GIS - Reaching New Heights in Info Technology

CADARO WATERSHED

Diffun, Quirino
Region 2

Buri Species
Suitability Rating
(For Reforestation)

High Suitability
Moderately Suitable
Low Suitability
Roads
River Network
Settlements

North

MAIN OPTIONS

TOPICS   CRITERIA   IDENTIFY   EXIT

Photo-Based Tax Map
Section 04, Barangay Burayoc
Pagudpud, Ilocos Norte
Scale 1:4000

South China Sea

Barangay Saud

Junction 03

Legend
Sugarland
Cornland
Coconutland
Uncultivated
Cemetery
Corals
Property Index No.
Property Boundary

REGION 7

SAPANGDAKU
WATERSHED

Erosion Potential

Legend
Heavy Erosion
Moderate Erosion
Low Erosion

Sub-Classified
Natural Resources
and Development

CONTINUE   CANCEL

Editorial

S etting up a GIS facility today may prove to be the one single most important decision to be made by any organization. Worldwide, GIS has proven to be a powerful tool in planning and management, allowing integration of voluminous data from different sources in different forms to come up with an entirely new, updated and useful output.

The exciting possibilities offered by GIS, particularly in Environment and Natural Resources (ENR) planning and management, may obscure several issues that have to be considered for the success of the GIS facility. As we explore the various applications of GIS, we must simultaneously take into account issues that concern manpower, hardware and data.

Considerable financial investment is required in setting up a GIS facility. This is especially true for long term GIS applications. Financial support for the wear and tear of equipment as well as the purchase of newer models must also be programmed.

Database creation and manpower development also involve sizable amounts of money, time and effort. Data from different sources must be diligently gathered and carefully analyzed based on the objectives of the projects. And all technical staff must be continuously trained to keep them abreast of the developments of the technology.

Maintaining accuracy of data is essential in order to preserve the credibility of outputs. One can't expect GIS to magically transform worthless data into quality products. Critical in the creation of a data base is the selection from among a plethora of information which ones to include and which to exclude. Here, the bias of the decision maker may inevitably, though unintentionally, set in. Decision makers must be as objective as possible in the selection of data keeping in mind the overall objectives for which the data base is being created.

Perhaps the most important issue to consider in the setting up of a GIS facility is the organizational structure. Once a GIS facility is established, information flow within the organization has to undergo dramatic changes. There will be a need to redesign and realign the thrusts of the projects to conform with the demands of the GIS activities. Close coordination among the different departments or offices is vital in order to fully systematize the creation, transformation and management of data into usable formats.

Data access and sharing among agencies and companies utilizing GIS is also a pressing issue to be addressed. With the ever increasing number of GIS users in the country today, coordination will help facilitate the completion of projects and prevent duplication of outputs. The ongoing discussions among various government agencies for the creation of an inter-agency body on GIS is a major step in this direction. ●

NEW PRODUCTS

Seven 1: 5,000 scale topographic map sheets of Metro Cebu (including portions of Mandaue and Lapu-lapu) have been printed during the second semester of 1992.

These are available at the following NAMRIA Map-Sales Offices:

Main Office: NAMRIA Map Sales Office
Fort Andres Bonifacio, Makati Metro Manila
Tel. Nos. 810-48-31 to 44
Telex No. 14607 CARTCE PS

Branch Office: NAMRIA Binondo Branch
421 Barraca Street San Nicolas, Manila
Tel. Nos. 47-96-11 to 14

Sales Offices: NAMRIA Legaspi Sales Office
Legaspi City Supermarket
Legaspi City, Albay

NAMRIA Cebu Sales Office
Room 3-E, J King Building II
Magallanes St., Cebu City

NAMRIA Iloilo Sales Office
Suite No. 6, Sarabia Manor Bldg.
Gen Luna St., Iloilo City

NAMRIA Davao Sales Office
President Lines Cmpd.
Sasa cor. Airport Road, Davao City

Features

Government going GIS

- Future Directions of GIS in Government -

by Roland M. Rodriguez
Information Management Department

Automated mapping and facilities management (AM/FM), local government planning, cartographic production, forest management planning, geodemographics and marketing, Operations: Desert Shield, mining exploration, vehicle dispatch, suitability mapping, land classification, resource inventory and many, many more. You name it... *GIS can Do it!!*

In the Philippines, GIS is fast gaining popularity with its integrative and analytic capabilities. Government agencies like the Departments of Transportation and Communication (DOTC), Health (DOH), Public Works and Highways (DPWH), Education, Culture and Sports (DECS) and the National Mapping and Resource Information Authority (NAMRIA) have already completed several projects and still more are up in their sleeves. Huge corporations and utility companies such as Meralco and the Philippine Long Distance Telephone (PLDT) Company have been raking in tremendous success with their GIS-related projects and programs.

In the works at the DOTC is the *Traffic Monitoring Database* which will be integrated and overlaid with the digitized map of Metro Manila to effectively monitor problems and obstructions which slacken traffic in the Metropolis. The DOTC's Traffic Engineering Center (TEC), Metro Manila Authority (MMA) and the Philippine National Police (PNP) are building the traffic database wherein clogged road intersections, road obstructions, excavations and traffic routes in Metro Manila are stored.

The DOH will soon establish projects for GIS applications for malaria control, family planning and the monitoring of the incidence of red tide. DOH is going GIS to determine how the country's health branch can best maximize the technology's capabilities and apply them for better planning and decision-making

Initially, DOH is setting up three projects: the *Malaria GIS in Palawan, the Family Planning GIS* in Cebu, and the *Red Tide Monitoring GIS* at Manila Bay. Among the information GIS applications give out regarding a location or area are population density, surface elevation and contours and flora and fauna.

These could help a lot in institutionalizing GIS technology in health related planning and management activities.

In the other Departments, DPWH is planning a nationwide project to integrate its *Road Network Database* with the digitized map of the entire country. Currently on-going is the initial phase of the project which classifies all roads nationwide, after which DPWH will embark on the nationwide digitization of the country's road networks.

DECS has also expressed interest in using the technology to identify areas and localities in establishing schools and educational institutions.

Meanwhile at the NAMRIA, several projects have been lined up in the coming years. The projects will utilize several softwares and utilities and are expected to be completed before 1998.

For 1993, NAMRIA hopes to finish three projects: *Development of a GIS for the Mining Titles Computerization Project* in cooperation with the Mines and Geosciences Bureau (MGB), *Development of GIS for Site Management and Parks and Wildlife Zoning* with the Protected Areas and Wildlife Bureau (PAWB) and the *GIS for Ecological Profiling of Laguna* with the Environmental Management Bureau (EMB).

The Mineral Rights Application aims to strengthen the management, planning and monitoring capabilities of the mining sector through GIS as applied to mining titles administration. The project will also help monitor mining activities in support of any program for development and ENR management; automate and integrate thematic maps and systemize the storage and handling of mining maps and titles; and utilize GIS spatial capabilities to complement the textual database of the project.

NAMRIA and MGB expect an efficient storage, retrieval and updating system for geographic-based information. Both agencies will also be able to efficiently monitor mining permit applications to facilitate processing and conformity with existing mining regulations using the various output maps, statistical reports and processing systems.

For the Parks and Wildlife Zoning Project, PAWB and NAMRIA will create and establish a protected area and wildlife information database for site management and monitoring of protected area and wildlife resources. This database will then be overlaid with the digitized maps of the target areas to come up with a powerful management and planning tool for site managers and planners. With the various output maps, PAWB will also be able to effectively implement activities within the protected areas.

The development of GIS for an ecological profile of Laguna was conceptualized to complement and further increase the capability of EMB in its ENR planning and monitoring activities concerning the quality of environment in the area. The project will also support the Environmental Impact Assessment (EIA) program of the bureau in order to strengthen the decision and policy-making processes of the Department of Environment and Natural Resources (DENR). The pilot project will then be duplicated in all provinces in order to create a clearer picture of ENR planning and monitoring activities nationwide.

In the coming years, NAMRIA and the other agencies nationwide, local or private, will continue to make full use of this world class technology. ●

Title	Completion Date	Software to be used
1. Integration of Thematic and Topographic Data for a Three-Dimensional Natural Resources GIS Database	1998	TYDAC SPANS
2. Flood Risk Assessment of Major Population Centers using GIS	1998	TYDAC SPANS
3. Assessment of Agricultural Resources Using Photo-Tax Mapping	1998	TYDAC SPANS
4. Creation of Digital Database		ARC/INFO
5. Development of an Integrated Utilities Information System		ARC/INFO

References:
Suarez, Ike and Magno, Leo Jr. *Metropolitan Computer Times*, Vol. VII Nos. 41, 42, and 43, 1992
Future GIS Projects Survey. Media Production Division, 1992.
Concept Papers: Mineral Rights Application, Ecological Profiling, Wildlife Zoning for PAWB. NAMRIA, 1992.

* Terms in bold type and marked with asterisks are defined in the glossary of Terms on page 16.

GIS Comes of Age in the Philippines

by Charmaine C. Aviquivil
Information Management Department

The GIS revolution is now sweeping the world. Advanced computer technology has made possible the development of GIS configurations with superior analytical, graphical, and integrative capabilities. Today's GIS commercial software are more powerful, flexible, versatile, interactive, and much cheaper compared to those in the market ten years ago. It is no wonder that with its many existing and potential applications, GIS has virtually become a byword among sectors engaged in spatial information worldwide.

Realizing the need for such a technology, the Philippines has kept abreast of global developments in GIS. Today, GIS is increasingly being used for various applications in the different sectors of Philippine society.

Evolution

From the use of manual map overlaying to analyze spatial data, GIS users have moved on to more sophisticated computerized systems. A wide variety of hardware and software options are currently available and users can now opt for either a mainframe-, **workstation*** or PC-based environment and can take the best pick from a wide range of software packages whose developers almost annually try to outdo each other in coming up with better features.

Unknown to the international community, the Philippines is one of the pioneers in the development and application of GIS. According to NAMRIA Deputy Administrator Ricardo Biña, as early as 1974, a prototype GIS model - Computerized Land Assessment and Planning System (CLAPS)- had been developed and used for land use planning and environmental assessment (the generic term GIS was unknown at that time).

CLAPS was developed by the Synergistics Consultants, Inc. (SCI), a local multi-disciplinary consulting group composed of professors from the University of the Philippines, Running on mainframe computer and written in COBOL, the system used as inputs encoded map attributes in raster format. It differed from today's systems in the absence of interactive elements and modern peripherals (e.g. digitizers, mouse, color monitor, color plotter). Nonetheless, key spatial analytical tools of modern GIS such as matching, overlaying, proximity analysis, histograms and theme mapping were incorporated in the software package. Outputs were in the form of alphanumeric prints of various attribute-thematic maps and decision maps.

DA Biña adds, "The first applications of GIS in the country were initiated by the private sector circa 1974-1978. In 1979, CLAPS was introduced to the then Ministry of Human Settlements, the National Environmental Protection Council (NEPC), and the Natural Resources Management Center (NRMC), one of the precursors of NAMRIA, marking the three agencies as the first government institutions to use GIS. The three agencies collaborated in using CLAPS in the environmental assessment and planning of Boso-Boso and Dumaguete City."

Since CLAPS was a propriety tool of SCI for its environmental consulting works, it was never introduced in the market as a commercial software package. It died a natural death when SCI closed operation in 1982.

The first Philippine GIS workshop in November 1982 held under the auspices of the NRMC introduced to the public for the first time the availability of a commercial GIS package, the mainframe ARC/INFO, developed by ESRI of California. It was not until the late eighties, however, when computer hardware became cheaper and various PC-based GIS versions appeared in the market, that general interest in GIS developed. This interest is sustained today not only by aggressive marketing activities of GIS vendors but also by the numerous local and international conference, workshops, and trainings on GIS.

In the eighties, there were only a handful of organizations which were aware of or were actually using GIS. Today, GIS has attracted more and more users in the public and private sectors. GIS is the Philippines has certainly come a long way from its humble beginnings a decade or two ago.

GIS in Government

As previously mentioned, the Ministry of Human Settlements, NEPC, and NRMC were the first users of GIS among government agencies in the late seventies. In 1986, NRMC was the first agency in the country to acquire and operate the world's first PC-based GIS- the CRIES (Comprehensive Resources Inventory and Evaluation System) - GIS. Originally developed at Michigan State University through USAID support, the CRIES-GIS was meant for third world agencies which have access to PCs but cannot afford mainframe computers. The introduction of C R I E S - G I S spawned the development of various commercial PC-based GIS in the market, with better and more sophisticated capabilities. These PC-based versions are now found in several government entities in the country.

In 1987, NRMC was merged with other survey and mapping agencies to form NAMRIA. One of NAMRIA's mandates is to "integrate geographic and related information to facilitate access to and analysis of data and its transformation into useful information for resource policy formulation, planning, and management." With this mandate, NAMRIA is tasked not only to continue the GIS tradition started by NRMC but to lead in the development of application models and promote the use of GIS through technology transfer. Aside from CRIES, the agency now includes PC-based versions of ARC/INFO and TYDAC-SPANS in its library. The installation of ARC/INFO into a network of workstations is currently being undertaken.

NAMRIA has already completed GIS pilot projects such as the Integrated Resources Management Process under the RP-Australia Natural Resources Management and Development Project covering the Ganano watershed in Region II and the Sapangdaku watershed in Region VII; GIS for Municipal Planning and Management, a prototype system covering streets, cadastral lots, and business establishments with Makati as pilot area; Zoning Information System (also for Makati) designed for monitoring and regulating land use to effectively implement zoning regulations; an ENR Provincial Planning System (EPPS) for Tarlac[1] Determination of Suitable Upland Agricultural Areas (parts of Benguet), Application of GIS to Soil Erosion Susceptibility Mapping (parts of Palawan), and Assessment of Agriculture Resources through Photo Tax Mapping[2] (Parts of Sorsogon and Ilocos Norte). A GIS map of Mt. Pinatubo containing pre-eruption data has also been completed. Some ongoing projects include: The EPPS of Laguna, the CALABARZON Ecological Profile, and the Leak Monitoring System (LMS)[3].

Ms. Linda SD. Papa, NAMRIA Information Management Department (IMD) Director and head of the agency's GIS think tank, has this

NAMRIA's GIS staff at work.

to say about GIS at NAMRIA: "I envision the development of a centralized national geographic information database at the NAMRIA to better serve the needs of our clientele. Probably, we can also supplement the training needs of interested potential users of GIS." Sadly, this cannot be realized at the moment as NAMRIA's GIS equipment capability is still inadequate.

The NAMRIA is currently spearheading a move to create a coordinative body on geographic information. "No agency can singlehandedly do all the work needed to effectively share and exchange data. A coordinative body is important in that it can serve as a nucleus for improved data access, sharing, and standardization," Mrs. Papa stressed.

The Bureau of Soils and Water Management (BSWM) has also been using manual-based GIS for many years before it acquired more sophisticated GIS equipment in December 1990 from a Japan International Cooperative Agency (JICA) grant. Today, BSWM uses mainframe ARC/INFO version 4, workstation ARC/INFO version 5, and PC ARC/INFO version 3.4 D+.

According to Ms. Eleanor M. Liganor, BSWM GIS Division Chief, GIS at BSWM is mainly used for agricultural applications such as the derivation of land management units, agricultural land use, and crop suitability; updating of land cover data; and database development, among others. Ongoing projects include: Regional Base Map Digitization/Topographic Database Development which aims to digitize four layers (roads, rivers, administrative boundaries, and annotations) of 1:250,000 scale base maps of all regions; Geographic Land Resources Information System (GLARIS) which involves the evaluation of crop suitability in given locations: Soil Information System which will determine the soil characteristics of all agricultural areas in the Philippines, and the updating of data on the Ashfall/Lahar Affected Areas of Region III whose outputs include a Mudflow and Siltation Risk Map and Land Use/Vegetation Map showing depth of ashfall deposits, among others.

Asked about BSWM's future plans for GIS, Ms. Liganor says, "I have set my sights on a complete database of soil, water, and land resources in the country. The development of more expert systems is also needed to utilize GIS to a maximum at BSWM."

A government-owned corporation, the Philippine National Oil Corporation (PNOC) also uses GIS. It is currently implementing with the help of consultancy companies the project Zoning and Management Plans for PNOC Geothermal Reservations in four pilot areas, all geothermal reservations-- Tongonon, Leyte; Mt. Apo in Kidapawan, South Cotabato; Bacon-

Manito in Sorsogon; and Southern Negros. This five-month project which started in August this year aims to develop zoning/land use plans using GIS which will serve as guides in the management of geothermal reservations by PNOC and the local government.

GIS is also being used in the government by the Philippine Institute of Volcanology and Seismology (PHIVOLCS), National Water Resources Board (NWRB), Bureau of Agricultural Research (BAR), the Department of Environment and Natural Resources (DENR) and its bureaus, and many more.

GIS Service/Consultancy Companies

GIS consultancy groups have increased these past few years. One such organization is Cybersoft Information Technologies, Inc., which was founded in 1986. Cybersoft, the local distributor of GENAMAP GIS software, began to use GIS as recent as two years ago. Today,

Residential zone
Agriculture zone
Forestland
Tourism zone
Aquaculture zone
Mangrove rehabilitation zone
Passive fishing gear zone
Active fishing gear/ General use zone
Reef flat
Coral reef reserve
—— Core zone
······ Buffer zone

Map Courtesy of ICLARM

An output of ICLARM's GISCAMP showing a general zonation scheme for Lingayen Gulf.

however, it considers GIS as its main thrust. The company's range of services include computer consulting and integration services, data conversion, data entry, and system development. It has also been providing offshore keying and conversion services in the US for more than two years

now. Cybersoft has set up a training center at the University of the Philippines Computer Literacy Center (CLC) in Diliman as a joint undertaking with the UP Science Research Foundation. This center caters to the training needs of not only the student but of government workers in the nearby areas as well.
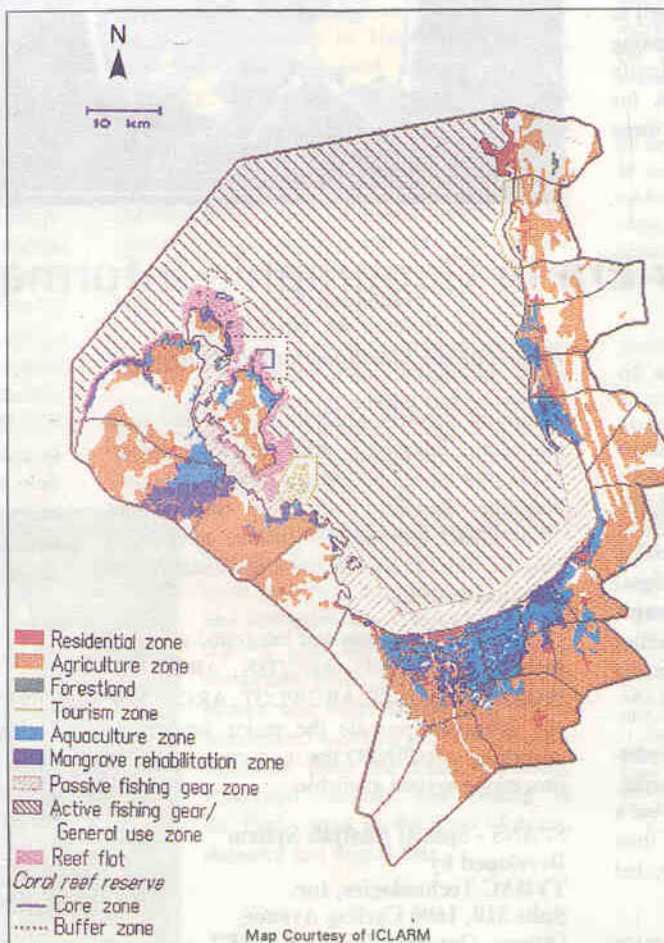
Geodata Systems Technologies, Inc. which was founded in February 1991 is engaged in data conversion services which include manual digitization, textual data entry, linking of attribute and graphic information, and others. Geodata also provides a variety of consultancy services on ENR and forestry management, tax mapping, site analysis and design, urban/municipal planning, land use planning and zoning, among others. Geodata is the exclusive distributor of ARC/INFO software in the country.

Project (Preparation) Consultants Group, Inc. or PCG is a multi-disciplinary organization of professional and technical personnel with expertise in project development and packaging as well as in GIS technology. It was established in 1988 by a group of consultants involved in an internationally funded project. PCG offers the following services: GIS services such as spatial analysis, digital data development, development studies and planning; and architectural engineering and technical services. It is the Philippine distributor of TYDAC SPANS GIS software.

GIS in Utility Companies

Utility companies have found GIS useful for their mapping requirements. The Philippine Long Distance Telephone (PLDT) Company is one of the major establishments in the utility industry which has realized the potentials of GIS technology as a resource in improving operational efficiency. According to Mr. Ferdie Leonor, Manager of the PLDT Plant Records Management Department (PRMD), the company is currently implementing the pilot phase of its AM/FM project called "SMART" (System for Mapping and Recording Techniques). This GIS-based asset management computer system runs under a UNIX environment.

SMART has been designed primarily to address: 1.) the mapping requirements of the company; and 2.) management of information on the company's system-wide plant assets. On top of this foundation are several customized applications designed to handle processes like engineering design and work order management, to name a few. The workstation-based system runs on an Integraph platform and the application programs have been customized using Integraph's Facilities Rulebased Application Model Management Environment (FRAMME) utility.

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1 See Technical Paper on page 14.
2 These were discussed in Infomapper Vol. I No. 1.
3 See LMS article on page 10

GIS is now widely used in almost all sectors of society. Its popularity quickly accelerated with the rapid advancements in computers and in the information technology sector in particular.

Just like other computer-aided information systems, GIS largely depends on available softwares and computer packages for different applications. Worldwide, there are literally hundreds and hundreds of software specifically designed for almost all **geoprocessing*** processing involving geographic data and application needs.

The names GIMMS, FRAMME, CRIES, ILWIS, IDRISI, GENAMAP, EPPL2, ARC/INFO, TYDAC SPANS and MAFINFO are some of the popular software used by millions of GIS users worldwide. In the Philippines, the names TYDAC SPANS, ARC/INFO, CRIES, Genamap and MAPINFO always ring a bell to legions of satisfied users. The increasing number of firms in the country using GIS signify the strong foothold in a rising market for GIS softwares. Take a peek at some of these softwares used locally:
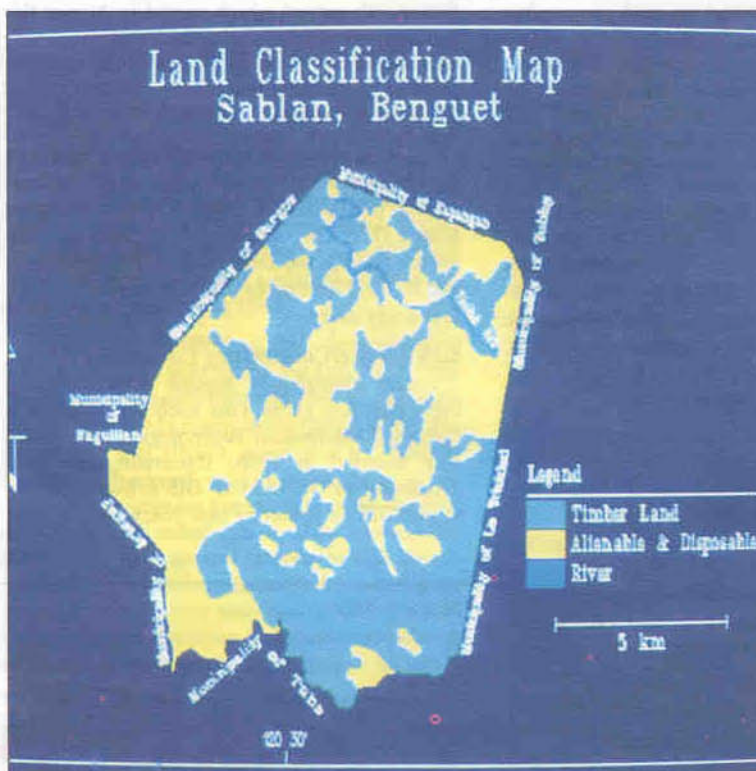
Land Classification Map of Sablan, Benguet made using GIS

New Era in Geographic Information

by Roland M. Rodriguez
Information Management Department

ARC/INFO
Developed by
Environmental Systems Research, Inc.
(ESRI)
380 New York Street, Redlands CA 92373

Regarded as the first database-oriented GIS to be developed, ARC/INFO revolutionized digital cartography and spatial information management worldwide. With its sweeping capabilities and features, ESRI's ARC/INFO has dominated worldwide sales in the GIS market.

ARC/INFO is ably supported in all platforms: PCs, workstations, minis and mainframes. Starting out with 40 commands that ran on a mainframe, ARC/INFO now has more than 1,200 commands and is continuously upgraded at least once a year.

ARC/INFO has an image integrator feature that can display raster and image data and can convert images from one format to another (ERDAS, RLC, TIFF, BIPI, etc.). It can also transform image data to map coordinates. ARC/INFO's Database Integrator supports simultaneous connection to a maximum of five logical databases contained in one or more relational database management systems (RDBMS).

In its new version, ARC/INFO Rev. 6.1., new features have been added including its capa-

bilities in network analysis and hydrological modelling, interactive ARC macro language (AML) for menu creation and editing, localized language handling aside from enhancement of its GRID extension to include hydrologic analysis, surface interpolation, and distance and statistical analysis.

Other components and integrated modules such as ARC/COGO, ARC/TIN, ARC/NETWORK, ARC/EDIT, ARC/PLOT, ARC/VIEW and Librarian provide the major support in propelling ARC/INFO the most complete geoprocessing system available.

SPANS - Spatial Analysis System
Developed by
TYDAC Technologies, Inc.
Suite 310, 1600 Carling Avenue
Ottawa, Ontario, Canada K1Z8R7

SPANS' history dates back to the "custodial" type of GIS or when systems were specifically designed to create and maintain large geographical databases. From there, TYDAC Technologies, Inc. embarked on an extensive research and consultation with actual users of existing GIS at that time -- thus developing a powerful system that can build and integrate spatial databases and at the same time accept and generate geographic information stored in various data structures and formats.

SPANS boasts of over 20 generic interfaces to existing GIS and database file formats and links to graphics systems, spreadsheets, word processors and spatial analysis packages including the capability to construct models of reality using various information and statistical methods. SPANS' modelling language can define and visualize simple and complex models of dimension of reality that are geographically dependent.

Available in three operating systems: DOS, OS/2 and IBM compatibles and IBM's RISC System/6000, SPANS supports **vector*** and **raster*** images, **arc-node*** digitizing, multiple map queries, area analysis, buffers and various overlaying processes. Its feature on visibility and three-dimensional viewing provides ENR planners and managers with accurate spatial data and analyses.

SPANS consists of seven interrelated modules which aid in maximizing the software's capabilities and provides ample room for users to design their own system depending on their needs. These include the CORE module which sets the softwares foundation, TYDIG for digitizing, CONTOUR for contouring, POTMAP for potential mapping, VECTOR for vector interface, RASTER for raster interface and MAP INDEX for map indexing.

GENAMAP
Developed by
Genasys II Pty. Ltd.
13th Level 33 Berry St.
N Sydney, NSW 2060 Australia

GENAMAP is an applications oriented GIS designed around the UNIX operating system. It provides a seamless data coverage and topological database capable of managing and analyzing large volumes of spatial information.

GENAMAP performs comprehensive spatial analysis: buffers, overlays and proximities; provides full two-way spatial/aspatial data management suitable for a wide range of GIS/LIS applications; and provides full integration with single or multiple commercial RDBMSs in conjunction with GENACOMM. It is also capable of integrated cartographic composition, relational attribute management, georeferencing and the reformatting of data into various forms.

GENACELL, a cell-based data management system integrated with the GENAMAP GIS provides for the creation, display and analysis of cell data and has utilities for contouring, **viewshed definition*** and sun shading, among others.

Another integrated component in GENAMAP is GENACIVIL, a road design module programmed to assist the design of roads both in urban and rural environments. This user-friendly component solves a wide range of civil design tasks and is interactive. It also supports surveying, coordinate geometry road design, and **Triangulated Irregular Network (TIN)*** and hydrological modelling.
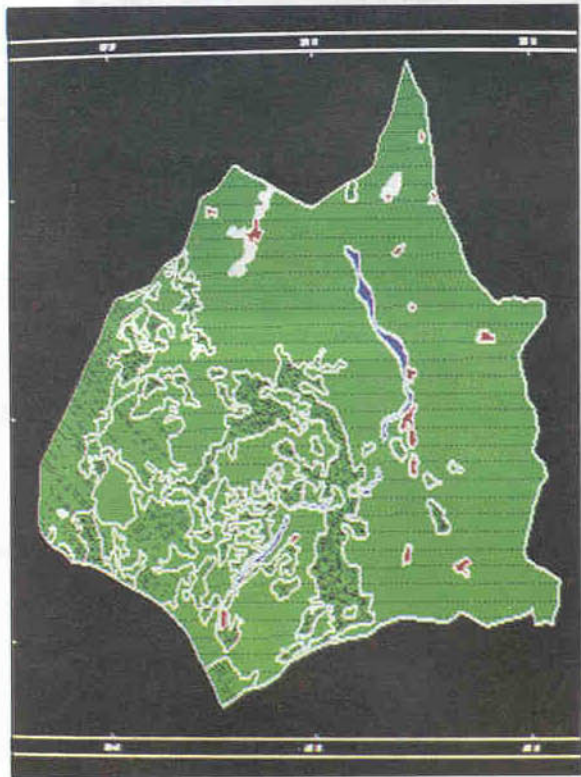
A GIS map of Tarlac

CRIES - Comprehensive Inventory and Evaluation System
Developed by
Department of Resource Development Michigan State University
in cooperation with
US Agency for International Development (USAID)

CRIES-GIS is the first PC-based GIS software in the world developed for public distribution. It is the cheapest system of its kind today, running on a minimum hardware requirement of an IBM XT or compatible. Even in the absence of a table digitizer, map data can be entered through manual encoding in a raster format. An ordinary printer can be used to produce attribute maps using various graphic patterns or symbols.

Developed as an output of the CRIES Project, the software represents the cooperative efforts of the Michigan State University and the USAID missions to Honduras, Jamaica, Dominican Republic and the Philippines. Primarily, CRIES (the project) aimed to apply a consistent approach to land resource assessment which is adaptable to many countries. It also aimed to provide assistance in integrated surveys, development of resource database and computer aided analysis software and provide training and technical assistance to assess crop production potential/alternatives.

Luckily, all of these objectives were met with the development of the CRIES-GIS - a system capable of storing, editing and processing digital map data and creating a master database which produces outputs in the form of statistical summaries and computer maps.

CRIES-GIS provides an analytical framework to evaluate physical and socio-economic attributes by location and determine the comparative advantage of sites for alternative uses. It comprises seven major modules, 30 phases and eight sub-phases. These interrelated modules perform separate functions from the basic inputting, functional analysis and editing to the final output in the form of maps, statistics and digital data.

MAP INFO
Developed by
Mapping Information Systems Corporation (Map Info Corp.)
200 Broadway, Troy, New York USA 12180

MAP INFO is a desktop mapping system that lets users display and analyze data geographically. It is used in creating, manipulating and analyzing color maps of states, cities, towns, housing developments or any other images that can be shown on a map and can generate floor plans and organizational charts.

MAP INFO maps are created by layering independently controllable databases: *boundary files* - areas enclosed by connected line segments representing sales territories, cities, towns, ZIP codes, etc; *map files* - contain information about line segments and data such as railroads, rivers, utilities, streets, etc.; *point files* - represent houses, offices, buildings, students, location (lat. & long.), etc.; and *image files* - represent labels or drawings on maps such as titles, legends, circles, rectangles and texts used for presentation graphics and object identification.

MAP INFO also creates and displays maps of any area from 52 feet to 1200 miles wide and is capable of panning, zooming and finding addresses or specific points anywhere on the map. It can also perform thematic mapping which can graphically display almost any type of demographic data distribution and trends.

These and other GIS software packages worldwide make up the exciting arena in the field of automated geographic information. Soon, as more and more people, planners, managers and ordinary computer users are exposed to the technology, softwares will continue to be developed and enhanced to suit every user's needs. And believe me, by the time you have tried, used and tested an efficient package, there will always be a new and improved version coming your way. So what are you waiting for, take your pick. ●

References

Alba, J., et al. Report on a *Study of GIS Requirements*, NAMRIA, 1992.
Environmental Systems Research, Inc. *ARC/INFO Manual*, Redlands, California.
Schultink, Ger, Buckley, Brian, etc. al. *CRIES Manual*, 1987.
Tydac Technologies. *SPANS Manual*, 1989
Genasys II Pty. Ltd. *GENAMAP Leaflets*, Brochures, Sydney, Australia.
Mapping Information Systems Corporation. *MAPINFO Manual*, New York.

Contributions

The National Surveys, Mapping, and Resource Information Technology (Infomapper) is accepting contributions for its forthcoming issues. Manuscripts should be typed, double-spaced and must indicate the author's name, position, and office/home addresses. Photo-graphs and illustrations with captions are also welcome.

The Editors reserve the right to edit materials submitted. ●

GIS Maps for Pro

INPUT MAPS

CRITERIA MAPS

River System Map

Land Classification Map

River System Conservation Map

Slope Map

Land Cover Map

Forest Cover Conservation Map
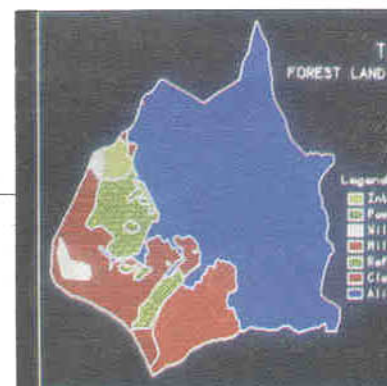
Elevation Map

Elevation Conservation Map

Regulatory Status Map
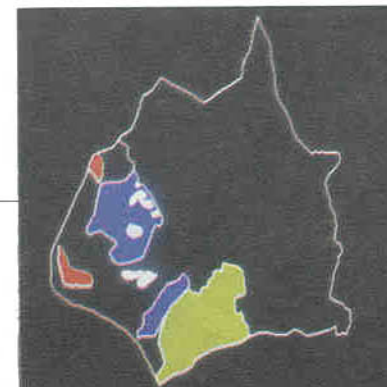
Proclaimed Areas Map

rovincial Planning

An output of the Environment and Natural Resources (ENR) Provincial Planning System (EPPS) is an ENR Conservation Domain Map which identifies areas that must be conserved and where developmental activities cannot be implemented.

The system is designed to showcase the capability of GIS technology in assisting planners in the preparation of provincial development plans. It was developed using the outputs of the Provincial Atlas of Tarlac, the pilot area of the project.

EPPS outputs such as the ENR Conservation Domain Map of Tarlac are useful in the preparation of the Resource Use Framework Plan Component of the long term and comprehensive Regional Physical Framework Planning.

OUTPUT MAP
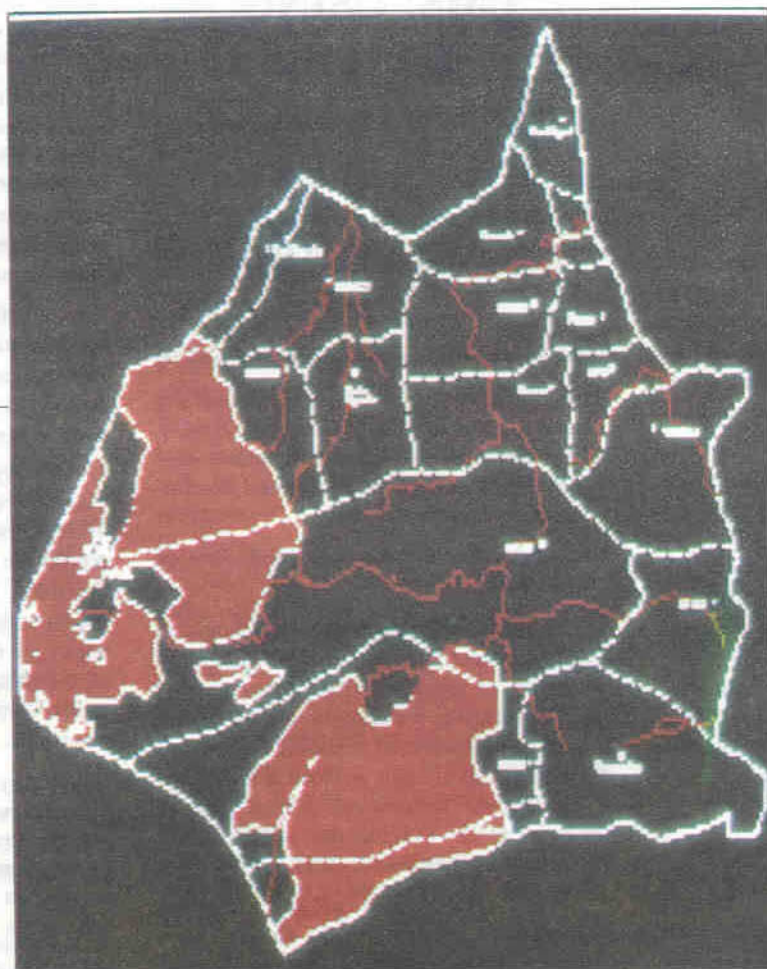
ENR Conservation Domain Map

Most people go about their daily business without really thinking about what makes life bearable. We pound the keys of our PCs to meet deadlines, get hold of important data over the phone or through fax, wash Metro Manila's grime away from our bodies under the shower, and do a host of other things we take for granted.

But what if we find our monitors refusing to light up, our phones silent, and our showers empty? Then we begin to appreciate basic utilities such as electricity, communication lines, and water as well as the utility companies which bring these into our homes.

Water is definitely not the least important of all these, as it is not only a matter of convenience and comfort, but more a matter of survival to have this precious commodity in our households. Thus, woe to the Metropolitan Waterworks and Sewerage System (MWSS) if it cannot ensure an adequate and uninterrupted supply and distribution of potable water to Metro Manila's almost eight million residents as well as those living in parts of Cavite and Rizal.

MWSS Current System

MWSS, the sole agency tasked with the proper operation and maintenance of the waterworks system in the metropolis, supplies about 2,400 million liters water to its consumers daily and loses around 648 million due to pipe leaks.

In order to expedite repair activities on leaking pipes, the agency has created the MWSS Action Center (MAC) which coordinates among the different sectors and departments involved in leak repair activities. It has also developed the Computerized Complaint Monitoring System (CCMS) to provide an efficient method for leak management and facilitate the recording and transmitting of complaints to the various units involved in leak repair.

The CCMS, however, still needs to be improved. It cannot provide all the data on utilities which repair men need to know and it does not provide a chronological history of repair activities done on a specific utility. For instance, dispatched repair crews may not know the exact address of a complainant, may bring inappropriate equipment because the nature of the road surface or the type of pipe is not known, or waste time digging in the wrong location because the exact source of the leak is not known.

The Leak Monitoring System (LMS)

As part of its Research and Development (R&D) efforts on the potential uses of GIS, NAMRIA has initiated the creation and development of a Leak Monitoring System (LMS) for the MWSS. The agency is now working on this system which will eventually provide an efficient storage and retrieval of information to enhance

the management and monitoring of water utilities. The LMS is expected to enable the MWSS to more effectively deploy pipe repair teams and to monitor the progress of repair jobs. Through the use of GIS technology, this system also facilitates the updating and production of utilities maps.

The system's distinguishing feature is its capability to graphically pinpoint the exact location of map features, thus simplifying the process of identifying pipeline interconnections among other operating devices.

The main objective of the LMS is to increase MWSS' ability to monitor and manage leak repair activities through the efficient storage and retrieval of water utilities information. Specifically, it aims to:

1. enhance the capabilities of the CCMS by integrating utilities maps and attribute information of utilities map features using GIS technology;

LMS: USING UTILITIES MANAGEMENT AND MAPPING

by Charmaine C. Aviquivil
Information Management Department

2. provide a system for efficient storage and quick retrieval of utilities information to facilitate the recording of waterworks related complaints, generation of job orders, and monitoring of repair activities; and

3. automate the updating and production of utilities maps.

The proposed system covers the complaint handling process, preparation of job orders and monitoring of repair activities. Processing of inquiries related to waterworks utilities repairs as well as generation of statistical reports and plotting of maps are also included in the design of the system. Waterworks utilities such as pipelines, valves hydrants and water service connections are likewise covered.

Pilot areas for the project are three barangays of Makati which already have available digitized graphical and non-graphical databases: Guadalupe Viejo, Guadalupe Nuevo and Poblacion.[1]

Functions

The system has four major functions:

1. *Processing and Monitoring of Complaints* - concerned with the build-up of the complaints file, assigning control numbers for complaints received and ascertaining whether a particular complaint has been acted upon and the corresponding repair job undertaken.

2. *Processing of Leak Repair Jobs* - involves the generation of job orders for each recorded complaint and prooflist of all job orders which assists the dispatcher in scheduling repair activities.

3. *Monitoring of Repair Activities* - concerned with updating the status of repair activities and keeping track of the progress of work implemented.

4. *Updating and Plotting of Utilities Maps* - automates the updating of features on utilities maps.

How LMS Operates

Phoned-in complaints are encoded while those which are reported personally are recorded by filling-out the Complaint Action Slip (CAS) prior to processing. All keyed-in complaints are screened to avoid duplication.

Graphical data on pipelines, hydrants, valves and pumping stations are updated using the Arcedit module of ARC/INFO. The corresponding attribute data on dimension, type, size, and make, among others, are updated using information gathered from repair activities and reports from various units of MWSS.

Monitoring of repair work done for a specific utility is through the accomplishment reports submitted by team leaders. These provide the basis in updating the status of a complaint after repair work has been done.

The system generates a job order for each complaint received to facilitate implementation of repair work, after which accomplishment reports are immediately processed to determine the status of the complaint. Jobs which are not completed are automatically provided with a new job order for rescheduling. The process of assigning job orders is repeated until the repair work on a reported leaking utility is completed.

The system facilitates inquiries on locations of pipelines and other utilities including house service connections. Inquiries can be made on the status of a particular complaint as well as those by the type and nature of complaints.

LMS can also produce several types of reports in pre-defined formats and 1:2,000 scale utilities maps.

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[1] Digitization was done in connection with the project Zoning Information System

System Requirements

1. Inputs

The system must have the following inputs: complaint slip which contains information on the nature and type of leak, its location, and the date and time reported; 1:500 as-built drawings* which reflect replaced features/attributes; and fire hydrant, valve, house service connection and accomplishment reports.

2. Outputs

The expected outputs are:

A. *Monthly Report on Leak Repair* - gives information on the number of reports received per nature of leak complaint, the number of days the complaint was resolved and the number of jobs which were not completed.

B. *Weekly Report on Leak Repair* - gives a statistical account of all leak repair and other miscellaneous activities handled by the Leak Control Force on a weekly basis;

C. *Job Order Form* - a system-generated document which summarizes information on the complaint and on utility attributes such as location, size, type, make, type of pavement, etc.

D. *Job Order Prooflist* - used by the dispatcher for planning maintenance activities and scheduling team assignments to the repair crews for their respective shifts;

E. *Repair Replacement Notice* - documents materials that are replaced for each utility repaired;

F. *Complaint Status Report* - contains a comprehensive listing of the current status of complaints after the implementation of job orders.

G. *Report on Complaints Reaction Time* - shows the total number of complaints acted upon per type of pavement and presents a comparative analysis on the number of jobs completed as against the total number of days it took since the receipt of the complaints to the date they were resolved;

H. *Accomplishment Report Form* - used in updating the status of repair jobs and for reporting the work done on utilities, materials, vehicles and equipment used, personnel involved, and other repair work related data;

I. *Utilities Map* - a plotted map which shows the location of pipes, valves, hydrants and pumps at scale 1:2,000. It also shows road networks, street blocks, rivers, and barangay boundaries;

J. *Inquiry Outputs* - facilitates inquiries on utilities, status of complaints and leak repair activities implemented on a particular pipeline.

System Design Characteristics

1. Hardware Requirements

LMS is ideally implemented on a **networking environment*** using workstations to facilitate the transfer of information from the various implementing units and departments involved in leak repairs situated in different areas of Metro Manila. However, this cannot be done during the development stage since NAMRIA does not have facilities for this purpose. This can be done later during the actual implementation of LMS. Thus, for proto typing purposes, LMS is being developed in a **stand alone computer environment*** using microcomputers and other peripherals.
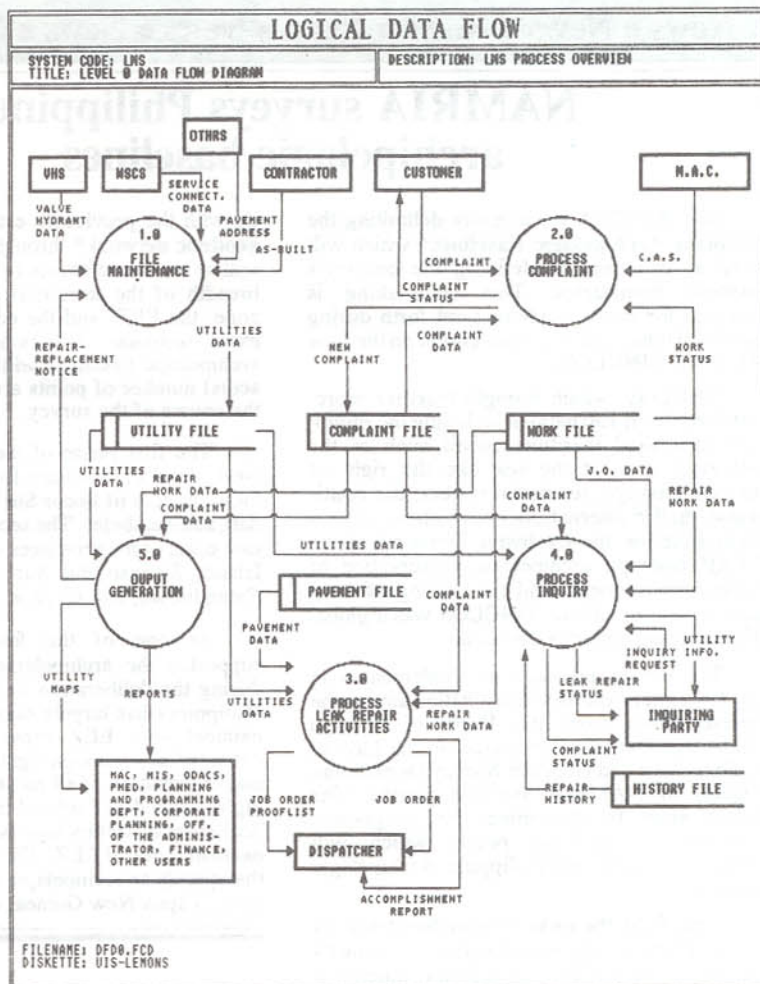
2. Software Requirements

LMS requires ARC/INFO, a GIS software used for conversion of maps into digital format, editing, plotting and query processes which require graphical files. DBASE III will be used for the non-graphical files and Clipper will be used for compiling DBASE III programs.

Project Status

The NAMRIA has already completed the system design which is now ready for presentation to MWSS. Programming is currently being performed. The system is expected to be completed in December this year.

The completion of the system and its presentation to the intended user is expected to provide benchmark information needed in estimating the cost of data conversion in utility companies. It could also pave the way for further joint undertakings between NAMRIA and the MWSS.

The Leak Monitoring System is just one of several other similar information systems being developed and/or used by other utility companies such as the MERALCO and PLDT. These developments are certainly welcome bit of news

to utility consumers in many parts of the country who fervently hope for the day when an uninterrupted and adequate supply of water, power, and communication facilities is guaranteed.

LOGICAL DATA FLOW

SYSTEM CODE: LMS
TITLE: LEVEL 0 DATA FLOW DIAGRAM
DESCRIPTION: LMS PROCESS OVERVIEW

FILENAME: DFD0.FCD
DISKETTE: UIS-LEMONS

Leak Monitoring System Process Overview

References

Baldonado, E. "Leak Monitoring System." NAMRIA, 1992.
Gayban, E. "Leak Monitoring System: Proposed System Design." NAMRIA, 1992.

NAMRIA surveys Philippine archipelagic baselines

The NAMRIA is currently delimiting the Philippine **Archipelagic Baselines*** which will serve as reference in defining the country's maritime boundaries. This undertaking is provided for in the guidelines set forth during the 1982 United Nations Convention on the Law of the Sea (UNCLOS).

UNCLOS, which brought together representatives from 150 nations including the Philippines discussed maritime issues such as the traditional uses of the sea like the right of innocent passage, territorial waters, the **continental shelf,*** international navigation through straits fisheries, the **Exclusive Economic Zone (EEZ)*** concept, archipelagic preservation of marine environment, and the mining of deep sea-bed, among others. UNCLOS was a global effort to bring order in the ocean.

The survey project was implemented in July 1992 after extensive consultation among the representatives from the Dept. of Foreign Affairs, the Cabinet Committee on the Law of the Sea, Coast and Geodetic Survey Department (CGSD) of NAMRIA and the Senate. The project aims to determine the geographic positions of the base points which will technically define the Philippine Archipelagic Baselines.

In the field, the survey teams dispatched by the CGSD are occupying and surveying some 84 base points which are actually the outermost points of the outermost islands and outlying reefs of the archipelago. These base points will be tied up with the previously established **first-order geodetic network*** throughout the country and will be used as reference points in measuring the breadth of the territorial sea, the contiguous zone, the EEZ, and the continental shelf. The exact technical definition of the Philippine archipelagic baselines will be known after the actual number of points are determined during the course of the survey.

The first phase of the project covers the west coast of Northern Luzon which includes the provinces of Ilocos Sur and Norte, Pangasinan, and Zambales. The second phase covers the east coast of the provinces of Davao, Sarangani Island, Surigao del Sur and Norte, Samar, Catanduanes, and Quezon.

As one of the few countries which supported the archipelagic doctrine principle during the deliberation in the Convention, the Philippines has largely benefitted from the 200 nautical mile EEZ provision. The doctrine extended its sovereign rights for the exploration and exploitation of all natural resources including its seabed and subsoil from 290,00 sq. nautical miles of archipelagic waters to 652,000 sq. nautical miles of EEZ. The other island nations that qualify as archipelagic states are Fiji, Indonesia, Papua New Guinea, and the Bahamas. ●

PHILIPPINE MAP

Yellow Line - archipelagic baselines drawn along outermost islands. All waters inside the baselines are internal waters or archipelagic waters.

Red Line - extent of territorial sea of 12 nautical miles from the baselines.

Philippine Map showing archipelagic baselines, territorial sea, contiguous zone and EEZ .

NAMRIA upgrades equipment

NAMRIA's Mapping and Reprography Department (MRD) has recently acquired ZEISS Planicomp P2, a universal analytical stereoplotting system and five multi-terminals NEC/Multi-Sync 5D for AutoCAD users with corresponding Epson LQ - 1170 printers.

The acquisition is aimed to upgrade the workstation of the department's Photogrammetry division. The division produces line map manuscripts at various scales showing contours and man-made and natural features. It also determines additional geodetic control points and rectifies differential and conventional photographs, among others.

Modern analytical plotters like Planicomp P2 represent a higher level of accuracy, has more convenient handling of the speed of operation and versatile application as compared to their analogue instruments.

P2 Planicomp is a cost-effective analytical plotter which combines the capability of C100 Planicomp viewer and the new PHOCUS features. It contains P-Series Control Unit and integrated P-processor. ●

Philippines to co-host RS-GIS seminar

A Regional Seminar on the applications of Remote Sensing (RS) and allied GIS technologies in various development projects will be held at the Asian Development Bank (ADB) building in Mandaluyong, Philippines on 2 to 4 December 1992. This will be participated in by senior managerial/policy level specialists from developing countries of the Asia-Pacific Region such as Bangladesh, China, India, Indonesia, Malaysia, Nepal, Mongolia, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam. Other participants will come from developed countries like France, Australia, Canada, Japan and USA and international organizations such as ADB, European Space Agency (ESA) and United Nation Economic and Social Commission for Asia and the Pacific (ESCAP).

This RS-GIS seminar is a follow-up of the ESCAP/ADB Regional Conference on the assessment of the economics of RS applications to natural resources and environment development projects held in Guangzhou, China in November 1990.

It aims to evolve a pragmatic approach for the application of RS and GIS for sustainable natural resources development and environment management in developing countries of the Asia-Pacific Region.

It is also expected that the gathering will ensure interaction among the participants from developing countries who use RS and GIS technology and the developers of the technology who will be represented by experts from France and other developed countries and the representatives of the ADB.

The three-day seminar will include lectures, presentations, and discussions on various topics including an overview of RS and GIS and their applications in agriculture, forest management, and environmental monitoring, among others. In addition, there will be a session on the application of RS and GIS in development planning and a workshop on information needs for development.

The final output of the seminar will be a report that will provide the basis for initiating applied RS and GIS activities in the region for sustained natural resources and environment development projects.

The seminar is jointly organized by the ESCAP, the ADB, the Governments of France and the Philippines.

ESCAP thru its Natural Resources Division is the overall coordinator of the seminar. The ADB will provide the venue for the three-day conference as well as secretariat support. The Philippines through NAMRIA will provide local support and the Government of France through SCOT CONSEIL will provide the funding and technical support. ●
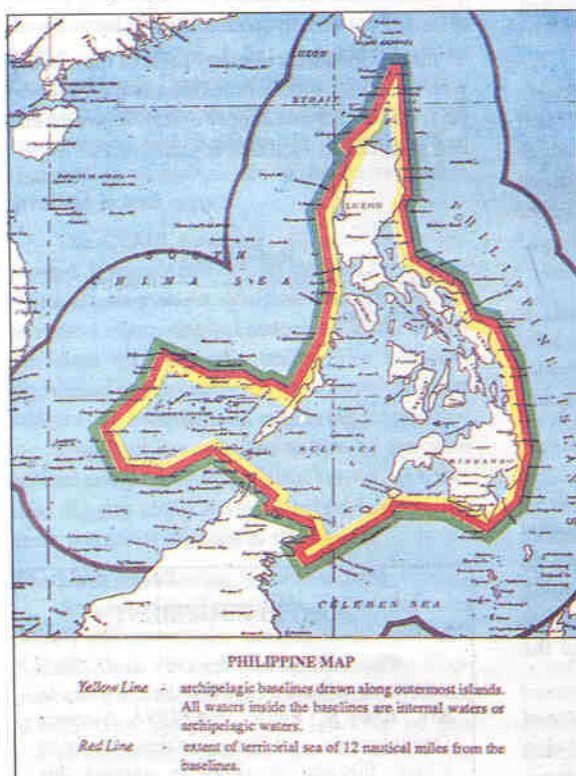
LGUs receive maps from NAMRIA

Local government units (LGUs) in Albay, Cebu, Iloilo, Guimaras and the municipality of Makati have received various maps of their areas of jurisdiction from the NAMRIA in separate turn-over ceremonies this year.

Products given to Albay were topographic maps of its municipalities, as well as land cover, provincial and administrative maps. Cebu received the topographic map of Metro Cebu (1:5,000 scale) which was launched on 4 September 1992. Cebu and Iloilo received harbor and nautical charts, and provincial and land cover maps. Guimaras received a nautical chart, a SPOT satellite image, and several 1:50,000 topographic map sheets covering its municipalities and portions of the neighboring province of Iloilo, as well as an administrative map of Region VI.

In Makati, NAMRIA presented to Mayor Jejomar Binay and the municipal officials a system developed by the agency, the GIS for Municipal Planning and Management for Makati and its outputs: cadastral, zoning and street maps. Planimetric, contoured and land-use maps were also turned-over to the municipality.

Exhibits set-up by NAMRIA in every turn-over site enabled the public to view the maps received by their local government.

The undertaking is a continuing activity of the agency's Information, Education and Communication program. The turn-over activities gave NAMRIA the opportunity to assess the map and other ENR data requirements of the LGUs.

These activities are being undertaken by the Information Management Department in cooperation with other NAMRIA departments. ●

Cebu Vice Governor Apolinario Abenis cuts the ribbon formally opening the exhibit on 3 September 1992, assisted by DENR RED Jeremias Dolino and NAMRIA IMD Director Linda SD. Papa.

NAMRIA maps Pangasinan

The NAMRIA thru the Remote Sensing and Resource Data Analysis Department (RSRDAD) will undertake a joint project with the local government of Pangasinan for the thematic mapping of the province.

The project aims to produce and update existing thematic maps which are vital inputs to the rural development projects of Pangasinan. It will have three components: the resurvey of coastal zones for conversion into tourist spots; tax mapping to generate additional income for the provinces; and production and updating of thematic maps.

RSRDAD Director Virgilio Basa presented the draft proposal to the provincial board members last October 1992. The board members unanimously approved the implementation of the project. However, the governor was not around during the presentation. Another meeting between the governor, the provincial board members, and DENR and NAMRIA officials is scheduled to be held in NAMRIA sometime in December to finalize the project. ●

Lake Lanao-Agus watershed forest cover updated

The NAMRIA has completed the survey of the Lake Lanao-Agus Watershed to update the forest cover data of the area.

The survey team composed of foresters from the RSRDAD used the latest satellite data, the 1990 Landsat TM for ground validation and interpretation of the forest data. The result of the survey showed that the total forest land of the area is 96,798 hectares (ha). and the waterbody is 98,202 ha.

Of the total forest land, 41.38% (40,025 ha) was determined as old growth forest, 36.21% (35,050) ha as residual forest while the rest are submarginal forest, mossy forest, brushlands, and grasslands. Other land uses are mainly upland agricultural farming.

The project was undertaken through the project Updating of Forest Cover Using Satellite Data of RSRDAD pursuant to a Memorandum of Agreement between the DENR and the Autonomous Region in Muslim Mindanao (ARMM) stipulating mutual responsibilities of the national government and the LGU for the protection of the watershed from commercial logging. Both parties will also undertake the development, rehabilitation and protection of the watershed as well as

the region's resources.

Lake Lanao is the prime source of power of the Agus I Hydro electric plant which complements the source of electric power supply of Mindanao.

Lake Lanao-Agus watershed encompasses the provinces of Lanao de Sur and Lanao del Norte. It has an area of approximately 195,000 including the water bodies.
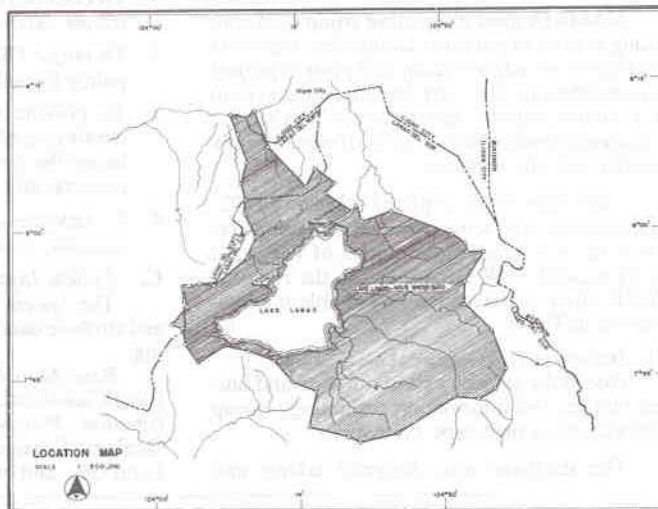
With the data, NAMRIA will provide ARMM with the baseline information needed in the formulation of plans, programs and policies for the preservation and maintenance of the watershed area. ●

Lake Lanao-Agus watershed location map

Environment and Natural Resources (ENR) Provincial Planning System [1]

by Evangeline C. Cruzado and Emerson B. Gayban

I. Background

The advent of Geographic information System (GIS) technology in ENR mapping and information management has revolutionized data integration and analysis. NAMRIA has programmed several projects using GIS which are aimed at increasing capabilities in planning and management in the ENR sector. One of these is the "ENR Provincial Planning System" (EPPS). Apart from utilizing GIS technology, the EPPS was developed using the outputs of the provincial Atlas of Tarlac, a compilation of various thematic maps and discussions on the socio-economic and natural resources profile of the province.

The project supports one of the main thrusts of the government: to achieve economic growth and secure a more equitable distribution of resources through decentralization. The project outputs will also provide valuable inputs to the Regional Physical Framework Plan (RPFP), which would be the basis for the formulation of Regional Development Plans. The NAMRIA plays a major role in the development of the plan with its expertise in mapping and information management.

The RPFP includes provincial governments in the land use or spatial planning process. It is a multi-disciplinary and inter-agency effort that would enable the private and the public sectors to arrive at decisions concerning land and other natural resources so that these are devoted to their most beneficial use and at the same time are property managed and conserved for future generations.

The NEDA through its Regional Offices is the agency coordinating the preparation of the RPFP together with implementing agencies such as the DENR.

II. Geo-Information Technology Implementation

The development of the EPPS for Tarlac consisted mainly of four stages: (1) compilation and preparation of data; (2) systems study and design; (3) data conversion; and (4) system development.

NAMRIA used its existing equipment consisting mainly of personal computers, digitizers and plotters which were acquired prior to project implementation. The staff developed the system in a microcomputer environment. ARC/INFO was selected since most of the staff were already familiar with the software.

The system was completed in January 1992. Arrangements are being made for its demonstration to the Provincial Government of Tarlac, to the Provincial ENR Office, and to the regional DENR office to determine its possible implementation in Tarlac.

III. Database Development

Due to the project's short duration and limited budget, the information technology group planned only a prototype system.

The database was designed taking into account selected requirements of ENR provincial planners based on findings from earlier consultation activities. Special attention was focused on ENR applications in support of DENR offices in the province of Tarlac.

The available data and maps from Atlas Project minimized data gathering activities. Some maps and ENR data were updated and verified using information from the latest satellite maps and through additional data gathering in Tarlac. Atlas map outputs at scale 1:250,000 were used instead of thematic maps at scale 1:50,000 since the latter were unavailable.

IV. Hardware and Software Technology Used

To facilitate digitizing, control points were identified and listed; features to be digitized were also coded and manually checked. The digitization and editing of graphical files were then performed through the ARC/INFO ARCEDIT module.

Data entry for ENR statistics was also minimized since data files were already available in LOTUS 123 format. Existing files were converted into DBase III files with the software's conversion facility.

Map outputs were generated using the ARCPLOT module of ARC/INFO. Generation of maps were also automated through programs written in Simple Macro Language (SML).

V. Overview of the Provincial ENR Planning System

A. System Summary

The EPPS is an integrated approach in the presentation of maps and statistics using GIS. It updates spatial information, generates various maps and statistics, processes ENR queries, and overlays maps to produce composite maps to be used by planners and managers in the ENR sector.

B. Objectives

Main: To provide provincial planners with a tool to enhance management and planning capabilities.

Specific:

1. To establish computerized graphical and attribute databases for the RPFP and PPFP;

2. To utilize GIS technology for planning and policy formulation in the provincial;

3. To provide for an automated integration/overlaying of maps of various themes to enhance the provincial ENR decision making process; and

4. To develop an integrated approach in the analysis, visualization and use of resources.

C. System Inputs

The system uses both spatial data in maps and attribute data in statistical form of the following:

Base Map & Administrative Boundaries, Land Classification Map, Metallic Mineral Distribution, Non-Metallic Mineral Distribution, Geology, Erosion, Slope, Land Cover, General Land Use, and others.

D. System Outputs

1. Computer Data Bases - graphical databases (maps in digital form) and non-graphical data bases (information on map features).

2. Computerized ENR Provincial Planning System - provides for the efficient storage and retrieval of ENR information, automated overlaying of maps and easy generation of maps and statistical reports.

3. Thematic Maps-hard copies of maps are produced at a minimum scale of 1:250,000.

4. Decision Maps - 1:250,000 maps are generated by the automated overlaying of thematic maps.

E. System Capabilities and Functions

The system has five Modules:

1. Database Creation - for the entry of statistical data and creation of graphical files.

2. Maintenance - for updating graphical files and non-graphical data, with graphical files updating implemented using the ARCEDIT module of ARC/INFO.

3. Display/Query - for viewing all the available maps for display, query on the displayed features, plotting of selected maps and the generation of statistical reports.

4. Overlay/Query - for the automation of map overlaying, for queries on composite maps, and for generating hard copies of these maps.

5. Report Generation - for the generation of ENR statistical reports.

F. System Requirements

1. Hardware

The minimum hardware configuration of the system is as follows:

PC 386, with a minimum of 70 MB of hard disk, matheoprocessor, 640 RAM, with one 1.2 disk drive; VGA Color monitor; 132 column dot matrix printer; digitizing table; and plotter.

2. Software

The system uses ARC/INFO and DBASEIII and requires programs using Simple Macro Language (SML).

VI. Geo-information Technology Application

A. Conservation Areas

This application was developed to identify areas where developmental activities cannot be implemented (see Table A).

B. Reforestation Application

This application was developed for the identification of possible areas for reforestation (see Table B).

VII. Impact of Geo-Information Technology

The pilot-testing of this GIS application in Tarlac initiated the NAMRIA staff in the potentials and obstacles GIS implementation may bring. For instance, the automated production of composite maps will enable local planners to have a wider perspective of resources, create scenarios needed for planning purposes, and facilitate decision-making.

The installation of the system in local offices will depend on the availability of funds and technical expertise in the area. The system uses sophisticated equipment which require large capitalization. Additional financial investment is also required for manpower training.

The project developed only two applications: ENR conservation and identification of possible reforestation areas. However, its applications can be expanded to include production land use, environmental rehabilitation, settlement planning and long-term infrastructure planning.

The eruption of Mt. Pinatubo has altered the Tarlac landscape and as such, the digitized maps no longer reflect the real situation. However, these outputs can be used for comparison with the present situation.

The Tarlac Provincial Government and the Provincial Development Staff were very receptive of the system. With the approval of the Local Government Code which empowers the provincial government to raise revenues, the information and maps generated through the GIS project will be important tools for physical planning and, more importantly, for revenue generation of the province.

With the potentials in improved planning and revenue-generation the GIS implementation can bring about, the project proponents anticipate the same positive response if the EPPS would be introduced to other local government units (LGUs).

LGUs would immediately need additional fund sourcing to support hardware and software acquisition. A proposed solution is sharing of equipment. A centralized processing center can be established in regional centers with the funding coming from the provinces in region.

VIII. Conclusion

The experience of developing the system shows the application of GIS technology for planning and management purposes. Its flexible mapping facility and other features for the integration of graphical and non-graphical data and spatial data manipulation are also very useful for these purposes. ●

Table A - Conservation Areas

Map Input	Criteria
Land Classification Map	---
River System Map	20 meters (m) from both river banks for rivers in lands and 40 m for rivers in forestlands
Land Cover Map	Closed canopy and open canopy
Slope map	very steep, greater than 50% in slope
Elevation Map	1,000 meters and above
Fl Regulatory System Map	all areas proclaimed for conservation through Presidential Decrees and related laws

Table B - Reforestation Application

Map Input	Criteria
Land Cover Map	Brush & openland
Land Classification Map	Timberland
Slope Map	Moderate to steep 18% and above
Erosion Map	Medium to low
Geology Map	Sedimentary and metamorphic
Soil Map	Depth is 50 cm. and ph is 5 - 7.5

References:

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Gayban, E.B. 1991. Geographic Information System for Makati.
NEDA. Regional Physical Framework Plan, Revised Outline.
Nolledo, J.N. The 1991 Local Government Code with Basic Features.
Serote, E.M. A Framework for Integrating National/Regional and Local Development Planning.

In addition to mapping, multi-layered data storage, area zooming, and zoning, SMART facilities the posting of work orders, improves the access and sharing of plant data, provides accurate and current data for application and design support, answers plant queries, and generates ad hoc reports. All of these and more functionalities have been geared towards improving the quality of plant information while reducing the cost of maintaining all these information.

The pilot phase started in the middle of 1992 and is being implemented over an area equivalent to 100 km^2 within Metro Manila. It will run for 17 months.

Mr. Leonor says that "AM/FM is still in its infancy in the country but as more and more people realize and appreciate its tremendous potentials, the technology will eventually be absorbed." He foresees the use of the system in the next few years for more customer-oriented applications.

The Manila Electric Company (Meralco) is another utility company which, like PLDT, uses FRAMME. Meralco has formed a pilot team which is customizing this AM/FM system for its needs.

Meralco has conceptualized the establishment of an AM/FM System in the late 80s. The selection of a system was actually started in the second semester of 1991 with a pilot project covering Makati and was delivered in the second quarter of 1992. The pilot targets the creation of an AM/FM Information Systems Plan which will identify and prioritize business processes and operations in Meralco where the system can best be applied to provide the optimum value-added benefits to the company. The pilot application called the Pole Management Information System is expected to help the user departments in monitoring/keeping track of plant facilities, specifically in-service poles, and to provide benchmark figures for the evaluation of its full implementation.

The results of the pilot will determine the pacing for a company-wide implementation of the entire AM/FM System. Eventually, its application will be expanded to cover not only the technical but also other aspects of Meralco operations. The team can already see the potential of using AM/FM to enhance Meralco's Work Order Information System, Customer Service Information System, Fixed Assets Accounting System, and other applications.

GIS in Scientific/Research Institutions

GIS is also being used extensively in some international research/scientific institutions. The International Rice Research Institute (IRRI) was established in Los Banos in 1960 has been using GIS together with remote sensing (RS) since 1990 in the management and analysis of the complex variables of rice- growing ecosystems. With the use of GIS, land areas best suited for certain rice varieties and farming system/technologies can be determined. The information gathered can then be extrapolated to other areas.

IRRI's GIS/RS assets include PC ARC/INFO, SPANS, Dragon image processing software, Atlas Mapmaker and Atlas Draw, a laboratory with three digitizing stations, two editing and map composition stations, and one image processing station. These are linked to a mainframe computer and to Oracle, a centralized database.

The International Center for Living Aquatic Resources Management (ICLARM), another GIS user, is a non-government, autonomous, non-profit international scientific center established in 1977 which undertakes research in fisheries.

One of ICLARM's programs, the Coastal Area Management Program (CAMP), is actively using GIS to address certain issues affecting the coastal zone in two sites in the Philippines -- Lingayen Gulf and San Miguel Bay. The projects using GIS include the GIS for Coastal Area Management and Planning Project (GIS-CAMP) and the Resource and Ecological Assessment Project of San Miguel Bay (REA-SMB). Both projects are to be completed by 1993. The GISCAMP aims to establish a GIS databank for planning and management and develop an operational zonation scheme in the Lingayen Gulf area in collaboration with the National Economic Development Authority (NEDA) Region I office. For the REA-SMB, GIS is being used to assess coastal resources utilization including fisheries resources through modelling studies in order to develop strategies for the sustainable development of the bay's resources.

The GIS packages used at ICLARM are PC-based SPANS and IDRISI.

Yes, signs do portend that GIS is indeed coming of age in the country. As such, it deserves all the support and encouragement it can get from the national government. As more and more people come to appreciate and find new applications of this technology, who knows if it just might help propel this nation towards economic recovery in the years to come. ●

References:

● Interviews

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Project Profile

Determination of Suitable Upland Agricultural Areas using Geographic Information System

In response to the growing acceptance of GIS technology in the country, NAMRIA conducted a two-area pilot study in 1990 and 1991 using GIS. The pilot sites in Benguet (Tuba in 1990 and Sablan in 1991) were extensively analyzed to determine the potential areas suitable for upland agriculture. This was done to support government plans for agricultural development.

The study tested the applicability of GIS technology in determining upland agricultural areas and generated maps and data statistic of the pilot areas. The Tuba pilot area utilized the TYDAC-SPANS GIS Software while the Sablan study used PC ARC/INFO.

The study focused first on data collection on the following themes: climate and crop adaptation, rainfall, physiography and topography. All available documents such as maps, remote sensing data and aerial photos as well as field survey reports were utilized and evaluated. These were then entered into the computer to create digital maps. Criteria were then set to determine suitable upland agricultural areas. The TYDAC-SPANS capability for modelling was used to analyze and compute a suitability formula. A model of suitability was likewise created.

Results of the study showed that in Tuba, only 3.5% or 1,225 ha out 35,000 ha are highly suitable for agriculture. Moderate suitability has been found in only 6.71% or 2,349 ha as compared to 89.79% or 31,428 ha found not suitable for agriculture. The suitable areas were found to be highly accessible to barangay roads and national roads necessary in transporting farm inputs and marketing of agricultural products. Land use and land classification maps of the area were also produced.

In Sablan on the other hand, 4,080 ha or 35.62% of the 11,453 ha was classified as highly suitable and only 489 ha or 4.27% were moderately suitable upland areas. All other areas in the pilot study were classified as either marginally suitable or were not considered for suitability classification based on the set criteria.

The studies both revealed that GIS is indeed a valuable tool in suitability assessment and is capable of displaying and analyzing data on suitable upland agricultural areas and related land information. The results further revealed that the technology could easily be used for in-depth land use analysis, zoning and development planning.

The proponents of the project recommend that the technology be tested on more complex applications to further prove the effectivity of the model. ●

Source: Technical report on *Determination of Suitable Upland Agricultural Areas Using GIS Technology*, dela Cruz, Rolando et al, 1990 and 1991.

Glossary

Arc - a continuous string of x,y coordinate pairs beginning at one location and ending at another, having length but no area; a digital line.

Archipelagic baselines - lines joining the outermost points of the outermost islands and outlying reefs of the archipelago, and from which the extent of the territorial seas, contiguous zone, and the EEZ are measured.

As-built drawing - a 1:500 scale drawing which shows the physical layout of newly constructed or rehabilitated waterworks facilities and corresponding tie points which are the reference points for utilities.

Continental shelf - composed of the seabed and subsoil of the submarine area that extend beyond the territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin or to a distance of 200 nautical miles from the baselines from which the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance (from the *Primer on the United Nations Convention on the Law of the Sea*, Department of Foreign Affairs, 1991).

Exclusive Economic Zone (EEZ) - the area adjacent to the territorial sea which shall not extend beyond 200 nautical miles from the baselines from which the breath of the territorial sea is measured (from the Law of the Sea primer).

First-order geodetic network - a network of geodetic control points with a prescribed high degree of accuracy which serves as the reference for all surveying and mapping activities.

Geoprocessing - processing involving geographic data.

Networking Environment - a computer environment wherein components or systems are interconnected by means of high speed data links.

Node - the beginning and ending locations of an arc which are topologically linked to all arcs meetings at a node; the intersection of three arcs.

Raster format - raster refers to a regular grid of cells covering an area. Data are stored in grid or cell format.

Stand alone computer environment - a single computer environment with no interconnection with other computer systems.

Triangulated Irregular Network (TIN) - vector-based topological data model which is used to represent terrain data.

Vector format - vector refers to a quantity having both magnitude and direction. Data are stored in terms of x and y coordinates.

Viewshed definition - visibility analysis from one point to another.

Workstation - a computer system designed for a networking environment and for technical and scientific computing. Unlike a PC system, it has greater storage capacity and a faster processor. ●

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