Making A Difference in Managing Water-Related Disaster Through Survey and Assessment

by

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ABSTRACT

The management of water resources within the context of river basins encompasses the need to anticipate risks and disasters brought about by water. This paper aims to highlight the need to address water-related hazards and risks such as floods and landslides. It must be noted that landslides and floods are water- related events that can be attributed to changes in climatic regime.

In the 2004 global report of the United Nations Development Programme (UNDP), the Philippines ranked as the third in terms of number of people exposed to earthquake and tropical cyclones annually. Uncontrolled human activities such as settlements in the flood plains, urban congestion and development activities in the uplands have exacerbated the impacts of natural hazards, both natural and man-induced.

As a tropical country with an annual rainfall of more than 2,000 millimeters, the Philippines has to live and cope with the reality that water is both beneficial and a major threat to the lives of thousand of Filipinos. The 2003 landslide in Panaon Island in Southern Leyte and in Surigao City has prompted actions for the need to address geohazards particularly water-related disaster through the conduct of a systematic geohazard assessment and mapping of areas susceptible to such phenomena. Southern Leyte and Surigao City were located in that part of the country which are subject to extreme rainfall condition that often results in flooding and often trigger mass movement or landslides. It has therefore become imperative that a systematic geohazard assessment and mapping be conducted to identify unstable sites so that appropriate measures can be instituted.

To address problems of geohazard, especially those that are triggered by water in the form of excessive rainfall, a study on the development of a mitigation scheme for geological hazards was undertaken by the Department of Environment and Natural Resources (DENR) as part of the Environment and Natural Resources (ENR) Shell Programme under the auspices of the United Nations Development Programme (UNDP). The study was implemented from March to December, 2004 and was intended to generate information on the vulnerability of portions of the selected pilot areas to natural hazards like landslides, flooding, subsidence, coastal degradation, tsunamis, earthquake and similar geologic events, and make these information available to

decision makers, planners and other national and local authorities. These information can become the solid basis for land use planning and development and more importantly for disaster management and risk mitigation. The study was also designed to better prepare local communities to manage and cope with disasters and risks related to geological and water induced hazards. The approach adopted involved the characterization of various events in terms local conditions (past occurrences of landslides, flash flooding, subsidence) together with the identification of areas or sites susceptible to different geologic and water-related events. The main concerns of the project were flooding, rain-induced landslides and other mass movements, subsidence, ground instabilities and coastal storm surges. Furthermore, actual flooding surveys and landslide inventory were also conducted with the communities as provider of information. These were done using survey questionnaire and checklists

The final outputs of the project were geohazard susceptibility maps of the pilot areas of the scale 1:50,000 and 1:10,000. The maps produced by the project provided immense value to policy makers, land use planners, investors and agencies involved in disaster management and risk mitigation, urban planning, housing development, and land use planning. By carefully considering the susceptibility of certain areas to a particular geologic and water related hazards, the government can effectively come up with realistic programs for disaster management, risk mitigation and land development.

Cognizant of the vital role of LGUs in the preparation of comprehensive land use plans of their respective areas (province, city and municipality) in general and the formulation of zoning regulations, these geohazard maps will provide vital inputs that would serve as basis for land use and zoning policies at the local levels. It is expected that with the geohazard information, local government units can effectively develop programs addressing water induced disasters.

On the other hand, these geohazard maps need also to be communicated to local communities who are directly affected by water-induced disaster such as flooding and landslide. This is necessary to enable the local communities to understand the implications of such water-induced disasters and effectively put in place coping mechanisms and schemes to address said problems. Information campaigns and capacity building programs for community members to manage water-induced disasters should be pursued. Thus, ensuring disaster and risk preparedness at the same time minimizing damages to life and property. It is of utmost importance that geohazard survey and assessment be recognized as an effective way to address and cope with water related hazards and climate variability brought about by continuing climate change.

Key words: water-related hazards, landslides, flooding, geohazard, disaster management, risk mitigation

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I. Introduction:

The Philippines, considered as the Pearl of the Orient Seas, is a country famous for its tropical climate and scenic spots . However, its geographic location within the circum pacific rings of fire, renders it highly vulnerable not only to natural disasters that are geologic in nature such as earthquake, volcanic eruptions, but also susceptible to climatic variability causing tropical cyclones and floods. Because of this, Philippines has to contend with geological hazards (or geohazards) most of the time. Geological hazards or geohazards are natural hazards which result from geological phenomena. These could be endogenous in origin (such as earthquake and volcanic hazards) or exogenous in origin (such as mass movement or landslide, floods, accelerated erosion and drought.

In the 2004 global report of the United Nations Development Programme (UNDP), Philippines ranked as the third in terms of number of people exposed to earthquake and tropical cyclones annually. The same report places the country with the highest frequency of tropical cyclones with reported deaths. Uncontrolled human activities such as settlements in the flood plains, urban congestion and development activities in the uplands have exacerbated the impacts of natural hazards. Based on reports compiled by the (Philippine) Office of the Civil Defense for the period 1990 to 2001, the total damages from natural disasters was estimated to be US$3 B. This means an annual average damage to property of US$ 259 M. It must be noted however that this figure considered only direct cost which means that the total actual damages brought about by natural disasters could be much, much higher. It is worthwhile to note that a considerable amount can be attributed to damages caused by flooding resulting tropical cyclones.

The landslide that occurred in Panaon Island in Southern Leyte and in Surigao City in 2003 has prompted actions for the need to address geohazards with focus on water-related disaster through the conduct of a systematic geohazard assessment and mapping of areas susceptible to such phenomena. Both Southern Leyte and Surigao City were located in that part of the country which are subject to extreme rainfall condition that often trigger mass movement or landslides and flashflood. While the threat of landslide and flashflood in these areas may have subsided at present, the instability of these and other contiguous areas due to its geologic composition and the amount of rainfall it receives remain and would continue to pose threat to the local population. It has become imperative to conduct a systematic geohazard assessment and mapping to identify unstable sites so that appropriate measures can be instituted. Being a tropical country with an annual rainfall of more than 2,000 millimeters , the Philippines has to contend and cope with the reality that water is both a benefit and a major threat to the lives of thousand of Filipinos. Flooding often results from heavy rainfall. Excessive rain almost always trigger landslides in high and sloping areas.

Figure 1 : Photos showing examples of water-related hazards such as flooding and landslide in the Philippines (Photos courtesy of Mines and Geosciences Bureau, DENR)

II. Management of Water-Induced Disaster Through Survey and Assessment:

In 2004, the Department of Environment and Natural Resources (DENR) and the Mines and Geosciences Bureau (MGB) implemented a project on geohazard assessment and mapping with emphasis on water-induced hazards. This undertaking was made possible through assistance from the United Nations Development Program to address problems of natural disasters, especially those that are triggered by water in the form of excessive rainfall. Thus, a study on the development of a mitigation scheme for geological hazards was undertaken as part of the Environment and Natural Resources (ENR) Shell Programme. The study was intended to generate information on the vulnerability of portions of the selected pilot areas (mostly along the Philippine eastern seaboard) to natural hazards like landslides, flooding, subsidence, coastal degradation, tsunamis, earthquake and similar geologic events. The intention was to make these information available to decision makers, planners and other national and local authorities. These information were transformed into susceptibility maps that provided basis for land use planning and development and more importantly for disaster management and risk mitigation. The study was also designed to better prepare both local government units and local communities to manage and cope with disasters and risks related to geological hazards by educating and informing them of the susceptibility and vulnerability of their communities.

The approach involved the characterization of various events in terms local conditions (past occurrences of landslides, flash flooding, subsidence) and the identification of areas or sites susceptible to different geologic and water-related events. The main concerns of the project were flooding, rain-induced landslides and other mass movements, subsidence, ground instabilities and coastal storm surges. Furthermore, actual flooding surveys and landslide inventory were also conducted with the communities as provider of information. These were done using survey questionnaire and checklists. In addition, collection of soil samples were also done with soil samples brought and analyzed in the soils laboratory.

Figure 2: Photos showing interview with local population and collection of soil samples (Photos courtesy of Mines and Geosciences Bureau, DENR)

The project also made use of Geographic Information System (GIS) to collect, manage and analyze data in order to come up with the geohazard maps. There were six regional pilot areas selected on the basis of landslide and flooding events being experienced as well as criteria such as population and extent of growth and level of economic development. The selected pilot areas for the project were: Easter Rizal, Panaon Island, part of the Naga and Legazpi City, the Cagayan de Oro-Gingoog coastal strip, part of Tagum and Davao City as well as part of Surigao and Butuan City.

The production of the 1:50,00 scale geohazard maps were accomplished using GIS desktop mapping. The methods used were based on the standardized procedures developed by the Mines and Geosciences Bureau of DENR on Geological Hazard Maps Production for the entire country. Its production method purely involved the compilation of existing and available data, conversion to digital format and analysis using the Integrated Land and Water Information (ILWIS) software. Data were arranged into organized themes and each theme was further classified according to its attribute on the basis of susceptibility to a specific hazard type.
The production of the 1:10,000 scale geohazard maps involved interpretation of aerial photographs and satellite images and detailed geohazard field mapping of selected areas. The high risk areas delineated at 1:50,000 scale geohazard maps were prioritized for detailed ground mapping at 1:10,000 scale. Additional output in this mapping scale are suitability maps for human settlements in selected areas.

III. The Water-Related Hazard Maps: Its Uses and Importance

The final outputs of the project were geohazard susceptibility maps of the pilot areas of the scale 1:50,000 and 1:10,000. The medium term objective of the government is to complete the geohazard mapping of the whole country in the next two years. Based on standard procedures, flood prone areas either by sheet flooding or tidal flooding were mapped based mainly on elevation. Specific for flood-prone areas, these areas were mapped using digital terrain model (DTM) in combination with thematic data on terrain mapping units. The DTM was prepared in ILWIS using 1:50,000 topographic maps. Based on the DTM, flood prone areas were determined and identified.

On the other hand, the landslide prone areas were derived using several thematic data including one derived from the DTM. The themes included: rock formation, river systems, slope, faultlines and road network. Linear and point themes were derived by buffering to unify with polygonal theme and make them ready for overlay operations in raster mode. The result was a map showing areas of varying susceptibility of the pilot areas to landslides and flooding.

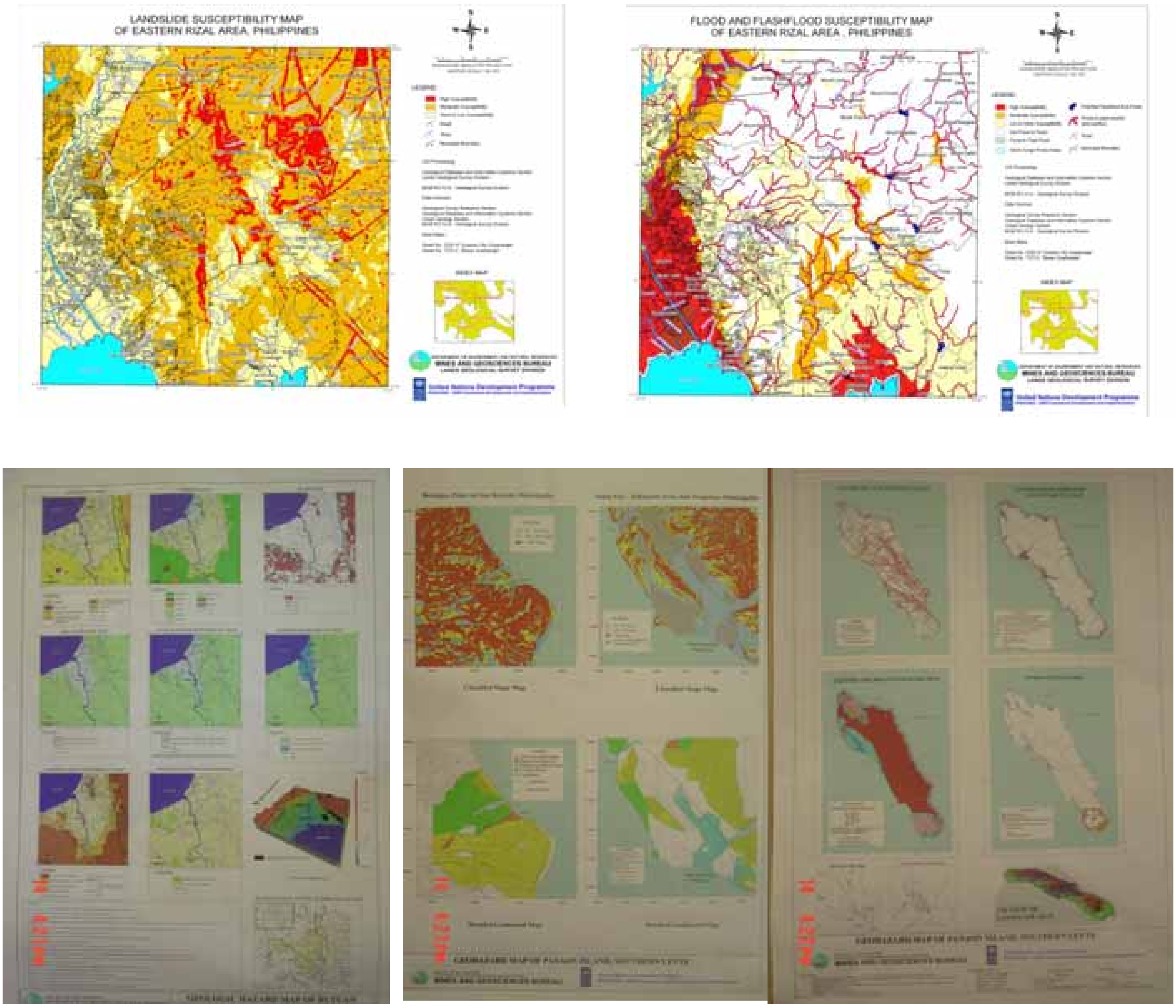

Figure 3: Photos showing examples of geohazard maps (landslide and flooding maps) produced and distributed (Maps courtesy of Mines and Geosciences Bureau, DENR and ENR Shell Programme)

The landslide susceptibility maps have three (3) distinct categories of the susceptibility of the area to said hazard namely: High, Moderate and Low Susceptibility. Accordingly, the prominent red patches are highly susceptible to landslide. These highly susceptible zones were derived based on their nearness to faults and road cuts, presence of highly altered rocks, moderate to steep slopes and those characterized as having denudational hills and mountain structures. Those areas described having moderate susceptibility to landslides were characterized by moderately steep slopes (of slope 15 to 30%), with most of the landslides developed of generally small, some of which have caused extensive damage to properties and loss of many lives. The zones with low landslide susceptibility are delineated in gently sloping to sloping terrain (from 5% to 15%) and are near the boundary of alluvial plains and low hills. Minor, isolated landslides may develop in these low hills but these are relatively insignificant in terms of their physical impact to the populace. Cognizant of the combined geological and slope characteristics and with excessive rainfall brought about by typhoons (tropical cyclones) as trigger for landslide, these tend to be highly prone to landslides or land mass movements.

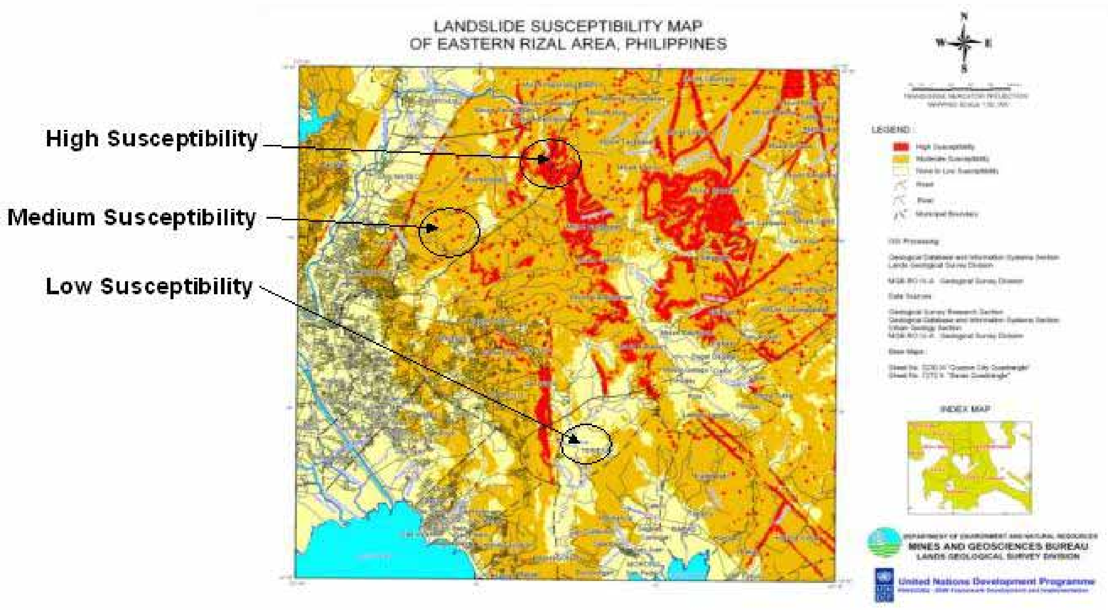

Figure 4 : An example of landslide susceptibility map (Courtesy of Mines & Geosciences Bureau, DENR and ENR Shell Programme)

In the case of flood susceptibility maps, delineation of flood prone areas were based on recorded events and geomorphological features of the study/pilot areas. Red patches on the maps represent regularly to frequently inundated areas which are strictly confined to swampy tidal flats, fluvio marine, fluvio deltaic levees and ridges, major river beds, backswamps and fluvial basins, abandoned river channels and meanders, meander core and point and alternating bars. Seasonally to rarely flooded areas include minor riverbeds and elongated alluvial plains, floodplains, incised valleys in lover volcanic footslopes and coastal plains. Areas where elevation is greater than 20 meters are designated to be not prone to floods. Of importance in the flood susceptibility map categories are the those areas identified to be of high susceptibility, moderate susceptibility and low to non susceptible to flooding. Areas shared red corresponds to areas that are highly susceptible to flooding and these areas are characterized as having an elevation up to 20 meters and include natural or man-made riverbeds, flood plains, alluvial plains and swamps or mashlands. Fluvial terraces, alluvial fans and infilled valleys are areas known to be moderately susceptible to flooding. Low hills and gentle slope with low to moderate elevation and have sparse to moderate drainage density generally belong to low or no flooding susceptibility. The flood susceptibility maps also contained information such as areas prone to tidal flood, storm surge prone areas and potential flashflood exit points.

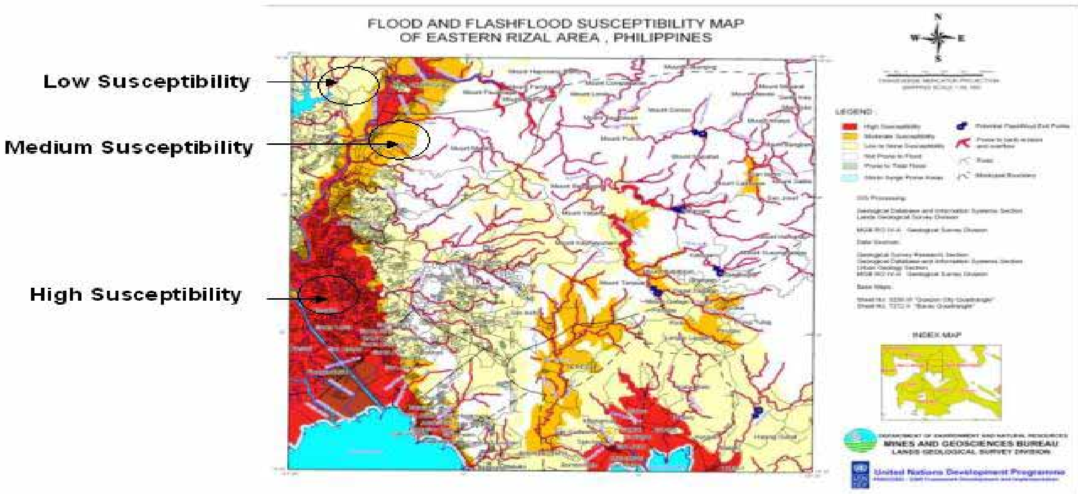

Figure 5 : An example of flooding susceptibility map (Courtesy of Mines & Geosciences Bureau, DENR and ENR Shell Programme)

From a water –related hazard perspective, potential flashflood exit points are relatively important. These are points where flash flooding is expected to occur, based on the premise that the time traveled by surface runoff over the distance to the exit point id shorter, thus the impact of many tributaries draining towards an exit point in such a short time would trigger sudden rise of water levels. The longer surface runoff travels (elongated-shaped watersheds) from the catchment basin to the point where it exits towards the main river channel, the less likely a flash flood will occur. Criteria for flash flooding event are based on configuration of the catchment area observed from a topographic map. Where the shape of the catchment area as it drains towards a single outlet is circular or oval shaped, flashflood will likely to occur. In the flood susceptibility map, areas prone to flashflood are given the symbol of a circle with an arrow, where the circle indicates the point of exit of floodwaters and the arrowheads point towards the direction of flow.

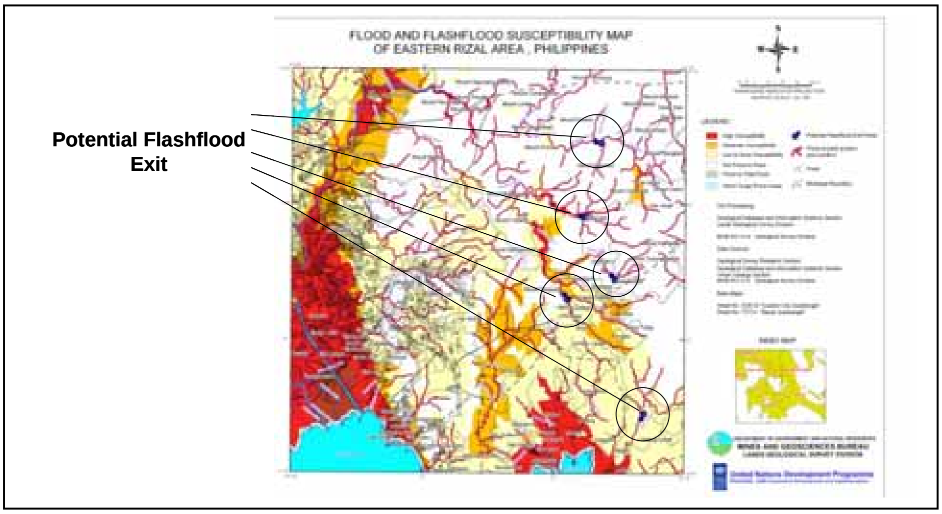

Figure 6 : An example of flooding susceptibility map indicating potential flashflood fxit points (Courtesy of Mines & Geosciences Bureau, DENR and ENR Shell Programme)

Viewed from a macro planning perspective, the geohazard maps produced by project provided immense value to policy makers, land use planners, investors and agencies involved in disaster management and risk mitigation, urban planning, housing development, and land use planning. These maps are now used as basis for comprehensive land use planning, in the issuance of zoning regulations and in the preparation of a national disaster management framework and plan. By carefully considering the susceptibility of certain areas to particular geologic and water related hazards, the government can come up with safe and realistic programs for disaster management, risk mitigation and land development. Thus, ensuring disaster and risk preparedness at the same time minimizing damages to life and property. It is of utmost importance that geohazard survey and assessment be considered as one of the solutions to address and cope with water related hazards and climate variability brought about by climate change.

IV. Engaging The Local Government Units (LGUs) as Partners in the Management of Water Related Disasters

The project recognized the important role of the Local Government Units as partners in the management of water related disaster. Thus, in addition to the geohazard maps which were the major outputs of the project, the project activities also focused in engaging the LGU. It facilitated the creation of a closer relationship with the local government units within the pilot regions and sites. At the start of the project, the team made it a point to coordinate with the local government units, in particular the local engineering departments/units and the municipal planning and involved them in the series of meetings and discussions. Data from the municipality on flooding and landslide incidents in the past years were collected and analyzed.

As an integral part of the project, an Information and Education Campaign (IEC) on water-related hazards was conducted in the pilot areas . Target participants from the LGUs include LGU heads such as the governors, mayors and barangay chairmen. Thus, with the completion of the geohazard maps of the barangays and municipalities in the priority regions, the same were the subject of the information campaign conducted by the project team with special emphasis of sharing these data and information with the local government units concerned. The primary objective was to inform the LGUs on the reality of water-induced hazards such as flooding and landslides and educate them on mitigation measures to cope with such hazards. During the said seminars/workshops, geologists and other experts were invited to discussed in detail the data and information contained in the geohazard maps. A thorough discussion of the flooding and landslide susceptibility maps were done with emphasis on the impacts of such areas to current and future developments within the concerned barangays and municipalities (within the pilot regions). The LGUs were also taught to understand and use the geohazard maps as guide to local comprehensive land use planning and zoning. To ensure the use of the geohazard maps in local development planning, copies of the geohazard maps were produced and distributed to the municipalities concerned. A compact disk (CD) containing the said maps with explicit information were also produced for the LGUs including a CD on geohazard for information, education and communication (IEC) campaign purposes The IEC CDs which were prepared originally in English, were translated in the local dialect to make it more useful and understandable to the local people. Furthermore, part of the advocacy campaign and in coordination with the LGUs concerned, was the placement of warning signs in English and in local dialects informing the community as to the susceptibility of certain areas within the locality to water related hazards, in particular, those that are highly prone to landslides. Through these signs, it is expected that these will serve as a reminder to the community as to the threats of building houses within such areas.

Figure 6 : Example of workshop with local government units officials and staff (Courtesy of Mines & Geosciences Bureau, DENR and ENR Shell Programme)

III. Involving the Community in the Management of Water –Related Hazards

Experience showed that almost always when disaster strikes such in the case of flooding and landslides, the first to be affected are the local population, meaning, the people that lives in the community that are highly prone to such disasters. Logic therefore dictates that the community as a whole should be regarded as the first line of defense for such water-related calamities. The readiness of the communities and their capability to cope with flooding and landslide need to be built up, strengthened and sustained. Thus, the involvement of local communities in managing water related hazards is not only critical but a vital aspect of water-related disaster management programs. In the case of the project, community involvement was made explicit in the project by the active participation of the communities in the provision on relevant information on floodings and landslides that were captured and collected during the conduct of the community survey and assessment. As respondents to the survey questionnaire, the community has provided the project with valuable information that were used in the preparation of hazard maps. Furthermore, the community also provide assistance in the collection of soil samples that were analyzed to provide additional primary information for the preparation of soil profiles.

The communities were the main targets during the conduct of the information and education campaigns. Men and women from the communities actively participated in the information drive activities. Using mainly the flooding and landlside susceptibility maps generated by the project, the information contained in the said maps were communicated and explained to the communities, thus providing the community with the knowledge and understanding of the dangers posed by these water-related hazards. The same knowledge and understanding had helped communities prepare to cope and anticipate such events. Awareness was created among them on the hazards posed by building houses in flood prone and landslide areas. This awareness was instrumental in the acceptance of the community to adhere to zoning regulations by not building or expanding settlements into areas that has been mapped and defined to be highly susceptible to flooding and landslides.

Fig. 7 : Interaction with local population through advocacy campaigns (Courtesy of Mines & Geosciences Bureau, DENR and ENR Shell Programme)

Figure 8 : Photos of signages indicating susceptibility of the sites for potentials landslides as a way of educating the community (Courtesy of Mines & Geosciences Bureau, DENR and ENR Shell Programme)

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