MULTI-HAZARD MAPPING
using Geographic Information System (GIS)

Multi-Hazard Mapping using GIS

ACF Disaster Risk Reduction (DRR) Project has been implemented in Camarines Sur and Catanduanes with the objective of reducing the population's vulnerability of population to natural disasters.

Hazards like typhoon, landslide, flood, storm surge, tsunami, and earthquake poses risks to life, property and livelihood compounded by physical exposure and proximity to hazard-prone areas, socio-economic, and cultural and behavioral conditions.

An integral part of disaster risk reduction undertaken by this project is the Geographic Information System (GIS)-based Multi-hazard Mapping conducted in pilot barangays from the two provinces. The process of multi-hazard m apping integrates different hazard-related information for specific areas to convey a composite picture of natural hazards in varying magnitude, frequence and areas of effect.

Combination of spatial analysis and local knowledge of communities are essential inputs in producing multi-hazard maps. Local knowledge of communities are gathered through Participatory Capacity and Vulnerability Assessment (PCVA) where community members develop community hazard and resource maps.

Using GIS, maps are produced through the integration of spatial data and local community knowledge. GIS aids in efficient development, storage, updating, access and sharing of multi-hazard mapping information.The availability of reliable multi-hazard maps are important risk assessment tools providing relevant information essential for community planning and decision making, especially in emergency response, and disaster preparedness and mitigation.

Key Concepts in Multi-Hazard Mapping

HAZARD: "A potentially damaging physical event, phenomenon or human activity that may cause loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards include latent conditions representing future threats and can have different origins: natural (geological, hydrometeorological, biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability."

GEOGRAPHIC INFORMATION SYSTEM (GIS): "Analysis that combine relational databases with spatial interpretation and outputs often in form of maps. More elaborate definition is that of computer programmes for capturing, storing, checking, integrating, analysing and displaying data about the earth that is spatially referenced. GIS are increasingly being utilised for hazard and vulnerability mapping and analysis, as well as for the application of disaster risk management measures."

Source: UN International Strategy for Disaster Reduction, 2004
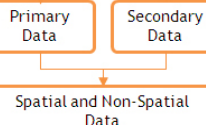
The Process of Multi-Hazard Mapping using GIS

1. Hazard Identification and Data Acquisition

- Primary Data
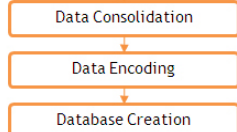- Secondary Data
- Spatial and Non-Spatial Data

Data acquired from primary and secondary sources were subject for field validation, ground truthing and accuracy check and cleaned up based on spatial and non-spatial data.

Primary data were collected from Global Positioning System (GPS) survey with georectified NAMRIA map and images from Google Earth, community consultation and use of PCVA community maps developed by community members including barangay council and representatives from women, elderly, and youth sectors. Secondary data were collected from NAMRIA, PHIVOLCS, and Google Earth.

2. Data Processing and Database Creation

- Data Consolidation
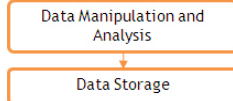- Data Encoding
- Database Creation

Relevant data are integrated, consolidated, and encoded in Microsoft Excel spreadsheet. Each datum identified is classified according to groups (i.e. Elevation, Northing, Easting, etc.). This process brings data into the electronic environment.

Database creation starts when encoded data are processed through GIS software developing a database for hazard maps per barangay (i.e. Flood hazard map, Landslide hazard map, etc.) with non-spatial attributes associated to spatial features (i.e. Longitude-Latitude) coming up with topology and themes allowing for iterative and interactive pair-wise comparison.

3. Data Manipulation, Analysis and Storage

- Data Manipulation and Analysis
- Data Storage

Analysis on data gathered for multi-hazard mapping and risk assessment focused on features and corresponding position on Hydro-Meteorological Hazard and Siesmic Hazard maps from national data incorporating local knowledge from the barangays. Spatial analysis tools are used to model, predict and reach conclusions include geometrics manipulation and analysis including data projection, joining tables, vertex adjustment, features symbology, GPS data integration.

Data Storage is the process of storing analyzed and manipulated data. On-screen digitizing of maps was done.
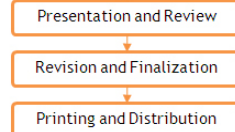
4. Data Exporting and Product Generation

- Data Exporting
- Product Generation

Data Exporting and Product Generation were done with the completion of maps. Outputs can be in the form of maps and other illustrations like charts, graphs, tabular reports depending on what specific information are required to be generated.

5. Review, Finalization and Publication

- Presentation and Review
- Revision and Finalization
- Printing and Distribution

Maps were presented to and reviewied by partner DCCs from regional, provincial, and municipal levels particularly to key persons involved with local development planning and disaster management, and partner agencies like PAGASA, PHIVOLCS, and MGB Region V. Revisions were incorporated based on inputs gathered.

Maps are printed and published in an interactive GIS stand-alone environment for CD distribution using HTML environment together with a Multi-Hazard Brochure.

Uses of Multi-Hazard Maps

Hazard and Risk Identification

Impact of natural disasters can be minimized significantly if proper and timely information is available. Multi-hazard mapping process supports the requirement of availability of relevant information since the first step in producing multi-hazard maps is the identification of hazards and risks. Information about areas that maybe affected by various hazards and location of vulnerable elements such as population, buildings, infrastructure, livelihood sources.

Emergency Response

During disasters, local government units (LGUs) are under extreme pressure to make abrupt decisions affecting thousands of people, often with limited time to analyze situations and undertake actions.

Maps are cartographically simple with information enabling local chief executives to make prompt and appropriate responses especially in emergencies. Maps help LGUs identify, prioritize, and allocate resources to vulnerable population in high risk areas for safe evacuation, rescue, relief and rehabilitation.

Risk Management and Local Development Planning

Hazard mapping is a crucial guide in optimizing development gains and minimizing potential loss of physical assets, human resources, and environmental capital.

Mainstreaming multi-hazard mapping into local development planning is essential to effective disaster risk management. The link between DRR and population growth, physical demands of human settlement, economic planning and appropriate use of land should be recognized by LGUs.

Maps contained and updated in local planning information database are useful documents for crafting of disaster risk management plans, local development plans, water management plans, tourism plans, land-use plans, zoning and other land use regulations.

Possible Problems in Multi-hazard Mapping

Data quality from reliable sources is an important consideration contributing to the multi-hazard mapping process credibility. Hence, LGUs need to be aware to anticipate possible problems that may be encountered in undertaking this activity, and take necessary actions to ensure that outputs produced are of high quality.

Lack of or Outdated Cadastral Base Maps

In many areas, updated cadastral maps may not be available to be used as base maps in preparing accurate hazard maps. Using old base maps might lead to inaccurate boundaries and other physical structures, and will not represent the area's real situation. Hence, GIS-based multi-hazard mapping should use updated base maps.

Differences between Available Base Maps

Discrepancies maybe observed in geospatial features like rivers and coastal boundaries when using maps from varied sources due to differences in dates. For example, NAMRIA maps were gathered in 1950s while Google Earth images are dated 2000. Hence, LGUs should determine base map source to be used or if using multiple base map sources, clearly indicate differences in the hazard maps produced.

Change of Geo-spatial Features Over Time

Dynamic environmental variations, human settlements and activities bring changes to geo-spatial features of areas. Hence, regularly updating of map information and conducting field validation are necessary to maintain validity, accuracy and reliability of the hazard maps.

Capacity Building

Investment on capacity building activities should be done to ensure active community participation and equip LGUs with technical staff possessing knowledge, skills, and equipment to successfully perform multi-hazard mapping.

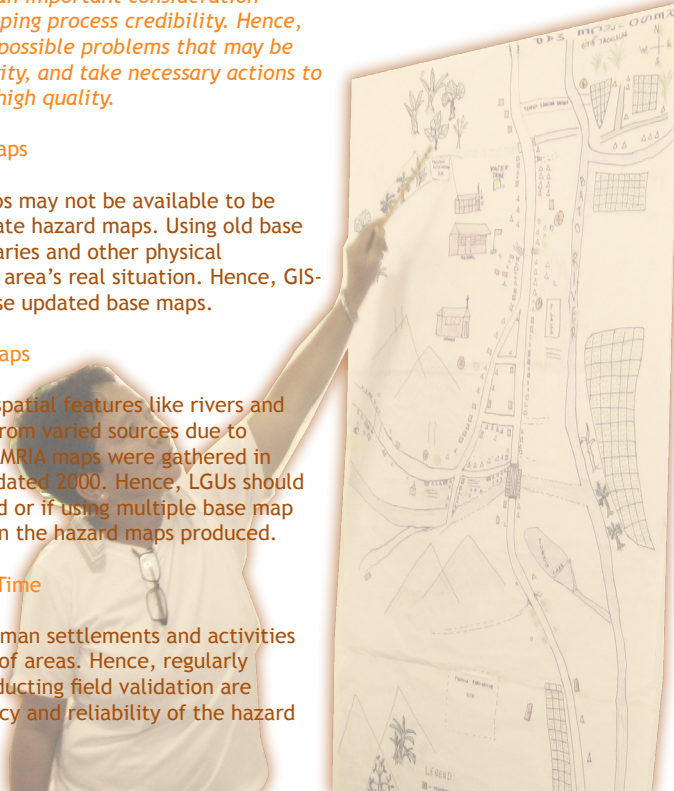## Participatory Capacity and Vulnerability Assessment (PCVA)

Community inputs are essential in mapping process, hence, community involvement is important. Communities where areas are subject for mapping should be aware with clear understanding of the purpose and importance of multi-hazard mapping. PCVA can be used as a venue were barangay council members, and sector representatives from women, elderly, livelihood and youth jointly participate in mapping hazards in their areas based from first-hand experience.

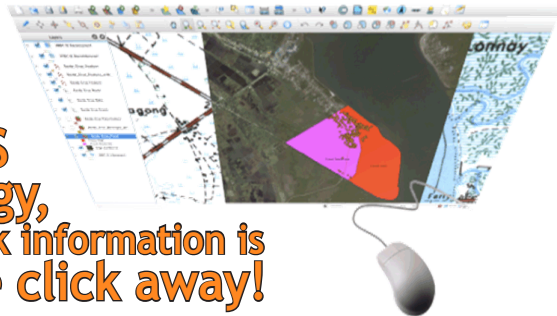## Training on Multi-Hazard Mapping using GIS

Local development planners, disaster risk managers, and technicians in-charge of producing and updating require trainings, especially on software use since GIS skills are software-specific.

Provision of Hardware and Software

Computer, GPS devices, and GIS software are needed to develop, store, and update hazard maps. Hardware with at least Pentium III with 128RAM and 64MB video card, GPS device of any model, and Operating System (Cross platforms). Softwares range from open source to paid.

With the aid of GIS technology, risk information is just one click away!

Multi-hazard Mapping using Geographic Information System (GIS) is a pilot activity of ACF under its Disaster Risk Reduction (DRR) Project. This information material includes a brochure and a CD.

The brochure describes the importance, process and possible problems faced in multi-hazard mapping with the aim of informing LGUs intending to pursue and replicate this activity in their localities. The CD contains the multi-hazard map database covering ACF project areas and are intended for use and subject for updating of respective provincial and municipal governments.

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