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Country Reports**

**Country Report on Surveying and Mapping
in the Philippines***

* Prepared by the Philippines

COUNTRY REPORT ON SURVEYING AND MAPPING IN THE PHILIPPINES

Salient Geographic Features of the Philippines:

The Philippine archipelago is composed of 7,107 islands. It is divided into three (3) main island groups, namely: Luzon, Visayas and Mindanao. It lies between 4° 15' N and 21° 25' N latitude and between 112° 15' E and 127° E longitude. The total land area of the country is about 300,000 square kilometers 46% of which is classified as forest and woodlands. The country has 2,229,438 square kilometers of territorial waters that is rich in marine life, and has 31,370 km of coastline. The terrain is mostly mountainous with narrow to extensive coastal lowlands. The highest point is the peak of Mt. Apo at 2,954m above mean sea level.

The climate is tropical with an average temperature of 27°C and humidity of about 75%. There are two distinct seasons, the dry and the wet. The rainy months starts from June to October when the southwest monsoon brings the rains.

Agencies Involved in Mapping and Surveying:

During the government reorganization in 1987, a central mapping agency was established to integrate and coordinate mapping and surveying activities in the Philippines. The National Mapping and Resource Information Authority (NAMRIA) was created to carry out water, coastal and land surveys, mapping, remote sensing, information management and statistical services for the government and the general public.

Surveying and mapping, however, is not solely undertaken by NAMRIA. Other government agencies also perform surveying and mapping activities to effectively carry out their respective mandates. Private mapping and surveying companies are upgrading their capabilities to keep in stride with present technology and cope with the demand for geographic information.

Geodetic Network Infrastructure:

The NAMRIA is responsible for the establishment and maintenance of the primary geodetic network of the country.

Prior to 1991, the geodetic network consisted of triangulation chains mostly along the coast. The network was established during those times to provide horizontal control in the conduct of hydrographic surveying for the production of nautical charts. The control network was considered in the old

standard as having second-order accuracy and referred to the Luzon Datum with Clarke 1866 as the reference ellipsoid.

Recognizing the need for a more accurate and homogenous national geodetic framework, the Global Positioning System (GPS) technology was utilized to establish a First Order Network with the support of the Australian government in 1992. GPS stations were established all over the country, with 334 first order stations, 101 second order stations, and 36 third order stations. A total of 84 old stations were occupied. The network was developed using multi-stations observed simultaneously. Each succeeding figure had common stations with preceding figures. In this way, a network of well connected figures was built up. A geoid model for the Philippines was also validated and adopted as part of the project. Considering the implications of using a global geocentric datum which include large shift in coordinates, the horizontal datum was retained utilizing the same reference ellipsoid. The vertical datum has been slightly modified by the adoption of a more realistic geoid/spheroid separation at the datum origin. The resulting new framework is known as the Philippine Reference System 1992 (PRS 92). Transformation parameters from WGS 84 to PRS 92 and vice versa are available.

An executive order was issued by the government directing the connection to PRS 92 of all surveys in the country by the year 2000. Due to serious backlog in the densification and transformation of all surveys in the country, this deadline was extended to year 2010. Densification of the GPS stations to make it more accessible to surveyors is still in progress. Moreover, due to the prohibitive cost of GPS equipment, local surveyors still adopt the conventional method in most property surveys.

Considered as one of the top priority activities under the Medium Term Philippine Development Plan (FY 2005-2010), PRS92 is currently being implemented with the following targets:

- a) Establishment of at least 36 Active Geodetic Stations (AGS) nationwide (six AGS are now operational, another six stations to be completed this year);
- b) Upgrading of 65 1st order GPS stations to zero order (This will be completed this year);
- c) Re-observation of the 318 1st order GPS stations established during PRS 1992;
- d) Establishment of the remaining 1473 2nd order horizontal control points;
- e) Establishment of 48,672 4th order horizontal control points;
- f) Completion of vertical control network comprising of about 24,000 km of level lines (14,248 km level lines completed);
- g) Establishment of 80 1st and 1,200 2nd order gravity stations nationwide;

- h) Upgrading of four (4) existing and establishment of 62 new tide stations;
- i) Development and operationalization of 18 Geodetic Network Information Systems and provision of other Information and Communication Technology support services;
- j) Integration of five (5) sets of environment and natural resources maps into the system in collaboration with DENR Bureaus;
- k) Formulation of relevant policies and standards and specifications; and
- l) Carrying out of related technical studies in preparation for the eventual migration to a geocentric datum.

Cadastral and Property Surveys:

Four (4) government agencies are involved in cadastral and property surveys. These are the Department of Environment and Natural Resources (DENR), the Department of Agrarian Reform (DAR), the National Commission on Indigenous Peoples (NCIP), and the Land Registration Authority (LRA).

Generally, it is the DENR that undertakes cadastral surveys of untitled properties either by administration or by contract with private surveyors. However, for lands declared as agrarian reform areas, the DAR undertakes its own cadastral surveys. The approval of these surveys, however, is the responsibility of DENR. The Original Certificates of Titles are issued either by the DENR or DAR, and registration of the same shall be made with the LRA.

The Lands Sector of the Regional Lands Management Services of the DENR is one of the key players in the implementation of the Philippine Reference System of 1992 (PRS92) Project, particularly in the Geodetic Network Development and Cadastral Data Integration components. Its role is to establish 3rd and 4th order geodetic control points in support for isolated and cadastral surveys. It is also responsible for the integration of various types of survey plans/maps and other Environment and Natural Resources (ENR) data produced within the bounds of its mandate. The Sector programmed also the computerization of its land records and the construction of warehouses wherein the same shall be properly archived and/or stored. As of this report, 55% of the 6,433,685 mother lots of approved cadastral surveys covering 570 cities/municipalities under the old reference system were encoded and converted to digital format to facilitate the transformation and integration into the new reference system. The NAMRIA developed an algorithm and corresponding transformation template to derive local parameters applicable for each cadastral survey. The transformed cadastral surveys will form part of the fundamental data sets in the development of the National Spatial Data Infrastructure (NSDI) of the Philippines.

The NCIP is mandated to protect and promote the interest and well-being of the indigenous cultural communities and indigenous peoples with due regard to their beliefs, customs and traditions and institutions. As such, the agency is responsible for the delineation, preparation of plans and technical descriptions, and issuance of certificate ancestral domain titles (CADTs) and certificate of ancestral land titles (CALTs). These titles are subject for official registration with the LRA. Such undertaking is covered by a Memorandum of Understanding between the NCIP and LRA.

The LRA is in charge of the management of records of titled properties and is mandated to approve subdivision, consolidation and relocation surveys of titled properties. .

The Certificates of Titles are entered in the Register of Deeds in a particular administrative subdivision.

Presently, the land records in the aforementioned offices are still in the analog format. For this reason, the LRA has embarked on a massive program to computerize land records and management.

Other Isolated Surveys of the DENR:

NAMRIA is responsible for the survey of lands of the public domain. It aims to delineate areas that are alienable and disposable lands viz timberlands. An inter-bureau action is being adopted under the present system of land classification of determining which of the unclassified lands of the public domain are needed for forest purposes and declare them as permanent forest to form part of the forest reserve. Those areas that are not needed for forest purposes are classified as alienable and disposable lands, the administrative jurisdiction and management of which shall be transferred to the Lands Sector for reservation and disposition purposes.

The agency is also currently providing technical services to the National Technical Evaluation Committee on land sub-classification. This includes the preparation of maps showing areas for protection and production based on the data provided by the different Land Evaluation Parties based in the DENR Regional Offices.

The Forestry Sector of the DENR is presently involved in the delineation of forestland boundaries. The Program includes the physical establishment of permanent markers of the boundaries between alienable and disposable lands and forestlands. The technical descriptions and plans serve as the basis in the preparation of laws which setting such marker defining permanent boundaries for future surveys and issuance of tenurial instruments and concessions.

The demarcation of protected areas, including national parks, reservations and sanctuaries, among others, is one of the major functions of the Protected and Wildlife Sector of the DENR. These areas are likewise marked with monuments on the ground and the technical descriptions and plans of which serve as the basis in legislating the same as protected areas.

The execution of tenement surveys covering mineral lands is lodged under the functions of the Mines and Geo-sciences Sector of the DENR. Survey activities encompass site topographic, perimeter and geological exploration surveys.

Topographic Mapping:

NAMRIA as the central mapping agency of the Philippine Government is mandated to undertake the topographic base mapping of the country.

NAMRIA is currently producing and maintaining the following maps:

653 map sheets	-	1:50,000	Topographic Maps
55 map sheets	-	1:250,000	Topographic Maps
Growth Centers	-	1:10,000/1:5,000	Topographic Maps
Regional and Provincial	-		Administrative Maps

Medium Scale Topographic Maps

The following is the status of the 1:50,000 topographic mapping:

121 map sheets	1988-2005 (18%)
126 map sheets	1976-1979 (19%)
406 map sheets	1947-1953 (63%)

In 2006, a development study project was implemented in cooperation with the Japan International Cooperation Agency (JICA) entitled "The Study for Mapping Policy and Topographic for Integrated National Development Plan in the Republic of the Philippines". The pilot project generated 24 topographic map sheets at 1:50,000 covering the Pampanga River Basin up north to the Agno River Basin. Eight (8) map sheets were compiled using new aerial photography while the rest were compiled using SPOT 5 satellite images. Specifications for 1:50,000 Topographic Mapping and nationwide implementation plan was developed as part of the project.

This program was implemented following the recommendations and specifications of the JICA project to revise three hundred forty five (345) map sheets at scale 1:50,000 for three (3) years in support of the geohazard mapping project. The old map sheets were converted in digital format and the

planimetry was revised using satellite images. SPOT 5 satellite images at 2.5 m and 5m resolution were acquired and orthoimages were generated in addition to the line maps. So far NAMRIA was able to purchase only 55% satellite imagery coverage of the entire country with $\leq 20\%$ cloud cover.

Large Scale Topographic Maps

The Large scale ($\geq 1:10,000$) topographic maps and orthophoto maps are being produced covering growth areas and population centers using aerial photography. The following line maps have been compiled by NAMRIA since 1994;

402 map sheets	1:10,000	
156 map sheets		1: 5,000
12 map sheets		1: 2,500

and the following orthophoto maps have been compiled since 2000 when NAMRIA shifted to fully digital process:

90 map sheets	1:10,000
118 map sheets	1:5,000
176 map sheets	1:4,000
505 map sheets	1:1,000

Aside from aerial photography, NAMRIA is currently utilizing very high resolution (VHR) satellite imageries (Ikonos and Quickbird) in combination with IFSAR-DEM for the compilation of 1:10,000 topographic maps.

Thematic Mapping:

Special purpose maps are being produced by both government and private agencies with information coming from various sources.

Geologic Mapping

The Mines and Geosciences Bureau (MGB) under the Department of Environment and Natural Resources is mandated to do the geologic mapping of the country. The MGB produced geologic quadrangle maps at scale 1:50,000. For available geologic maps, visit its website www.mgb.gov.ph.

As part of its program MGB produces geohazard maps of urbanized and urbanizing areas. Produced so far are geohazard maps of Metro Manila, Baguio City, Cagayan de Oro City, Zamboanga City, Butuan City, Subic,

Olongapo City, Davao City, Surigao City and portions of Cavite City and San Pedro Laguna.

Soil Mapping

The Bureau of Soils and Water Management (BSWM) of the Department of Agriculture undertakes soil mapping of the country. Soil Maps at various scale in digital and printed format are available at the BSWM. For details of available maps, visit its website at www.bswm.da.gov.ph

Volcanology and Seismology

The Philippine Institute of Volcanology and Seismology (PHIVOLCS) under the Department of Science and Technology is the agency charged with the responsibility of predicting occurrence of earthquakes, volcanic eruption and geotectonic activity. In line with its goal to formulate disaster preparedness and loss reduction plans with the occurrence of the various phenomena, PHIVOLCS prepares various maps and data information. For details of its activities, products and services, visit its website at www.phivolcs.dost.gov.ph.

Land and Forest Cover

The Japanese Government through the Japan Forest Technical Association (JAFTA) has extended assistance to the Philippines for the implementation of the Information System Development Project for the Management of Tropical Forest. The project utilized LANDSAT TM taken in 1993. The project produced Forest Cover Maps at scale 1:100,000. The forest cover statistics was updated using LANDSAT TM taken in 2003.

Multihazard Mapping:

Starting in 2006, a project "Hazards Mapping and Assessment for Effective Community Based Disaster Risk Management" (READY) funded by United Nations Development Programme (UNDP) and the Government of Australia through AUSAID. Five agencies will be implementing the project, namely, Office of Civil Defense (OCD), PHIVOLCS, Philippine Atmospheric Geophysical and Atmospheric Administration (PAGASA), MGB, and NAMRIA.

The project will produce in four (4) years multihazard maps, i.e., floods, storm surge, landslides, earthquake, liquefaction, volcanic eruption and tsunami, at scale 1:50,000 and 1:10,000 in twenty seven (27) provinces in the country. The project will also include community based early warning system and Information and Educational Campaign (IEC).

Hydrographic Charting:

Hydrographic surveying and nautical charting is the responsibility of NAMRIA which is being implemented by its Hydrography Department. As the National Hydrographic Office³ (NHO), NAMRIA is the focal point and beneficiary agency of the International Hydrographic Organization (IHO) in the Philippines.

The conduct of a comprehensive hydrographic survey is one of the priority programs of the government since this is vital to an archipelagic country particularly to its domestic and foreign trade as well as maritime security. Furthermore, there is a need to meet the international obligations/requirements under the International Maritime Organization (IMO) and the United Nations Convention on the Law of the Sea (UNCLOS) and most importantly to lessen the number of sea accidents particularly those related to vessel grounding.

In the late -90's, the NAMRIA embarked on a project which upgraded the Philippines capability in conducting inshore and offshore survey activities. Two (2) multi-disciplinary survey vessels were acquired from Spain and delivered in 1998 and 1999 to enhance the government's hydrographic, oceanographic, geophysical and nautical charting capabilities. These vessels are equipped with state of the art survey and navigational equipment and complimented by shore-based cartographic processing and printing facilities. Both vessels are being utilized for the programmed activities of NAMRIA to produce the necessary outputs such as the new and updated nautical/bathymetric charts for the safety and efficiency of marine navigation, environmental protection, delineation/delimitation of the different maritime boundaries/zones, efficient management of the country's marine resources and for many other purposes. Likewise, the vessels are utilized for local and international collaborative projects and scientific equipment installations.

With the acquisition of these new vessels, NAMRIA can pursue a long-term hydrographic survey program produce new charts of the ports and harbors, approaches, coasts and Exclusive Economic Zone (EEZ), as well as to make periodic updating of Charts covering the Philippine waters. One of the most significant accomplishments of these ships so far is the conduct of bathymetric and geophysical surveys of the potential areas of Extended Continental Shelf (ECS) of the Philippines, in which the country was able to use the collected data to submit an ECS claim in the Benham Rise region to the UN Commission on the Limits of the Continental Shelf (CLCS) on April 2009. The other significant achievement of the vessels was its successful finding of the sunken oil tanker M/T Solar I, carrying more than two million liters of bunker fuel, off the coast of Guimaras Island.

The shore-based data post processing and chart production system aids the fast delivery and publication of nautical charts both on paper and

digital form. A GIS-based processing system post process survey data, converts paper chart into digital format, and create a digital base is being utilized. In addition a large format two-color offset printing press was acquired. The NAMRIA will eventually shift from the traditional to modern techniques in hydrographic surveying and chart production. Presently, the NAMRIA is maintaining 183 paper nautical charts consisting of 14 General and Sailing Charts, 25 Approach Charts, 80 Coastal Charts and 64 Harbor Charts. The current re-scheming of the existing paper chart series in order to adequately cover the major shipping routes will benefit the users.

Electronic Navigation Charts (ENC), the data of Electronic Chart Display and Information Systems (ECDIS) that facilitates the integration of vessel traffic information into the ships navigation system, is being widely used in the international maritime community. Hydrographic offices in some parts of Asia are now providing the seafarers with ENC's. The NAMRIA through the assistance of the Japan International Cooperation Agency (JICA) was able to produce the initial small scale and large scale ENC's for selected areas in the country. It is expected to provide more ENC's for the Philippine waters to gain competitiveness in the maritime industry. NAMRIA has now completed and published 4 General Sailing and 6 Approach and 5 Harbor ENC charts.

Hydrographic information vital to navigation and maritime safety are being provided by NAMRIA in the form of nautical charts, ENC's and publications such as the List of Lights, Notice to Mariners, Philippine Coast Pilot and Tide and Current Tables. These products are being updated continuously so as to ensure the safety of navigation in the Philippine seas.

Despite these developments, there is still serious backlog in hydrographic and charting activities which affects the government's conduct of national and international maritime affairs commitments as well as the private sector's initiative on marine resources exploration and exploitation.

GIS and the National Spatial Data Infrastructure:

In this age of Information Technology, Geographic Information Systems (GIS) has taken the center stage in surveying and mapping. It has been used as a tool in automating otherwise tedious processes in surveying and mapping.

The issue of spatial data infrastructure had emerged in the past decade as a basic framework for addressing problems concerning geo-information related activities such as data duplication, high cost of spatial data acquisition, restricted access to geoinformation, difficulty in data interchange, and growing demand for timely and accurate geoinformation.

In 1993, the Inter-agency Task Force on Geographic Information (IATFGI) was created with the NAMRIA and the National Statistical Coordinating Board (NSCB) as the Chairman and Co-Chairman and was originally composed of seven (7) member government agencies. It is primarily tasked to promote and coordinate the efficient development, management and utilization of geographic information in the country.

The IATFGI is tasked to function as follows: a) review current policies, decisions, thrusts, programs and projects related to the management of GIS; b) determine the issues affecting the development of GIS in the country and recommend measures to enhance its development; c) recommend appropriate mechanism for the coordination of agencies involved in GIS; d) conduct and inventory of geographic holdings and projects; e) develop and recommend minimum standards for GIS interchange; and f) create technical working groups (TWG's) for specific purposes.

Five (5) TWG's were created namely: a) Agriculture, Environment and Natural Resources; b) Lands and Survey; c) Infrastructure and Utilities; d) Socio-Economics; and e) Research, Training and Technology.

In July 2001, The National Spatial Data Infrastructure (NSDI) Framework Plan was formulated through a World Bank funded project entitled "The Establishment of a Technical, Operational and Legal Framework for the Management of Geographic Information in the Philippines".

The establishment of NSDI in the country rest heavily on the efforts and initiatives of NAMRIA. But because of the high initial cost requirements, an incremental development of NSDI is being adopted by NAMRIA by launching NSDI Development Program. But even with the launching of the program, NAMRIA still continue to source funding for proposal that include the National Common Spatial Data Base (NCSD)