, known as the commercial capital of the country (Saha, 2014). Again, in many areas, the buildings are so congested and streets are so narrow that the sufferings of the people, especially lower and middle class, know no bounds (Financial express, 2012). The problem of water-logging has become worse as the remedial efforts of the Chittagong City Corporation and all other concerned authorities are both inadequate and ill-planned (Papry and Ahmed, 2015). The root cause of Chittagong's severe water-logging is its choked-up network of 16 major canals which are supposed to flush out the rain water. A large part of these canals have been encroached upon by the local influential people, causing disruption to the normal flow of water. Water logging should be considered as cautionary signal and it is essential to think about sustainable land management in Chittagong city to reduce the risk of future loss of both human lives and resources. In the context of the background for research, the objective of the research is to identify the factors which are responsible for water logging and to identify the water logging vulnerable areas in Badurtola, Bahardarhat, Chittagong.

Literature Review

Vulnerability is a degree to which people, property, resource systems, and cultural, economic, environmental and social activity is susceptible to harm, degradation, or destruction on being exposed to a hostile agent (Huq and Alam, 2003). There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors (UNISDR, 2007). Water logging is the situation of flooding in built up areas caused by rainfall, where water remains stagnant for long time due to lack of proper drainage system and creates many adverse impact on daily life (Towhid, 2004). Water logging in Chittagong Metropolitan area can be classified into two types which are rainfall induced water logging and tidal water induced water logging. Rainfall induced water logging in Chittagong City is caused by local rainfall that occurs in the built-up areas of the city several times a year on a various scale. The severe water logging is occurred during June to September. Tidal water from Bay of Bengal enters the port city

thus induced water logging which remains for few hours. Tidal water effect becomes very severe during rainy season (Papry and Ahmed, 2015).

Vulnerability Assessment through Participation

There are some techniques that are used to develop and assessment of vulnerability. The use of computer software programs to automate steps of the vulnerability assessment process such as Geographic Information System for hazard, vulnerability & risk mapping. The limitations of the technique include the lack of trained personnel; difficulties in exchanging data between different systems; difficulties in including social, economic and environmental aspect. A vulnerability analysis which includes the affected people in defining problems and needs, deciding solutions to them, implementing agreed activities to achieve those solutions and evaluating the results. The benefits of the technique are the growth of capacity, the creation of disaster risk management attitudes and behavior, and a greater insight into the communities enabling better results. Participatory analysis may be more cost-effective in the long term, than externally-driven initiatives, partly because they are more likely to be sustainable and because the process allows ideas to be tested and refined before adoption. The limitations of the technique are a poor fit within rigid timetables; impact will be limited at best if only some parts of the community are involved and where participation involves real social change it leads to the possibility of confrontation and conflict with those who traditionally hold power and influence (Disaster assessment portal, 2008).

Justification of Participatory Tools Used in Vulnerability Assessment

Vulnerability and capacity assessment uses various participatory tools to gauge people exposure to and capacity to resist natural hazards. It is an integral part of disaster preparedness and contributes to the creation of community based disaster preparedness program at the rural and urban grass-roots level (IFRCRCS, 2015). The vulnerability assessment identifies the elements are at risk and the causes of their vulnerable conditions (PRA, 2014). It also identifies the households and groups that are most exposed to a hazard. It also takes into account the physical, geographical, economic, social, political factors that are responsible for these kinds of vulnerable condition (ADPC, 2006). For disaster vulnerability assessment, community participation is an effective tool in which the people of the community are actively engaged in the identification of elements at risk and the causes for this kind of condition (ADPC, 2006). Local communities are the first responders when disaster happens. Participatory tools mainly focus on the people's opinion for identification of cause and also the factor. The involvement of most vulnerable social group and least vulnerable social group is necessary for successful assessment of vulnerability (ADPC, 2006). It also empower vulnerable communities a chance to organize themselves and take the future into their own hands (Christian Aid, 2008). Sometimes the most vulnerable communities possess skills, knowledge, resources (materials, labor) and capacities which reduce the vulnerability of that community. This can be better assessed through the participation of the community people (Humanitarian exchange magazine, 2007).

There are many reason of public participation in vulnerability assessment such as (a) Participation leads to more efficient and effective management. Interventions will be more carefully planned and executed if the people are involved. (b) Interventions will be more sustainable in the long term if the people who have to sustain them are involved and have participated to come to needed and appropriate interventions. (c) Participation is an effective tool of tapping capacities of local participants. Those are local knowledge and useful skills that can make the management more effective. Local coping can be integrated in disaster management. (d) Participation will be cost-effective in the sense that in the early stages of a process it tempers institutional optimism and thus reduces costs incurred in irrelevant or unaccepted interventions. (e) Participation leads to social learning. Through discussions and negotiations people shift in their labelling and giving meaning to situations and social structures and develop a shared appreciation of the basin's problems (Warner et al, 2002). (f) For identify appropriate rehabilitation and mitigation responses that not only address physical material need of the community but also organizational and attitudinal. (g) To ensure that disaster responses strengthen and build on people capacities. (h) To identify not only the immediate vulnerabilities of the communities but also root cause of people vulnerabilities. (i) To evaluate achievements of disaster response measure at the community level.

Methodology

The initial step of any research work is to select the topic. The topic of this study is selected to reduce the water logging vulnerability because it is major burning problem of the local resident of Chittagong. After selection of the topic, relevant literatures were reviewed to gather information about responsible factors that affecting the water logging vulnerability of area, different tools, their procedures, advantages and limitations by which the water logging vulnerability can be assessed. From these literatures it is clear that the PRA tools are very important for assessing water logging vulnerability in the cities of developing countries. In this step, different factors that affect the water logging vulnerability were also identified. The selected factors are drainage problem, topography, rainfall, tidal wave, Surface runoff, Construction work etc. In the next step, the goal and objectives of the study were fixed. The goal of this research work is to assessment the water logging vulnerability through using PRA tools. While conducting FGD, different participatory tools is used in each phases such as historical profiling, timeline, vulnerability mapping, seasonal calendar, dream mapping, Venn diagrams etc. Efforts have been made to have FGD sessions with economically challenged groups, low income floating people as well as with poor women in the study site. Then the analysis part is completed in where the social, environmental and economic vulnerability of water logging in Badurtola area are analyzed. The social vulnerability of water logging is assessed through the pair wise ranking method, spider diagram and daily activity schedule which are done by the consultation with local people of Badurtola area. From the social vulnerability it is also identified that which social activities, group of people are more vulnerable due to water logging. The environmental vulnerability is assessed through the seasonal diagram of PRA tools. The environmental vulnerability is also assessed which seasons are mostly vulnerable for water logging. The economic

vulnerability is further assessed through the mobility and connectivity pattern & service opportunity map of Badurtola area which is also done by the consultation with local people of Badurtola area. Then the recovery plan is prepared through dream map of PRA tools which is prepared by local people to reduce the water logging vulnerability. Dream map actually determines how the local people want to see their locality in future where most of the people will live in the lower vulnerable area and the water logging vulnerability is reduced within that area. Then the process map of water logging vulnerability assessment and recovery is prepared where the every step of vulnerability assessment and recovery is discussed briefly with responsible authority and time limit of implementation. This paper is based on the information and analysis of the findings.

Study Area Profile

Most of the families live in pucca houses in almost two to five storied buildings that are used for residential and commercial purposes. A few buildings are used for commercial purposes that are mostly shops. Beside the low land area, a few slums are located that are katcha, and mostly in brick walled with straw. Table 1 shows the information.

Table 1: Household information of Badurtola area

Type of the Household	Number of Household
Pucca	1500
Semi Pucca	350
Katcha	150
Total	2000

Although it is the mostly highly commercial area almost all of the roads are bituminous road that are located nearly four side and parts of some roads are brick and concrete made that is located every front side besides residential building. In this slum which become muddy in the rainy season and causes difficulties to the local people. The slum area mostly in beside the low land area who are mostly vulnerable group of water logging for lack of proper road and drainage condition. There are adequate numbers of drains in the slum and beside the roads to drain the water but in most places these drains became blocked. As most of the drain cannot link with main stream water logging is occurred in this area mainly in the rainy season and tidal wave. Social map is given at figure01 to describe the present scenario of study area. although it is a mostly residential area that are known as Arakan Housing Society mostly used pipe water supply by CWASA and then some are used tube well water for household purpose. A few of slum area are used tube well water for their household purpose.

Roads and Drainage

There are several roads for the communication of Arakan Housing Society in Badurtola area. The roads are bituminous road, brick made, concrete and katcha. Bituminous road are mostly in main surrounding road and brick road are in besides the residential housing. The roads are ranged through 6 ft. to 9 ft. There is also some Katha road in slum

housing beside the slum area. Almost all the roads have manmade drain and they are both pucca and katcha. The drains are 1.5 feet width. The drain water outfalls to the Karnaphully River which is situated in its south side and a canal also located at north side.

Topographic Condition

This is a systematic walk along one line (transect) across the community area together with the people involved to explore the spatial differences by observing, asking, listening, looking and producing a transect diagram. The transect walk is normally done during the initial phase of the fieldwork. It is best to choose a route, which will cover the greatest diversity in resources, land use, geographical conditions, etc. A graphical table 03 illustrated the present scenario of topographic condition of Badurtola area.

Historical Trend of Water Logging in Badurtola Area

Table 2 presents the historical information of water logging in Badurtola area. It has seen that water logging condition was severe at before which is more than 15-20 years ago. In 1995, the depth of water was 5-6 feet and moderate water logging occurred in 2000 and 2005 and also in 2010 which is 3-4 feet. But after 2005, some steps had been taken to reduce the water logging in that area and recently after 2010 height of adjacent main road increased.



Table 2: Historical trend of water logging in Badurtola area

Year	Drainage condition	Water logging depth	Waterlogging frequency(yearly)	Average duration of water logging	Tidal wave effect
1995	Moderate	5-6 feet	10-12	4-6 hour	Low
2000	Moderate	3-4 feet	10-12	3-4 hour	Low
2005	Bad	3-4 feet	12-13	3-4 hour	Low
2010	Bad	2-3 feet	13-15	3-4 hour	Low
2014	Bad	2-3 feet	13-16	5-6 hour	Low

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Table 3: Topographical view and information of Badurtola area

Topographical view and information of Badurtola area-1				
Landscape				
Feature				
Area locality	Chowdhury bari	Slum area	Arkan housing society	Arkan housing society
Land types	Plain land	Low land	Low land	Upland
Source of water	Tube well, pipe water	Tube well	Pipe water	Pipe water
Ownership of land	Private	Private	private	Private
Drainage condition	Bad and narrow	Bad and narrow	Bad and width	Moderate and width
Land use	Residential area	Slum area	Residential area	Commercial and residential
Structure type	Pucca	Semi-pucca	pucca	Pucca
Road type and condition	HBB and moderate	HBB and katcha, bad	Pucca, moderate	Pucca, moderate
Waste collection system	Dustbin	Open	Dustbin	Dustbin
Topographical view and information of Badurtola area-2				
Landscape				
Feature				
Area locality	Badurtola	Badurtola	Badurtola	Badurtola
Land types	Low land	Low land	Low land and upland	Upland
Source of water	pipe water	Pipe water	Pipe water	Pipe water
Ownership of land	Private	Private	private	Private
Drainage condition	Moderate and narrow	Moderate and narrow	Moderate and width	Moderate and width
Land use	Residential area	Residential area	Residential area	Commercial and residential
Structure type	Pucca	Pucca	pucca	Pucca
Road type and condition	Pucca and moderate	Pucca and moderate	Pucca and moderate	Pucca and moderate
Waste collection system	Dustbin	Dustbin	Dustbin	Dustbin

Availability of Service and Opportunities in Badurtola Area

Figure 4 depicts the map focusing on the services and opportunity of the “Badurtola” area. The use of visual makes the diagram attractive and useful for the non-illiterate person. The study area is depicted at the center. The various services and opportunities listed by the local people include bus station, park, tempo stand, police station, school, college, fire service, hospital, mosque, railway station, government buildings, etc. The size of the image of particular service represents the importance. The length of straight line represents the distance of service from the area.

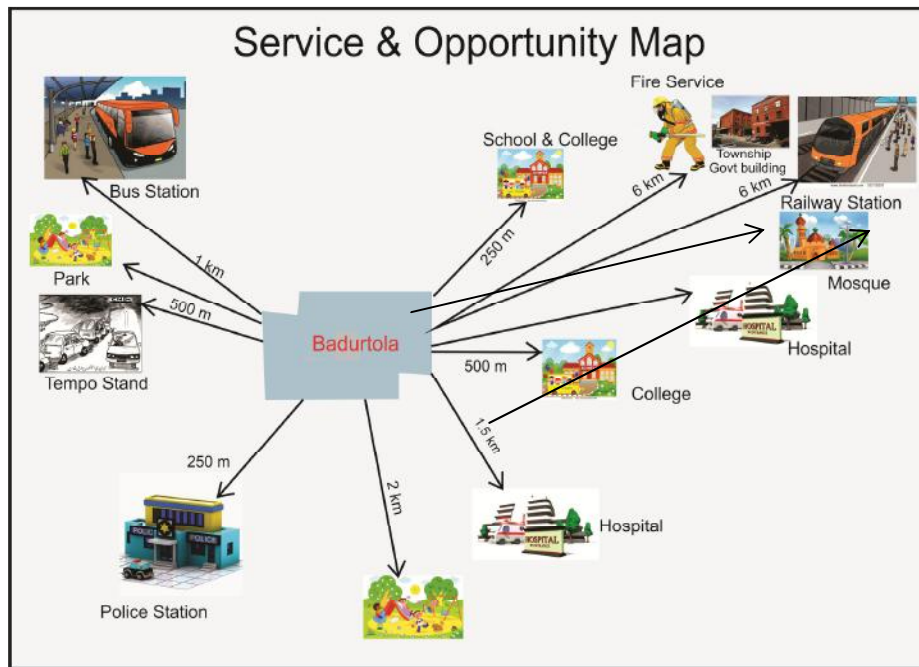


Fig. 1: Service opportunity for people of Badurtola area

Figure 1 shows that the people of the study area can easily go to the school, college, bus station, tempo stand, etc. The most important services, such as hospital, police station, and fire station are located near the study area. Only for travelling to railway station they have to cross a long distance in comparison to other services. Thus, the service-opportunity map in this case provides a detailed understanding of various services and opportunities and other relative importance like accessibility, magnitude of use, etc. as perceived by the local people.

Causes and Effects of Water Logging

Figure 2 depicts a cause effect diagram on water logging by some local men of Badurtola area of Chittagong in Bangladesh. The cause effect diagram shows different causes of water logging in the study area and also shows the effects due to this cause. The broad factor that causes water logging is perceived to be: drainage problem, topography, rainfall, tidal wave. In the study area the roadside drain is narrow so when there is

overflow of water then the drain cannot accumulate water properly and also due to absence of dustbin in the study area resident of this area dump there their waste in the drain which blocks the drain that is another important cause of water logging.

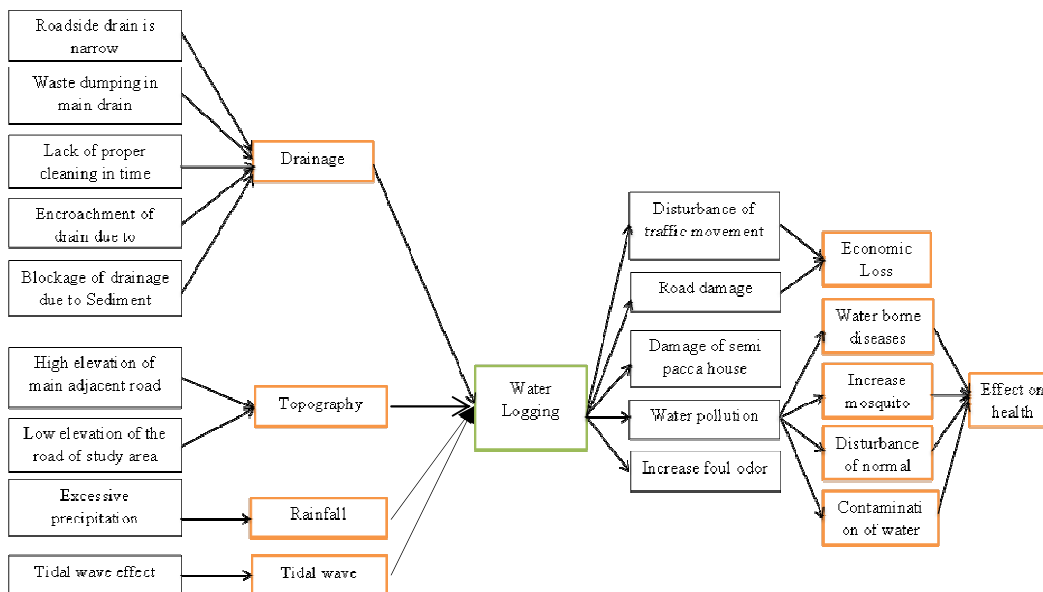


Fig. 2: Causes and effects of water logging in Badurtola area

The drains are not cleaned properly in time and encroachment of drain at the time of construction is another cause. Sometimes the drain block due to the sediment. The elevation of the study area is lower than the surroundings of study area and the elevation of adjacent main road is higher so when there is rainfall then all water from the surroundings area come to the study area and due to absent of proper drainage, water clogged on that study area for a while. Excessive rainfall is another prime cause of water logging. Sometimes, tidal wave causes water logging in the area for a while but it occurs a few times. Effect of water logging also shows in figure 05. At the time of water logging there are severe disturbance of traffic movement in the area and disturbance of movement of the local people. Another effect is the damage of road which as a result causes economic loss of a country. In the study area there are many low income families who live in the semi pucca house. Sometimes these houses are damaged due to the water logging but it is rare. Another effect is the water pollution which as a result increases water borne disease, increase mosquito, disturbance of normal life and also contamination of water tank which causes damage to health.

People's Perception about the Occurrence of Water Logging

Figure 3 provides a pictorial presentation of processes of water logging in "Badurtola" area. It has been used to depict the step by step process of creation of a situation of water logging in the study area. Figure 3 is a process map of water logging which depicts the entire process of water logging in the study area. It begins with the encroachment of drain due to construction. Due to absent of dustbin in the study area, people dump waste in the drain which blocks the drain. Then at the time of rainy season when rainfall occurs

the water logging happens in that area because of the blockage of drain are not capable of accumulating large volume of water. As water level decreases, the waste of the drain spreads out around the drain which is responsible for creating many kinds of problems like foul odor, increase of mosquito etc. The community associations collect this waste through their vans and dump it to the nearest dustbin, The city corporations then clean the drains and after some days a person again start to dump waste in the drain and thus happens the same thing again and again.

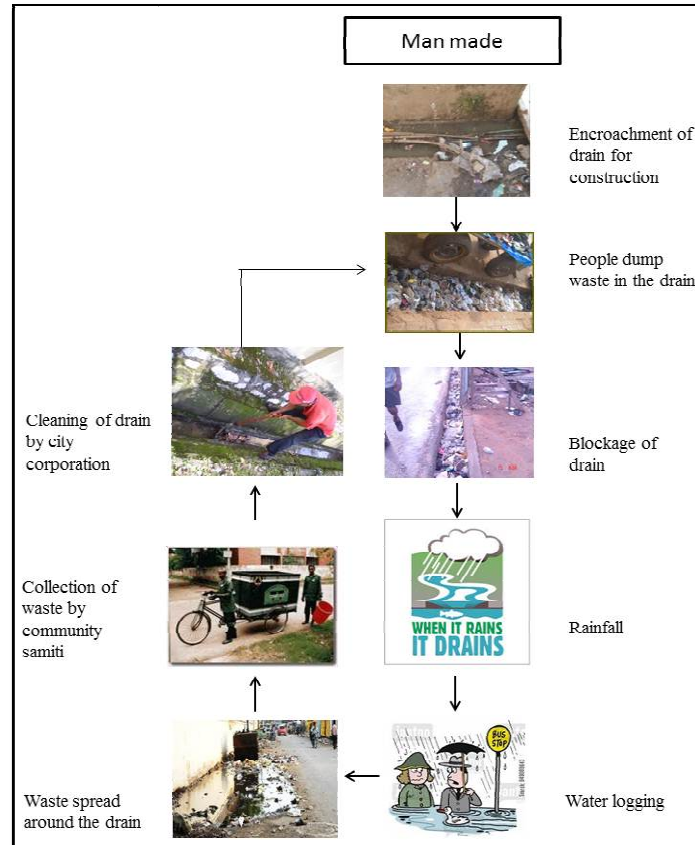


Fig. 3: Process of water logging in Badurtola

Conclusion

Water logging is the consequence of unplanned urban development. Due to rapid urbanization with unplanned construction, most of the storm water drainage have been encroached, filled up, diverted and caused obstruction to the smooth flow of water to the out fall rivers, creating severe water-logging every year during monsoon incurring huge loss in terms of adverse social, physical, economic loss. Coping strategies should be implemented at the household level supported by local institutions. Therefore, adequate macro political blessing is needed in the whole process, because resource allocation is extremely important in all the planning and implementation phase where political parties can intervene with their administrative hats. Local people should be actively

involved in the overall process of planning and implementation of local projects. Local people must have some strong and recognized platform to delivery their point of view to other institutions. Therefore, coordinated development actions from the part of Government and NGOs are necessary which must reflect local people's voice.

References

- Aditi Nandini Saha, 2014. Water logging in Chittagong, Bangladesh. Retrieved from http://www.adpc.net/igo/contents/iPrepare/iprepare-news_id.asp?ipid=236. Accesdate: 3 March, 2015
- Asian Disaster propperness center (ADPC), 2006. Community-based disaster risk management for local authorities, p 76- 81, Dhaka
- Awal, M. A., 2014. Water logging in southwestern coastal region of Bangladesh: local adaptation and policy options. *International Journal of Scientific innovation*, 4(1), 145-159
- Christian Aid, 2008. Christian Aid and Good Practice Guide: Participatory Vulnerability and Capacity Assessment (PVCA), p 99-105, Dhaka-1201
- Disaster assessment portal, 2008. Technique used in disaster risk assessment. Retrieved from <http://www.disasterassessment.org/section.asp?id=20>Dated 21 March, 2015
- Financial express, 2012. Water logging; more than a problem. Dhaka, Bangladesh.Dated 29August, 2012
- Hoque, M. M., Abdullah, and Khan, M. S., 1996. Storm surge flooding in Chittagong city and associated risks. *International Conference on Destructive Water: Water-Caused Natural Disasters, their Abatement and Control* (p. 115). California: IAHS.
- Huq, S. and Alam, M., 2003. Flood Management and Vulnerability of Dhaka City. Bangladesh Center of Advance Studies (BCAS). Dhaka
- Humanitarian exchange magazine, 2007, July 4. Working with vulnerable communities to assess and reduce disaster risk. Issue 38.Retrieved from <http://www.odihpn.org/humanitarian-exchange-magazine/issue-38/working-with-vulnerable-communities-to-assess-and-reduce-disaster-risk>. Dated 25 March, 2015
- International Federation of Red Cross and Red Crescent Societies (IFRCRCS), 2015. *Vulnerability and Capacity Assessment (VCA)*.Retrieved from www.ifrc.org/en/what-we-do/disaster-management/preparing-for-disaster. Dated 25 March, 2015
- Papry & Ahmed, 2015. Drainage Condition in Water Logged Areas of Central Part in Chittagong City Corporation. *International Journal of Engineering Science Invention*, 4(1), PP.24-29.
- The Daily Star, 2012. Rain causes water logging in chittagong city. Chittagong. Retrieved from <http://www.the-daily-star.net/beta2/news/rain-causes-water-logging-in-ctg-city>. Dated 25 march, 2015
- Towhid, K. G., 2004. Causes and Effects of Water Logging in Dhaka City, Bangladesh. Stockholm, Sweden: TRITA-LWR Master Thesis, Royal Institute of Technology.
- UNISDR, (August, 2007). *Terminology*. Retrieved September 12, 2014, from The United Nations Office for Disaster Risk Reduction: <http://www.unisdr.org/we/inform/terminology>.
- UNDP, 2004. *Reducing Disaster Risk: A Challenge for Development*. Bureau for Crisis Prevention and Recovery. Washington, DC: United Nations Development Programme.
- World Bank, 2005. *Natural Disaster Hotspots: A Global Risk Analysis*. Disaster Risk Management Series. No. 5, Washington, DC.
- Warner, J., Waalewijn, P. and Hilhorst, D. 2002. Public Participation in Disaster-Prone Watersheds.Time for Multi-Stakeholder Platforms?Irrigation and Water Management Group,Wageningen University.