



Final Report

Rainfall Triggered Landslide Hazard Zonation in Cox's Bazar & Teknaf Municipalities as well as Introducing Community-based Early Warning System for Landslide Hazard Management



April 2012

Comprehensive Disaster Management Programme (CDMP II)
Ministry of Disaster Management and Relief



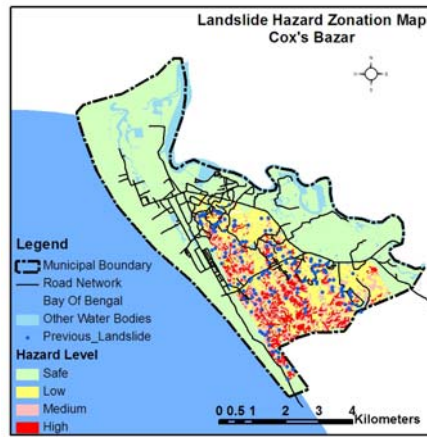
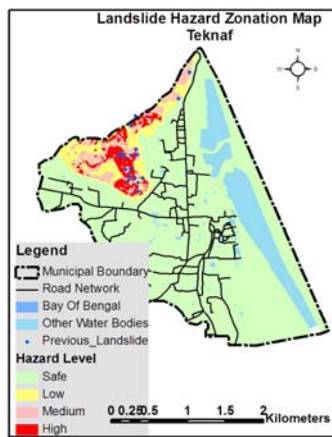


Comprehensive Disaster Management Programme (CDMP-II)

Ministry of Food and Disaster Management (MoFDM)
 Disaster Management and Relief Division (DMRD)
 Government of the People's Republic of Bangladesh

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Rainfall Triggered Landslide Hazard Zonation in Cox's Bazar & Teknaf Municipalities as well as Introducing Community-based Early Warning System for Landslide Hazard Management



April 2012

Submitted by

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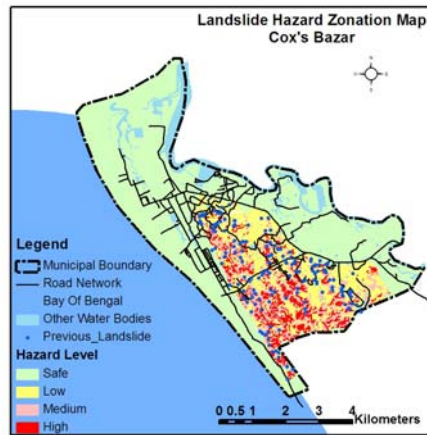
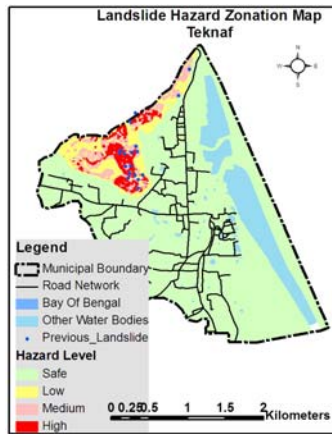
Ministry of Food and Disaster Management (MoFDM)

Disaster Management and Relief Division (DMRD)

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PART 1

Main Report



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Executive Summary

In recent years many landslide events have been experienced in hilly districts of Bangladesh such as Chittagong, Cox's Bazaar, and Teknaf. It shows that a significant landslide hazard exists for such urban centers and many communities are vulnerable to this newly known type of hazard in Bangladesh, which may result in severe damages and severe socio-economic consequences in future in many other areas too. The urban centers which are threatened by the landslide events in the recent past are fast growing and with considerable influence in the economic developments of the country. It is therefore essential to have a realistic understanding of the nature, severity and consequences of likely damages and losses that possible future landslide events could cause on the vulnerable communities living near the landslide hazard prone areas and to develop a model for landslide risk management.

The key to success in future is the study of the events occurred in the past and takes appropriate proactive actions using the lessons learned. It is necessary to have a critical evaluation of the facts associated with past landslides and more importantly why there is a sudden increase in number of landslides and their magnitude in the two target municipalities. Also the findings of such study will serve as the basis for studies in other cities such as Chittagong where similar escalation of landslide events have taken place.

This report is prepared to summarize the Mechanism for establishing landslide early warning at community level, community awareness programme at different level and landslide hazard mitigation strategies for Cox's Bazaar and Teknaf Municipalities. This report is supported with a training manual developed and used for providing training to the community volunteers.

1. Introduction

The incidents of landslides are becoming a very frequent disaster in many countries in Asia. Landslides usually do not bring significant negative impacts on the development initiatives like other major disaster events such as earthquakes and floods and the area affected is comparatively not very large. Therefore less attention has been given to landslide problems in many of the countries in Asia. However during past few years we have seen escalation in number and magnitude of landslide events in countries such as Bhutan, India, Indonesia, Nepal, Philippines, Sri Lanka and Thailand. The latest addition to this list may be Bangladesh. Usually Bangladesh is regarded as a flat country which gets affected often by flood and cyclone events. However in addition to such frequent hazards; landslides also continue to result in human sufferings, property losses during recent years especially in the southern hilly areas of Bangladesh. As population increases and societies become more complex, the economic and societal losses due to such events may continue to rise unless proper attention is given at early stages as increasing anthropogenic activities in the mountain areas can add to the existing vulnerability of communities further.

Bangladesh is highly vulnerable to several natural disasters and every year natural calamity upset human's lives and livelihood in some part of the country. Among major disasters concerned in the country, fatal landslides events in the recent years can be noted. Exposed soft sedimentary rocks in the vast tract of mountainous and hilly terrains (18% of the total area of the country) and interventions of human activities across the slopes caused fatal landslides triggered by the torrential monsoon rainfall. The hilly terrain in the southeastern part of the country has the long history of slope instability. The landslides hazard in Chittagong City area and its surroundings occurred on June 11, 2007 was a phenomenal one that took the life of 127 people and caused injury to hundreds of people and made many people homeless. The landslides were triggered by uncommon heavy downpour which was estimated 348 mm for a period of around 12 hours. Fatal landslides subsequently occurred in 2008 and 2009 at Chittagong city as well as Cox's Bazar and Teknaf (Golam Mahabub Sarwar 2008). In 2010, landslides again took place in Cox's Bazar and Teknaf and took the life of around 60 people. Considering the potential rainfall induced landslide hazard in Bangladesh and recent landslide events, attempt has been taken in CDMP-II to develop landslide hazard mapping of Cox's Bazar and Teknaf Municipal areas.

1.2 Objectives of this Report

This report is a submission as a part of the assignment being carried out jointly by datEx and ADPC. This report is prepared to describe the process of establishing community based early warning system in the most vulnerable communities in Teknaf and Cox's Bazar Municipalities as identified during this study. This report also presents the awareness programme and training conducted under this project and landslide risk reduction strategy as appeared from the outcome of the research.

2.0 Development of Community based landslide early warning mechanism and installing early warning devices for identified vulnerable locations.

Community Based Early Warning System for the municipalities of Cox's Bazar and Teknaf has been developed following several steps. First step was the consideration of the landslide hazard zonation mapping and the existing vulnerability of the communities. The basic criteria used for identifying most vulnerable communities are,

- i. Previous landslide record
- ii. Losses of lives
- iii. Damages of assets
- iv. Frequency of hill cutting
- v. Most vulnerable houses in the hilly area
- vi. Highly density of population in the hilly area
- vii. Underprivileged, most vulnerable people in the community like elderly, child, differently able etc.

In the second step, community volunteers were identified from each of the vulnerable communities to orient the Threshold Values, different levels and actions to be taken for the safety and preparedness of the community.

Community Based early Warning is a systematic and participatory process to install, monitor, record, communicate by the community based volunteers on behalf of community. Early Warning System will be generated & maintained by the community, of the community and for the community. The community Volunteers were also oriented with the reading and setting of Rain Gauges in the respective community.

A three step alerting system develop

"Alert"- 75 mm rainfall for 24 hours- Increase vigilance and observe appearance of any symptoms of slope destabilization on critical slopes.

"Get ready for Evacuation" to safer location from high risk locations on 100 mm rainfall for 24 hours

"Evacuation"- 200 mm rainfall for 24 hours- Warning for evacuation to safer places

Following is the detail of reading the Threshold Values as installed at community level.

These rain gauges have three different color codes as shown below:

Color code	Level	Threshold Values	Actions
	Evacuate	101-200 mm rainfall recorded within 24 hr	Evacuate to Safer Place
	Ready	76-100 mm rainfall recorded within 24 hr	Get Ready
	Alert	0-75 mm rainfall recorded within 24 hr	Get Alert

A total number of 43 and 15 volunteers have been selected and trained respectively from Cox's Bazar and Teknaf Municipality¹. However, in Cox's Bazar and Teknaf respectively 5 and 3 volunteers have been assigned with Rain Gauge in their locality. Moreover, Standard Operating Procedures (SOP) has been developed for Volunteers, Community and Municipality for assigning more specific responsibilities at different period of landslide hazard. Following is the SOP of different groups.

¹ List of Community Volunteers are attached as Annex-A. The Training Manual used to Train the Volunteers is also available as a separate Document prepared under this Project.

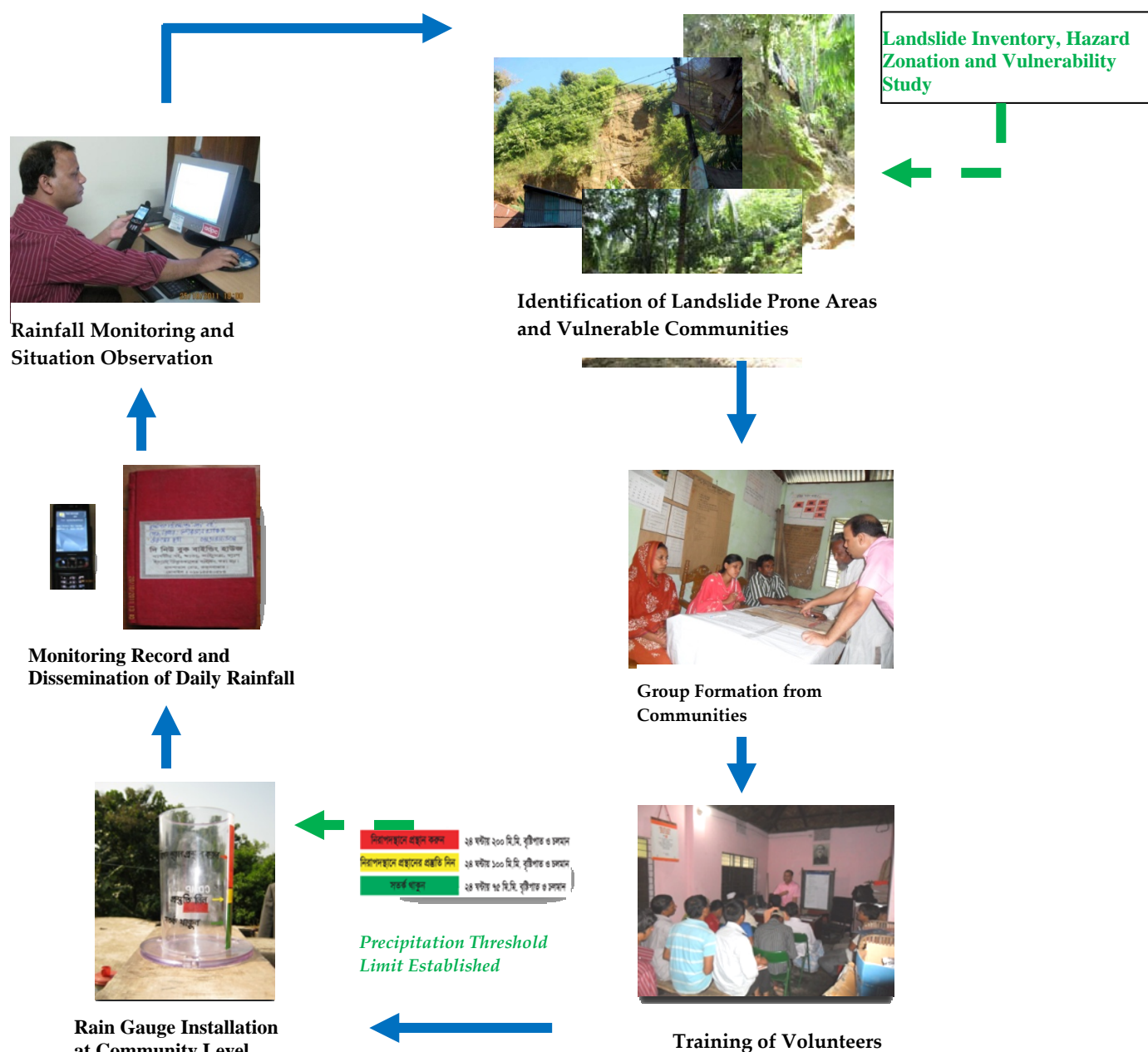


Figure: Landslide induced early warning system

Rain gauge observation:

1. Daily observation and monitoring of rainfall through “rain-gauge” and “critical slopes” in the area;
2. Daily documentation and maintenance of the observed data into a simple “log-book”;
3. “Communicate” to other clusters and rain-gauge observers, community, municipality and other agencies;
4. “Maintenance” and “secure” the rain-gauge;

Community:

1. Maintains “a list of socially vulnerable groups/people” (e.g. children, elderly, pregnant, disabled, women etc.);
2. Observes “settlements” and Operation & Maintenance of “critical slopes” in the area;

3. Make enhanced use of “local knowledge” for “traditionally practiced landslide alerting” measures (e.g. using dogs for observing critical slopes and heavy rainfall);
4. Raising “awareness for community-based landslide monitoring and early warning” through youth, students, religious leaders, teachers, volunteer groups and others;
5. Maintaining a sustainable “Community based Landslide Forums” in each community

Pourashava/ Municipality:

1. Takes “decision on the evacuation and coordination” for wards and respective communities for landslide risk management;
2. Maintains the coordination between the “District Disaster Management Committee (DDMC) and related DDMC member agencies;
3. Follow the nationally approved “Standing Order on Disaster (SOD)” of the GoB for landslide



Rain Gauge Installed in a Community at Cox's Bazar



A Volunteer at Teknaf Municipality with his assigned Rain Gauge and Log Book

List of Volunteers with Responsibilities of Rain Gauge Monitoring

SL	Rain Gauges Code	Name of Rain Gauges Monitors	Name of Community	Record's time
1	C-1	Md.Jalil (Dudu Bhai)	S.M Jadi Pahar, Ward # 08	10:30
2	C-2	Mr. Anil Dottoh	S.M Jadi Pahar, Ward # 08	10:30
3	C-3	Nejam Uddin Tushar	Koborsthan Para, Ward # 11	13:00
4	C-4	Md Shahidullah	Mohajer Para, Ward # 09	08:00
5	C-5	Md.Faraz	Mohajer Para, Ward # 09	08:00
6	T-1	Lukman Hakim	Fakirer Moora/Urumer Chara	21:00
7	T-2	Mr. Pulin Chandra Das	Ward # 2,Maymuna Primary School	
8	T-3	Nur Samad Mullah	Amer Ahmed's Joom	21:00

Recording and Documentation of Rainfall: Each of the community Volunteers take reading of the daily rainfall from their respective communities and keep record in the log-book assigned for them. At the same time each of the volunteers send the record of rainfall through mobile SMS to a central Mobile where all the records are stored and being observed for monitoring for landslide early warning. For the time being the rainfall is being monitored by ADPC Bangladesh office on Pilot Basis.

3.0 Conduct Awareness Programs for Different Stakeholders

A number of initiatives were taken for the awareness development of the communities and other stakeholders of Teknaf and Cox's Bazaar Municipalities. The awareness development programs including town level stakeholder meetings, Rapport building with the vulnerable communities, arrangement of orientation and training program, community risk assessment through involving the respective communities, Simulation Exercise for Landslide Early warning and Preparedness. Following is a brief on different initiatives of awareness development in the municipalities.

Municipal level meetings and workshops- Municipality level workshops were organized from the initial stage of the project. In the first orientation meeting with the municipal level stakeholder, all related town level agencies were invited to share the objectives, activities and outcomes of the project. The town level meetings² were held with the respective municipality mayors in Chair. The other town level stakeholders present in the meeting including the elected councilors, PDMC³ members, representatives from metrological department, CPP, Fire service & Civil Defense, civil surgeon, Women and Children affairs department, department of environment. During the workshop, the consensus was development that, municipality would take lead role in the implementation of the project. It was also discussed that the elected commissioner would be a change agent in this project and mobilizes community on landslide risk reduction.



Town Level Consultation Meeting on 5th March, 2011 at Cox's Bazaar Municipality



Town Level Consultation Meeting on 5th April, 2012 at Cox's Bazaar Municipality

Rapport building with vulnerable communities- With the identification of the vulnerable communities, volunteers and community facilitators were identified in each selected communities. These volunteers and community facilitators would act as a change agent for landslide risk reduction.

Orientation and Training Program for Volunteers and Community facilitators- With the identification of the community based facilitators and volunteers', training on early warning system was organized to orient. In this training, the focus was to discuss the basics of early warning components such as risk knowledge, monitoring and warning, dissemination and communication and response capability. The training also covered the process of community based disaster risk reduction (CBDRR) and how to mobilize vulnerable community.

² First Meeting at Cox's Bazaar and Teknaf held on 5th March 2011 at Cox's Bazaar Municipality.

³ PDMC- Pouroshava Disaster Management Committee

Community Risk Assessment (CRA) - After conducting the training, the communities were facilitated with the process of community risk assessment. Under this activity, risk mapping, early warning action planning and implementation were facilitated through the identified volunteers and community based facilitator. Risk and resource maps were developed for each of the community (most vulnerable) level.

Simulation Exercise for Landslide Early warning and Preparedness

People centric “Community-based Landslide Early Warning Simulation” was conducted in Cox's Bazar Municipality on 28th February, 2012 in the honor of the visiting high level delegation from the Sri Lanka. H.E. Mr. Mahinda Amaraweera, the Hon'ble Minister of Disaster Management, Sri Lanka along with six other high level officials has visited ward no. 9 and 8 of Cox's Bazar municipality where a simulation on community-based landslide early warning was carried out. The simulation was carried out at the Ghonarpara Kaderia Primary School premise. H.E was accompanied by Mr. Nerthesinghe Nanayakkara Douglas, Additional Secretary, Ministry of Disaster Management, Gen. Gamini Hettiarachchi, from Disaster Management Centre-Sri Lanka, Mr. Lalith Chandrapala, of Department of Meteorology, Mr. N. I. C. Peiris, from NBRO, and Dr. Ananda Mallawatantri, from UNDP-Sri Lanka. The officials from the UNDP-Bangladesh, CDMP-II program and Cox's Bazar district administration have also observed the event. Moreover, similar exercise was conducted in Teknaf Municipality at Mymuna Registered Primary School Premises on 5th April 2012. National Project Director of CDMP-2 Mr. Abdul Quiyum was present during the simulation. Among others, UNO Teknaf, Officials from CDMP, Representative from GSB also were present during the simulation.



Simulation Exercise at Cox's Bazar on 28th February 2012

The community has expressed that this type of community-based early warning system initiated by CDMP-II program of the MoFDM has given them a good opportunity now to monitor landslides in their respective communities and take systematic measures to reduce the landslide risks in an effective way. The community has appreciated this engaging initiative and given a strong emphasis on expansion of such community-based early warning system and risk reduction measure in all the vulnerable areas of the district and beyond.

4.0 Landslide risk reduction strategy

It is important to take initiatives for mitigating landslide hazards and its effects on the communities through implementation of the process being carried out during this project. However, it requires motivation and understanding by the stakeholders working at the municipality level for implementation of the strategies. Following is the Landslide Mitigation initiatives in Hong Kong as an example followed by the landslide risk reduction strategies proposed for the Municipalities based on the experience from this study.

Special features in the Landslide Mitigation System adopted in Hong Kong

- The Government's objective and vision on landslide risk management is to meet Hong Kong's needs for the highest standards of slope safety.
- To achieve this objective and vision, a comprehensive Slope Safety System has been formulated under the policy direction of the then Works Bureau.
- The Slope Safety System is managed by the Geotechnical Engineering Office (GEO) of the Civil Engineering and Development Department (CEDD), with the overall target of achieving further reduction in risk to the whole community as quickly as possible
- Since May 1995, a Slope Safety Technical Review Board (SSTRB) has been appointed to advise the Government on technical aspects of slope safety.
- The three Board Members have been selected based on their high international standing in the geo-technical engineering profession, possession of appropriate knowledge and experience related to slope safety, and no involvement in commercial projects in Hong Kong.'
- Slope Safety System is reviewed regularly and benchmarked internationally through the SSTRB.

- Improve slope safety standards, technology, and administrative and regulatory frameworks
 - *Enhancing our geo-technical control strategy on building and infrastructure developments*
 - *Publishing slope safety standards and professional guidance documents*
 - *Investigating the causes of significant and serious landslides to continuously improve the Slope Safety System and for forensic purposes*
 - *Undertaking geo-technical research, including the study of natural terrain instability.*

- Ensure safety standards of new slopes
 - auditing the design and supervision of construction of new slopes
 - providing input to land use planning.

- Rectify substandard Government slopes
 - implementation of the LPM Programme to upgrade high priority, large substandard Government slopes
 - improving the stability of Government slopes not covered by the LPM Programme.

- Maintain all Government man-made slopes
 - updating, maintaining and disclosing the Catalogue of Slopes which contains information of some 57,000 sizeable man-made slopes
 - updating, maintaining and disclosing the register of maintenance responsibility of man-made slopes
 - periodic Engineer Inspection and routine maintenance of all Government slopes
 - systematic inspection and repair of all Government underground drains and water pipes which may affect the stability of adjacent slopes.

- Ensure that owners take responsibility for slope safety
 - safety-screening of old private slopes and enforcing statutory action to require owners to investigate and carry out necessary upgrading works to substandard slopes
 - initiating and enforcing statutory action to require owners to repair underground drains and water pipes which may affect the stability of adjacent slopes
- Promote public awareness and response in slope safety through public education, publicity, information services and public warnings
 - public education campaigns
 - warning and emergency services
 - information and community advisory services
 - identifying squatter huts at high risk from landslides so that clearance actions can be taken.
- Enhance the appearance and aesthetics of slopes
 - improving the technology in greening slopes
 - improving the aesthetic aspects of all newly formed and upgraded Government slopes
 - encouraging private slope owners to improve the appearance of their slopes
- Risk assessment calculations indicate that the overall landslide risk arising from old substandard man-made slopes to the whole community of Hong Kong has been reduced to about 50% of the risk that existed in 1977.
- Demanding but achievable objective of HK Government is to further reduce the landslide risk from old man-made slopes to below 25% of the 1977 level by the year 2010.

General aspects of implementation strategy: The general approach for implementation of the project on “Rainfall Triggered Landslide Hazard Zonation in Cox's Bazaar and Teknaf Municipalities as well as Introducing Community-based Early Warning System for Landslide Hazard Management” by the study team is summarized as follows:

A. Operationalization of project activities

The effectiveness of the support provided under this Project for Rainfall Triggered Landslide Hazard Zonation in Cox's Bazaar and Teknaf Municipalities as well as for Introducing Community-based Early Warning System for Landslide Hazard Management under CDMP II will depend on the aspect of operationalization and strategy adopted for transfer of knowledge to Government of Bangladesh in general and relevant stakeholders in particular during and after the project. Also it is connected with institutional arrangements, legal framework and policy environment created for utilization of the project outputs, institutionalization of the outcome of the project and exit strategy for subsequent handing over to Government of Bangladesh.

B. Connectedness and complementarities

It is important that the activities undertaken through the tasks implemented under this project to take into account for incorporating in the previous and on-going related activities being carried out by different stakeholders as well as future directions emerging in the disaster management sector and associated sectors. This will help to consolidate the long-term disaster risk management objectives of the Government of Bangladesh. The long-term disaster risk management objectives of Bangladesh in general and landslide vulnerability reduction in particular can be achieved through integration of the output of the project with the upcoming related initiatives. For example, the Landslide Volunteers Groups developed under this project can be linked up with the current Cyclone Preparedness

Program (CPP) initiated activities and can be linked up with the local fire service and civil defense department to include in their regular training programs.

C. Continuation of Similar Activities through National Agencies

During implementation of the Technical for Rainfall Triggered Landslide Hazard Zonation in Cox's Bazar and Teknaf Municipalities, Geological Survey of Bangladesh (GSB) was actively involved with the process. Moreover, the Municipality of Teknaf and Cox's Bazar was involved in all stages of the project for implementation of the project. At this stage, for continuation of similar activities and for sustainability of the landslide early warning mechanism, CDMP should take initiative for developing a group of Volunteers like CPP program under the ministry of food and disaster Management.

D. Ownership by the Executing Agency

The success of the outcome of the project will depend on the degree of ownership by any local agency that will be continuing the process in the future. During the implementation of the project, the respective municipalities of Cox's Bazar and Teknaf were involved with the process. However, it is not ensured that the municipalities will continue the same process in the future. Therefore, it is recommended that CDMP-2 should take initiative for continuation of the process through the municipalities as the executing agency of landslide monitoring & mitigation measures.

E. Possibility for Replication and basis for planning strategy for loss reduction

The activities implemented during this project were designed with the aim of identifying key interventions which can be piloted or demonstrated to others within or outside Bangladesh as a good practice so as to serve as a successful model for wider replication in the future.

The study was integrated in Geographical Information System (GIS) platform and the analysis were useful for municipality government officials, planners, engineers, emergency professionals and other stakeholder who deal with the potential consequences of landslide hazard in the targeted urban centers. The results presented in the form of maps and other deliverables may serve as an effective means of transferring information from the scientific community to the decision makers involved in vulnerability reduction at urban local government level. The landslide hazard zonation maps can be applied in preparation of urban development plans, review of development applications, planning/sitting/design of public facilities/utilities, emergency management facilities, EWS based on precipitation threshold limits and a basis for city authorities to guide the development with ultimate aim of vulnerability reduction.

F. Flexibility in operations to allow changes and modifications

Landslide hazard assessment is collaborative work of different subject experts/professionals and was depended on the surveyed results. Within the general procedure framework, different methods have been adopted for each of the steps in undertaking hazard and vulnerability mapping and setting up landslide EWS (like rainfall threshold etc.). However, success in this depends on the extent of the scientific information and analytical resources available and wiliness of the agencies to share the same with project staff. Initiatives should be taken for necessary changes and modifications in operations when and where necessary in conducting the similar projects in the future.

E. Land-use planning or zoning regulations

It is recommended that the landslide hazard maps developed for the municipalities should be integrated with the landuse plans of the areas. This will help to ensure proper landuse control mechanisms and the hilly areas will be come under proper conservation.

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