

Annex 10: Utilizing GIS data for enhanced humanitarian shelter programming

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A geographic information system (GIS) is a system that allows for the creation, management, analysis, and mapping of all types of data. Relationships, patterns, and further analysis are easily drawn out through GIS as location data with all types of descriptive information are integrated into one space (ESRI, n.d.). The system allows for real-time manipulation of data which further translates to informed and deepened analysis for almost every industry, including the shelter and settlement sector.

Applicability of GIS for Enhanced Humanitarian Shelter Programming

The utilization of Geographic Information Systems (GIS) in humanitarian shelter programming offers numerous advantages and benefits. This tool can be employed in infinite ways thereby providing evidence for planning, decision-making, and action response. One notable application of Geographic Information Systems (GIS) in the context of humanitarian shelter programming involves the evaluation of site suitability and spatial vulnerability of prospective locations for transitional or permanent shelters.

The selection of locations for shelters, particularly those designated for evacuation or emergency purposes, necessitates careful consideration to ensure the community's safety. In order to mitigate the hazards present in a given area, it is necessary for the site to possess a suitable elevation and slope that can withstand these hazards. Furthermore, it is crucial that the designated area is situated at a considerable distance from industrial zones and locations prone to secondary calamities. The assessment of appropriate locations for evacuation shelters contributes an additional dimension to the field of disaster preparedness and the enhancement of resilience within an area in particular (Mabahwi et al., 2021).

The assessment of site suitability and spatial vulnerability of an area can be done through GIS. Relevant layers such as the administrative boundary, slope, elevation, land use, hazard, lifeline utilities (i.e., roads, electricity and water lines) and critical point facilities (i.e., institutional and social establishments such as hospitals, schools, church) can be used and laid on top of one another to pinpoint potential areas for evacuation shelters.

Utilization of GIS

There are two main “software” elements that must be at hand for a user to develop a visual presentation (i.e., map) – 1) a software that has all the necessary geoprocessing tools; and 2) the required data (i.e., layers such as raster or vector data, webmaps) that will be manipulated to result to a visual presentation of a certain theme.

GIS Program / Application / Software

A GIS program or application allows for a user to create, view, edit, visualize, analyze, and publish geospatial data and information through its built-in and extension functions and tools. There are several types of GIS software available for public use – Desktop GIS, Web GIS, Server GIS, and Specialized GIS. Among these, Web GIS is the most accessible especially for non-expert GIS users as this offers a quick and easy interaction with already developed map visualizations. On the other hand, Desktop GIS is commonly used for creating and editing geospatial data and maps (Mango, n.d.). For Desktop GIS, there are two most commonly used software: ArGIS and QGIS.

ArcGIS is a GIS software developed and maintained by Esri. It offers an array of tools to facilitate activities related to spatial analysis and data science, field operations, mapping, three-dimensional GIS, imagery and remote sensing, and data collection and management (Esri, n.d.).

QGIS is a free and open-source GIS software. This is a reliable software that can be utilized by organizations for its accessibility and well-rounded capabilities (QGIS, n.d.).

Platforms and Sources of GIS Data

Different types of organizations, both at the international and national level, have developed and are implementing initiatives to facilitate free and accessible GIS data for enhanced planning and programming, including that of the shelter and settlements sector. Shown in the table below are the platforms and types of data that these sources house and provide. It is noted that all national sources indicated do not require any GIS software as the data and information are readily presented on the website through the selection of specific thematic datasets and locations.

Table 1. International and National Sources of GIS Data

Source	Description	Website / Link
International		
The Humanitarian Data Exchange (HDX)	This source houses different types of humanitarian datasets (i.e., context of the humanitarian crisis, people affected by the crisis and their needs, response of organizations, people seeking to help those who need assistance). The data source platform is being managed by the OCHA's Centre for Humanitarian Data (Humanitarian Data Exchange, n.d.).	https://data.humdata.org/
Protected Planet	Protected Planet is a source of data on protected areas and other effective area-based conservation measures (OECMs). Through the platform, the public can access the World Database on Protected Areas (WDPA), World Database on OECMs, and Global Database on Protected Area Management Effectiveness (GD-PMAE), among others (Protected Planet, n.d.).	https://www.protectedplanet.net/
DIVA-GIS	The DIVA-GIS houses numerous country-level datasets including administrative boundaries, inland water, roads, railroads, elevation, land cover, population, climate, and gazetteer.	http://www.diva-gis.org/gdata
IUCN Red List of Threatened Species	The IUCN Red List of Threatened Species contains downloadable spatial data in various formats of the location of various threatened species globally.	https://www.iucnredlist.org/resources/spatial-data-download

Source	Description	Website / Link
Free GIS Data	The website presents a thorough list of resources for various types of data per country, particularly physical and environmental data.	http://freegisdata.rtwilson.com/#home
UMD Global Forest Change 2000-2016	The website showcases the global forest cover and change from 2000 to 2016. The developers made use of Landsat images to present a time series analysis of the forest area. Datasets that can be found in the platform are tree canopy cover, global forest cover gain, and year of gross forest cover loss, among others (University of Maryland Department of Geographical Sciences, n.d).	http://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.4.html
Global Biodiversity Information Facility	The Global Biodiversity Information Facility is an international network and data infrastructure that is funded by the governments of its participating and observer countries. The facility holds a diverse array of datasets on all types of life on Earth. As an observer country, dedicated datasets of the Philippines are readily available at the website.	https://www.gbif.org/ https://www.gbif.org/country/PH/summary
Ocean Biodiversity Information System	The Ocean Biodiversity Information System consolidates into a one single platform, numerous periodic datasets on marine life.	https://obis.org/
US Government data	The website houses numerous and diverse global datasets including elevation, and resource extraction, among others.	https://catalog.data.gov/dataset
National		
Geoportal PH	Geoportal PH provides geospatial data and services. Managed by the National Mapping and Resource Information Authority, the presence of the portal serves an advocacy for the use of standard multiscale base maps as tools for informed and strategic planning, decision making, situational analysis, and other activities needing this type of service (Geoportal	https://www.geoportal.gov.ph/

Source	Description	Website / Link
	<p>Philippines, n.d.).</p> <p>The portal houses the following datasets relative to the following:</p> <ol style="list-style-type: none"> 1. Administrative boundaries (regional, city/municipal, barangay) 2. Environment and Forest (i.e., topography, land cover, land uses, major river basins, CADT, natural resources, air quality monitoring stations) 3. Agriculture 4. COVID-19 Case Information Summary and Status 5. Natural and Man-made Hazards (Disaster Risk Reduction and Management) 6. Social and Institutional Infrastructure (i.e., NGA offices, hospitals, schools) and Utilities (i.e., road networks) 7. Tourism 8. Social Services and Population <p>A very useful dataset for the sector of concern that is found in the portal are the percentage of households living in makeshift housing and the percentage of households who are informal settlers.</p> <p>An inventory of data from the different national government agencies and local government units that can be found in the portal can be accessed through this link: https://www.geoportal.gov.ph/resources/GP_DataInventory.pdf</p>	
Nationwide Operational	The portal provides mapping data for three hazards	https://noah.up.edu.ph/

Source	Description	Website / Link
Assessment of Hazards	namely flood, landslide, and storm surge. Additional information layers that may be exposed to these hazards such as road networks and institutional infrastructures are also presented in the platform (ESCAP, n.d.).	
GeoRiskPH Integrated Platform	<p>The GeoRiskPH Integrated Platform is a product of the Geospatial Information Management and Analysis Project for Hazards and Risk Assessment in the Philippines (GeoRisk Philippines). GeoRisk Philippines is a multi-agency initiative led by PHIVOLCS and participated by Department of Science and Technology (DOST)-PAGASA, DOST-Advanced Science and Technology Institute (ASTI), DENR-MGB, DENR-NAMRIA, Department of National Defense (DND) – Office of Civil Defense (OCD), and Department of Education (DepEd) (GeoRiskPH, n.d.).</p> <p>The Integrated Platform houses five different tools which are HazardHunterPH, GeoAnalyticsPH, GeoMapperPH, PlanSmart Ready to Rebuild, and 3D Earth Risk Information System, and Map & Feature Services.</p> <p>Out of the five, HazardHunterPH and GeoAnalyticsPH offer immediate access to mapping data.</p> <ol style="list-style-type: none"> 1. HazardHunterPH is considered as a one-stop shop for hazard assessment and its related services. Using the platform, areas that are prone to hydrometeorological, seismic, and volcanic hazards may be determined. This tool is also available through a mobile app which promotes convenience and portability for its 	https://georisk.gov.ph/ https://hazardhunter.georisk.gov.ph/map https://geoanalytics.georisk.gov.ph/

Source	Description	Website / Link
	<p>users (PHIVOLCS, n.d.).</p> <ol style="list-style-type: none"> 2. GeoAnalyticsPH is a web application that can aid in the generation of maps and analysis of geospatial data using hazards, exposure, and location data from the GeoRiskPH database. It offers different types of thematic assessments - land area, population, and critical facilities for various hazards. Other tools such as maps, charts, and graphs are produced in an instant to properly visualize and understand the hazard (GeoRiskPH, n.d.). <p>Other tools that would require access from the national government agencies as owners and may provide specific mapping data are as follows:</p> <ol style="list-style-type: none"> 1. GeoMapperPH <p>GeoMapperPH is a platform for government and non-government entities to access, utilize, and contribute to the GeoRiskPH integrated database. The structure and system of the platform allows for easy data collection and updating of hazards, exposure, vulnerability, and coping capacity to inform the decision-making process pre-, during, and post-disasters. Real-time updates and analytics can be extracted from the platform through its dashboards which can enable data-informed decisions for disaster planning, risk assessment and management, and disaster response</p>	

Source	Description	Website / Link
	<p>(PHIVOLCS, 2020).</p> <p>2. PlanSmart Ready to Rebuild</p> <p>PlanSmart Ready to Rebuild is a web app and automated planning tool designed to aid the government especially the Local Government Units towards their respective disaster rehabilitation and recovery activities. The tool will enable government entities to develop the Rehabilitation and Recovery Plan (RRP) through auto-generation, building from the critical data and information available within the GeoRiskPH Integrated Platform (PHIVOLCS, 2022).</p> <p>3. 3D Earth Risk Information System</p> <p>The 3D Earth Risk Information System makes use of risk assessments, site suitability model tool, and 3D visualizations to aid the Philippine construction industry in developing safer structures through accurate, scientific, and verified surface and subsurface information. In particular, the 3D Earth Risk Information System is a platform that systematically identifies ideal and suitable areas for construction projects, including housing programs (GeoRiskPH, 2021).</p>	
LiDAR Portal for Archiving and Distribution (LiPAD)	LiPAD serves the repository of all data and maps gathered by the Phil-LiDAR 1 and Phil-LiDAR 2 Programs of the DOST. Datasets that are in GIS-ready formats can be downloaded from the website which include Digital Elevation Models, Digital Terrain Models,	https://lipad.dream.upd.edu.ph/#home

Source	Description	Website / Link
	Orthophotos, Flood Hazard Maps, and Resource Maps (e.g., agricultural, aquatic, forest, hydrological, renewable energy).	
Land Use and Zoning Information System (LUZIS)	Integrated within Department of Human Settlements and Urban Development's (DHSUD) housing operations, LUZIS is an information technology system for collection, archiving, analysis, and monitoring of data relative to land use and zoning (Kabagani, 2022).	Access to the system can be requested from DHSUD.

Among the pipeline initiatives of DHSUD relative to the development of digital planning tools is the Automated Land Use Compliance Assessment and Monitoring Tool (AutoCam). Expected to be undertaken from 2025 to 2026, AutoCam will be a satellite-GIS-Artificial Intelligence (AI) automated compliance detection and monitoring tool for land use development.

Process of Developing Maps

Development of maps as a process are divided into 4 steps: Data Collection, Data Processing, Creation of a Model and Design, and Publication (Jędrzejowska, n.d.). Briefly discussed below are each of these steps.

1. Data Collection

The first step of mapping requires the gathering of necessary primary and/or secondary data. The secondary data enumerated above may be used by agencies depending on required datasets for a certain mapping concern. If the data is/are not readily available, data may be secured through primary means through the collection of geodetic measurements or remote sensing methods to collect aerial, satellite, or drone imagery. Collected data are stored and fed into relevant databases for organization and consolidation.

2. Data Processing

The second step is the processing of collected data using the analytical tools and functions integrated in the GIS software of preference. Further processing of datasets and carrying out analyses may also be done by the developers depending on the framework and scheme needed or established to come up with the desired solution or product.

3. Creation of a Model and Design

The third stage involves the creation of design and graphics for the map. During this step, colors and symbols are assigned to specific categories and/or objects to both have an aesthetic appeal and be easily understood, even by non-typical map users. Critical elements of the map are ensured to be highlighted during this process.

For instance, the land use categories and color coding of maps associated with the Comprehensive Land Use Plan have been standardized in the country. The premise of this standardization is to have uniformity across all maps produced by Local Government Units (HLURB, 2014).

4. Publication

The fourth and last step is the publication of the product through its exportation as a map. Integration of other map features such as base maps can also be done during this stage to further contextualize the output that will be produced.

The significance of Geographic Information Systems (GIS) as a valuable tool in the domain of humanitarian settlement programming, particularly in the context of the Philippines, cannot be overstated. The integration of the system into the planning and programming of the humanitarian shelter and settlements sector is imperative at this stage, in order to establish evidence-based practices.

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