An Analysis of Causes, Impacts and Vulnerability Assessment for Landslides Risk In Rangamati District, Bangladesh

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An analysis of Causes, Impacts and Vulnerability Assessment for Landslides Risk in Rangamati District, Bangladesh

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ABSTRACT

The hilly area (18% of total land) of Bangladesh is becoming vulnerable to the landslide as chronological landslides (in the year 1968, '70,'90, '97, '99, '00, '08, '11, and '17) causes a huge property loss and affects the people living on the slope of hilly areas. Along with some natural cause's like - groundwater pressure, weak soil structure, erosion of the toe, earthquake, excessive rainfall, etc., many human activities intensify landslide. The paper explores the causes and impacts of landslides, effective vulnerability mitigation strategies for reducing economic and social losses due to landslides. The study also measures the application vulnerability assessment for landslides Risk analysis in Rangamati District. The study survey was conducted by 12th July to 31st July applying questionnaire survey with 150 respondents, and collection of secondary information, the study was carried out in recent landslide - prone sites located in Kaptai Upazila, Vedvedi, Amtali Union, Manikchari, Reserve Bazar areas of Rangamati Sadar Upazila. The approach has concluded vulnerability management mitigation strategies for reducing economic and social losses due to landslides on local people in Rangamati District.
Keywords: Rangamati, Landslide, Vulnerability, Mitigation strategies.

Introduction

Landslide is a geological phenomenon which includes a wide range of ground movements and happens in the hilly regions (Chisty, 2014). Landslide is recently one of the most common and devastating disasters in Bangladesh. The southern hilly regions, especially Rangamati District, experienced a chronological landslide and lost its valuable resources. The most recent landslide has occurred on 12 June 2017 and its total property damage is $223 million. Because of this landslide, the death toll went up to 118 and 1700 families of Rangamati District were devastated among which Vedvedi Neighborhood of Rangamati Sadar occupies 1130 families (Chowdhury, 2017). Because of the recent land slide, Rangamati district has been chosen as the study area. The study has been carried out in recent landslide-prone sites located in Kaptai Upazila, Vedvedi, Amtali Union, Manikchari, Reserve Bazar areas of Rangamati Sadar Upazila . The huge amount of natural, social and economic loses indicate its vulnerability. The vulnerable condition of people of Rangamati district is the consequence of landslide which demands mitigation strategies.

Different landslide studies describe the causes, impacts and mitigation strategies using questionnaire survey; Geographic landslide susceptibility mapping by the Conditional Analysis method using GIS, landslide quantitative risk analysis, effective vulnerability management strategies for reducing economic and social losses due to landslides. The alteration from other questionnaire surveys regarding landslide is that the survey was conducted just after a major landslide has occurred (survey duration, from 12 July to 31 July 2017).

The objective of the paper to find causes and impacts of landslides, effective vulnerability mitigation strategies for reducing economic and social losses due to landslides. The Participatory rural appraisal (PRA) was conducted by 7 participants who were witness and victim of the Rangamati landslide that happened on 12th June, 2017. A questionnaire survey, of 150 respondents is done for primary data collection. The vulnerability mitigation strategies will be developed involving the participation of local people who are affected by the landslides or in the risk zone of landslides.

Materials and methodology:

The study includes two type's data is used for information collection- Primary data & Secondary data. For primary data collection, a semi-structured questionnaire was prepared and the questionnaire was developed after pilot survey. The final questionnaire was developed on the basis of objectives to evaluate the landslide vulnerability and

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recommend for reducing the risk of landslide vulnerability and in a logical sequence so that the respondents could answer chronologically. A simple random sampling method was used to find the respondents. 150 respondents were surveyed from different sites (Amtoli Union-7, Kaptai Upazila-40, Manikchari-56, Rangamati Sadar upazila-47). The population and the landslide risk of these sites were considered to define the respondent to pick from that site. The respondents were both male and female of different ages and different backgrounds. A large number of papers, journals, books, magazines, newspaper, thesis and other recent publications were also reviewed for secondary data collection. The collected quantitative data were checked and then entered into the spreadsheet in MS Excel. Using statistical software SPSS, descriptive statistics including frequency and percentage were analyzed from the collected data according to the objectives. Pairwise ranking matrix was used to conduct a problem/preference ranking.
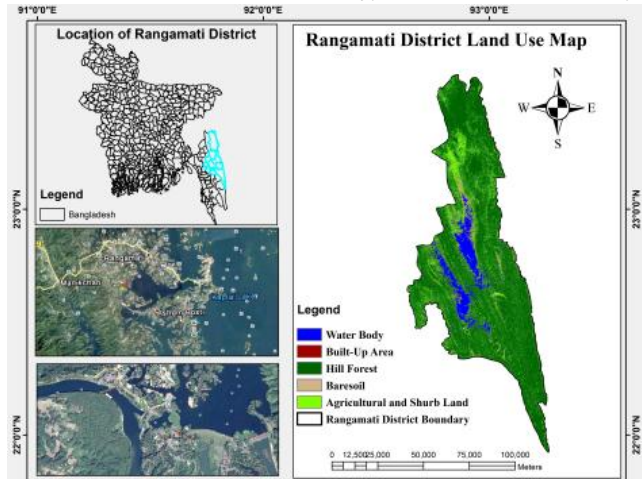

Figure 1 Map of Bangladesh showing Rangamati district, with an embedded Google Earth image and Land Use Map of the study area. *(Source: Prepared by Researcher)*

Results and Discussion

Socio-economic condition of the study area:
To realize the vulnerable condition of the people of Rangamati, the Socio-economic condition of the respondents is necessary. The socio economic condition was done by household questionnaire survey. The respondents were both male (72%) and female (28%). Respondents ages from 15 to more than 60 years though maximum (52%) respondents were middle aged (31 to 45 years old). Literacy status plays a vital role in an efficient participation and operational skill in all income generating activities. Maximum (42.7%) of the respondents had higher secondary level of education. Among rest of the respondents, 12% had secondary and 20% had primary level of education and 25.3% were illiterate. The respondents are from different occupations (Service-19.3%, Business-26%, Labor-18.7%, Driver-12.7%, Housewife-23.3%) and their monthly income also differs (ranging from taka 9000 to more than tk15000). Some of them are local and some are migrated and maximum (nearly 45%) live in tin-shed house. So, the respondents were of different backgrounds and that's why they could provide diversified information of different perspectives. There exist 25.3% buildings, 24.7% half buildings, 44.7% tin-shaded houses and 5.3% earthen houses.

Causes and effects of landslide:
According to the respondent's, the main causes of Landslides are shown in Figure- 2 where Hill cutting (22%), weak soil structure (1%), de-vegetation (4%), heavy rainfall (21%), steeper hill (4%), house construction (6%), earthquake (12%) etc. Basically hill cutting and heavy rainfall are main reason of landslide. After the questionnaire survey, participatory rural appraisal (PRA) was conducted to identify the main reason behind it and the cause-effect of the landslide of the study area. Major impacts of landsides are shown in figure-3 which demonstrates that all the respondents (100%) agrees economical loss is the main factor due to the landslide. According to them, destructions of infrastructure, damage of household utilities, necessary materials causes a huge economic loss which has great impact on the national economy. About 85% respondents reported that human life was destroyed due to landslide in Rangamati district which is very alarming. .According to the respondent Landslide causes environmental difficulties i.e., block of drainage connection, loss of soil fertility and loss of biodiversity of floral and faunal species etc.

Vulnerability Assessment for Landslides Risk: To assess the vulnerability Participatory rural appraisal (PRA) tools for example: Cause-effect diagram and Pair wise ranking matrix have used by the inhabitants in Rangamati District. In Table 1, Cause-effect diagram shows the causes and effects which generated from the reasons of landslides and in Table 2, Pair-wise ranking matrix describes the ranking of the problems which defines the leading difficulties behind landslides which helps for further analysis. According to the pair-wise ranking matrix heavy rainfall, hill cutting and weak soil structure is the basic three reasons behind landslide.

Mitigation strategies of the vulnerability of landslide: Mitigation strategies is to reduce risks prior to, during and post- disaster, which is related to short-term and long-term measures (Gabhok, 2004). Mitigation strategies for the vulnerability of landslide in Rangamati are done according to the questionnaire survey shown in the figure 4. The Strategies are:

Tree plantation and vegetation: In figure -4, 29 %(150 respondents) people suggest that tree plantation is the best approach to mitigate vulnerability in Landslides areas. Hill soil directly exposed to rain has high filtration rate which gets saturated by water earlier than the soil covered with plants. (Rubel and Ahmed, 2013).

Stop hill cutting: 143 respondents (figure -4) give their opinion about to stop the hill cutting to mitigate the risk of vulnerability in Rangamati district**.** Higher land price, building houses, soil for brick field and absence of policy hill management are some of the causes of hill cutting.

Resettlement of house after landslide: Before landslide occurrence, resettlement of the affected people can be done by governmental funding.

Provide a drainage improvement incentive: As landslide occurs because of heavy rainfall, so improved drainage system can mitigate landslide.

Development policy by the government*:* A comprehensive policy formulation related to hill cutting, land use, hill use etc. is the starting point for risk reduction activities.
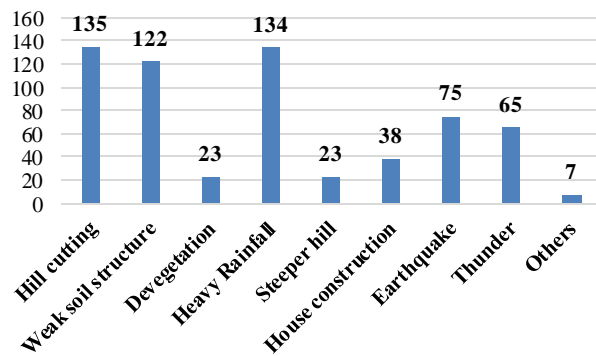

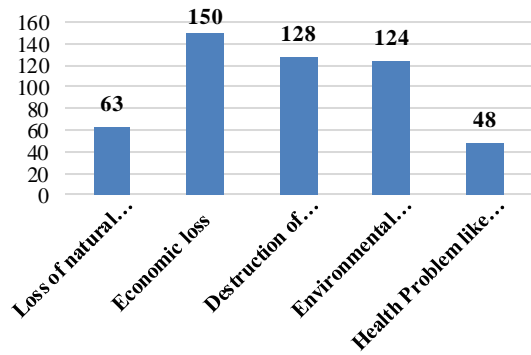**Figure 2 Causes of Landslides in Rangamti District**

Figure 3 Impacts of Landslides in Rangamti District

Source: Field Survey, July, 2017

Table 1 Cause Effect Diagram of landslide vulnerability

Effect	Soil erosion, Flush flooding, Siltation in river &	Collapse of hill.	Climate change, Loss of species, effects on the water	Flooding, risk to human life, Damage building,	Less stability,	Hill cutting, collapse hill, Less stability of hills	Loss of human life, & Economic loss	
Reasons for landslide	Hill cutting	Weak soil structure	De-vegetation	Heavy Rainfall	Steeper hill	House construction	Thunder	Earth quake
Cause	High plain land price, Population rise, Absence of hill policy & brick field	naturally porous soil, Less strength of soil	Less applicable environmental policy, for settlement establishment, furniture's.	Global warming, Climate change and Deforestation	Hill cutting, Underg round Explosions	Over population & Migration of people	Plate-tectonic movements, Volcanic activity &	

Table 2 Pair wise Ranking Matrix for landslide vulnerability

	Hill cutting (i)	Weak soil structure (ii)	De-vege tation (iii)	Heavy Rainfall (iv)	Steeper hill (v)	House construc tion (vi)	Earth quake (vii)	Thunde r (viii)	Frequency	Rank
Hill cutting(i)		(i)	(i)	(iv)	(i)	(i)	(i)	(i)	6	2
Weak soil structure (ii)			(ii)	(iv)	(ii)	(ii)	(ii)	(ii)	5	3
De-vegetation (iii)				(iv)	(v)	(vi)	(vii)	(viii)	0	6
Heavy Rainfall(iv)					(iv)	(iv)	(iv)	(iv)	7	1
Steeper hill (v)						(vi)	(vii)	(viii)	1	5
House construction(vi)							(vi)	(viii)	3	4
Earthquake(vii)								(vii)	3	4
Thunder(viii)									3	4

Conclusion:

Basically, landslide is a burning issue in the hilly region of Bangladesh nowadays. Present study has highlighted the overall scenario of landslides and its impacts which are very miserable and consequently people of the study area had to displace and migrate and risk of securities. The study analyses the facts and concludes the major causes and effects of landslide and vulnerability mitigation strategies for reducing the damage. The research helps to identify the reasonable factors for cause and effect of landslide of Rangamati and the mitigation strategies adoption can be applied to the hilly region of Bangladesh. Therefore, proper measures to be taken by the government to protect the people of the study area to give the people a stable and peaceful life.
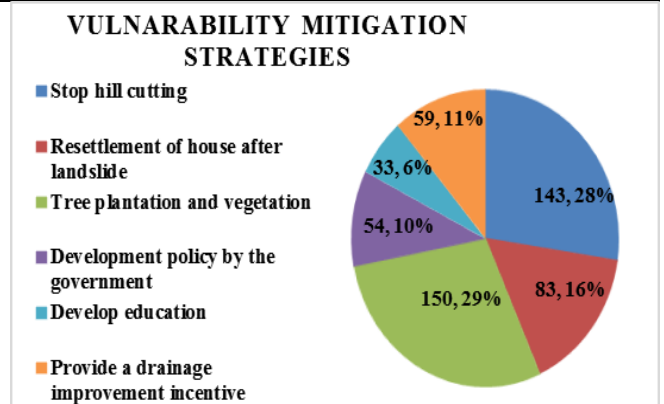

Figure4: Vulnerability mitigation strategies in Rangamati District; *source: Field Survey, July, 2017*

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