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LIST OF ACRONYMS AND ABBREVIATIONS

AIDAB	Australian International Development Assistance Bureau
AS	Administrative Service
BSWM	Bureau of Soils and Water Management (DA)
CENRO	Community Environment and Natural Resources Officer (DENR)
CFM	Community Forest Management Work Element (NRMP)
DA	Department of Agriculture
dbh	Diameter at Breast Height
DENR	Department of Environment and Natural Resources
DILG	Department of Interior and Local Government
DPWH	Department of Public Works and Highways
EMB	Environmental Management Bureau (DENR)
ERDB	Ecosystems Research and Development Bureau (DENR)
FASPO	Foreign-Assisted and Special Projects Office (DENR)
FLMA	Forest Land Management Agreement
FMB	Forest Management Bureau (DENR)
FMSS	Forest Management Support System
FSO	Forest Service Organization
GIS	Geographic Information System
GOP	Government of the Philippines
GPS	Global Positioning System
IFMA	Industrial Forest Management Agreement
IPAS	Integrated Protected Areas System
LGU	Local Government Unit
LMB	Land Management Bureau (DENR)
MES	Monitoring and Evaluation Section
MDC	Municipal Development Council
MGB	Mines and Geo-Sciences Bureau (DENR)
MISD	Management Information Systems Division (DENR)
MPDO	Municipal Planning and Development Authority
NAMRIA	National Mapping and Resource Information Authority
NEDA	National Economic Development Authority
NGO	Nongovernmental Organization
NRMP	Natural Resources Management Program
NRMDP	Natural Resources Management and Development Project
NRMIS	Natural Resources Management Information System
OGA	Other Government Agency
PAGASA	Philippine Atmospheric, Geophysical, and Astronomical Services Administration
PAWB	Protected Areas and Wildlife Bureau (DENR)
PDED	Project Development and Evaluation Division (DENR)
PENRO	Provincial Environment and Natural Resources Office (DENR)
PMD	Planning and Management Division (DENR)

PPD	Planning and Programming Division (DENR)
PPDO	Provincial Planning and Development Office (DENR)
PPS	Plans and Programs Section (DENR)
PPSO	Planning and Policy Studies Office (DENR)
PSD	Policy Studies Division (DENR)
PVO	Private Voluntary Organization
RED	Regional Executive Director (DENR)
RSD	Research and Statistics Division (DENR)
SIU	Spatial Information Unit
TLA	Timber License Agreement
TPSA	Timber Processing Sharing Agreement
TSD	Technical Support Division (DENR)
USAID	United States Agency for International Development
USec	Undersecretary (DENR)

EXECUTIVE SUMMARY

Background and Goals of the Work

Natural resources planning is an inherently spatial activity. Decision makers must be able to evaluate the spatial distributions and relationships of physical and human characteristics in order to choose the most suitable management options. This report contains the results of a three month effort to identify a spatial information management process to enhance resource planning and management in the Department of Environment and Natural Resources (DENR).

The specific goals of the exercise were to:

> Target the decision makers within DENR and define a process to support their decision-making;
>
> Develop a model database and outputs for resources management planning.

To accomplish these goals, the consultant, in collaboration with a counterpart from the DENR Planning and Policy Studies Office (hereafter referred to as "the team"), assessed the current natural resources planning process, as well as existing spatial data and mechanisms for incorporating new information.

Current Planning and Needs

The assessment of the current approach indicates that resource planning and management can be greatly improved by creating a system to provide the appropriate decision makers with the information they need to assess alternative management options. Confusion about how the devolution process will be implemented and lack of a clearly defined information sharing process represent constraints on decision-making abilities. DENR needs to develop a vertical path to target the supply of information to the primary decision makers: the Secretary, the regional executive directors (REDs), and the provincial environment and natural resources officers (PENROs). The planning offices at the central, regional, and provincial levels are the appropriate entities to manage information and the flow of information to the appropriate decision makers.

Moreover, natural resources planning and management decisions currently are not supported by adequate spatial information. Decisions will be made whether or not decision makers have adequate information. Consequently, development of a system to acquire and use spatial information is crucial to sustainable natural resources management. The process should focus on the acquisition of spatial information at the provincial level and the use of spatial information for planning at the central, regional, and provincial levels. A standardized approach to data

collection and management should be developed. All groups collecting and managing information for DENR should be required to use these standard procedures.

Status of Spatial Information Management

A number of Government of the Philippines (GOP) agencies have employed spatial information management for a variety of special projects. In addition, several plans to develop geographic information systems (GIS) at DENR have been proposed. With the exception of the Natural Resources Management Information System (NRMIS), developed under the Natural Resources Management and Development Project (NRMDP), none of these projects or plans has much potential for replication or expansion. A few of the spatial information databases and outputs created for special projects may represent sources of data.

The team does not encourage a serious effort to create a system by consolidating earlier or on-going GIS efforts because outputs tend to be specific to a project or unavailable. In addition, the databases and outputs vary widely in scale, data collection and analytical methods are not well documented, and a variety of often incompatible software packages are used. Plans to develop a DENR-wide GIS tend to propose complex, multi-sectoral systems, with minimal guidelines for developing or using the systems. These plans also ignore the central issue: the profound lack of spatial data.

A Spatial Information System for Natural Resources Management

The team recommends that DENR use NRMIS in Region 2 and introduce manual spatial information methods in Region 11 as a foundation to develop a model information system designed specifically to provide adequate spatial information to the key decision makers: the Secretary, REDs, and PENROs.

The system should include components to acquire the basic set of spatial data needed to evaluate alternative resource management options, to analyze the data and provide outputs in useable formats, and to distribute the outputs to the key decision makers in DENR and related agencies. Spatial information units should be created within the planning offices at the DENR central, regional, and provincial offices to coordinate data collection, analysis, and distribution. A policy group, composed of senior decision makers, should be created at the central level. User groups, composed of mid-level planners, should be created at the central and regional levels. Data acquisition should be undertaken mainly at the provincial level (Figure 2).

Data Acquisition

The team concluded that lack of a basic set of spatial data is the major impediment to effective resource planning in DENR. We recommend that the first tasks of the policy and user groups

be to identify the critical data sets needed and establish data collection standards and methodologies. Regions 2 and 11 should be the model for development of a national data collection effort. Field survey units of DENR and local government units in the regions should be assigned to collect these data for each province or for selected provinces. DENR central and regional spatial information units should support the data collection effort by aggregating existing spatial information. The report defines the basic data sets recommended for a resource management database and identifies some collection mechanisms.

The team also concluded that the use of social and economic data for resource management needs careful evaluation. In addition, methods to collect social and economic data for purposes of spatial analysis need to be developed. Some suggestions for improving data collection are included in the discussion of the database developed for the forest site in Isabela Province.

Data Management and Analysis

Spatial information units should be set up in the planning offices at DENR central, regional, and provincial offices. These units should be composed of a planning officer, who acts as supervisor for the unit, and at least three support staff. The units should be equipped with the appropriate hardware and software.[1] Staff should have or receive training in spatial information management and its applications for resource planning.

To help evaluate the kinds of information and analysis needed for resource management, the team developed a spatial database and outputs using data from the Natural Resources Management Program (NRMP) resource inventory exercise in Isabela Province (Region 2). The results of this exercise are presented in the report. Spatial applications include distributions of timber and non-timber species and measurements, timber cutting priority models, and reforestation models. The report also contains examples of other spatial analytical techniques commonly used for resource management.

Distribution and Sharing of Spatial Information

The report suggests both vertical and horizontal linkages to aggregate data and make spatial data analyses available to the relevant parties. Data collection should occur at the provincial level, with local government units involved in the process. The provincial spatial information unit will prepare spatial analyses relevant to provincial-level resource management. The regional spatial information units should aggregate provincial databases and outputs, as well as prepare spatial information analyses for purposes of regional resource management. The central DENR spatial

[1]Some staff at the central and Region 2 DENR planning offices have been trained in some aspects of spatial information management. They will need additional training to expand the existing system. The units also will need some additional hardware and software.

information unit should aggregate regional databases and prepare spatial analyses for national resource management planning and evaluation.

Provisions to acquire from and share information with other GOP agencies will be important so that DENR is aware of their plans and can make adjustments to its own plans when necessary. In addition to involving the local government units in data collection plans and processes, horizontal linkages with GOP agencies who contribute to or are affected by natural resources management should be maintained by the policy and central/field user groups. These groups should include representatives from related GOP agencies, e.g., the National Economic Development Authority (NEDA). DENR should make information available to these agencies.

Training

Expertise in the methods and applications of spatial information for resource management is an essential requirement. A few DENR staff have received training in some aspects of spatial information management. Training is recommended for spatial information users, managers, and data collection units. Workshops and seminars focusing on the principles of spatial information for resource management should be held for policy and user group members. Data analysts and technicians in the spatial information units at the central, regional, and provincial offices will need both formal coursework and on-the-job training in spatial data management techniques and applications development. Data collection units should receive formal and field training in methods suitable for spatial information (e.g., mapping standards, sampling techniques, ground truth collection, use of global positioning systems (GPSs)). The report contains details on the specific kinds of training needed for each component of the system, as well as potential training sources.

The team recommends that NRMP, in cooperation with formally assigned counterparts from the DENR Planning and Policy Studies Office (PPSO), organize and supervise the training needed to develop the policy and user groups, as well as the automated spatial data management and data collection efforts recommended for Region 2 and the manual spatial information effort recommended for Region 11.

Technical Assistance

Technical assistance will be needed primarily for training. For the system to be sustainable, the team recommends that foreign technical assistance be used only for training not available from local sources. Local companies and the Universities can provide most of the training needed for software and database development. Spatial information user and applications development will require approximately six months of foreign technical assistance.

Milestones and Workplan

A comprehensive monitoring and evaluation system and workplan should be designed once decisions about the scope of the work are made. The report contains illustrative milestones (with verifiable indicators) and a workplan covering a two year period.

Costs

Actual costs similarly cannot be defined until DENR levels of effort are determined. Levels of effort for the DENR central, regional, and provincial spatial information units are recommended in the description of the proposed system. Indicative costs for hardware, software, other equipment, system environment, and technical assistance/training are included in Annex G.

A SPATIAL INFORMATION SYSTEM FOR NATURAL RESOURCES MANAGEMENT

I. INTRODUCTION

Sound natural resources planning is based on the spatial relationships and distributions of physical and human characteristics. At present, DENR resource management planners have no easily accessible system for including site-specific spatial information in the planning process. This report presents the results of a three month effort to create a model spatial information database to support planning in residual forest areas and to define a process to incorporate spatial information into the overall resource planning of DENR.

The work was performed by a team consisting of Dr. Kerry Connor (Geographer and Spatial Information Specialist from Development Alternatives, Inc.) and Ms Yolanda Gomez (Senior Planner/Forester from DENR).

The team focused on the creation of a spatial information planning database for resource complexes associated with forested land. The approach we recommend, however, can be applied to the management of any natural resource sector or service. In addition, forest management cannot be separated from its larger environmental setting. Thus, the process we recommend considers a variety of related natural resource and environmental factors. This process can be replicated or expanded to support planning in agencies other than DENR.

A. Goals and Objectives

This exercise, following the consultant's scope of work, had the following goals (see Annex A for complete scope of work):

- Develop a model spatial information database and outputs to support preparation of resource management plans for the NRMP Conservation and Development of Residual Forest inventories, using data from the Isabela (Region 2) site;

- Introduce spatial information management and outputs, using manual methods, for resource management plan preparation, using the data from the site in Samar (Region 8);

- Simplify and refine the socio-economic data collection process associated with the residual forest inventories; and

- Recommend a spatial information process to strengthen natural resources planning.

To accomplish these goals, several supporting activities were undertaken. These activities included the following:

Identify information needs and output priorities for natural resources management, focused on, but not limited to, forest management;

Assess existing data and their sources, as well as the availability and quality of the data and identify additional data and sources for formulation of resource management plans;

Define a process to acquire and manage spatial data for natural resources planning;[2]

Assess existing spatial information systems related to natural resources management;

Recommend equipment and software required to manage spatial information;

Identify technical assistance to implement a provincial-level spatial information system for resource management and estimate the technical assistance for a national-level system;

Provide illustrative costs and levels of effort for a provincial level spatial information system.

The goals and objectives are discussed below in separate sections, with details in the annexes. Sections are presented in the following order:

- Natural resources planning and needs
- Status of spatial information for resource planning
- Proposed spatial information system
- Training requirements
- Technical assistance requirements
- Illustrative monitoring and evaluation system
- Illustrative costs

[2]The description of the Isabela inventory database (Annex D) also defines a way for the NRMP CDRF to apply the model to future inventory exercises in Regions 2 and 11.

B. Departures from the Scope of Work

The team found it necessary to depart slightly from the scope of work in three areas. These include:

- The scope of work states that the team would work with the Geographic Information Unit in the Region 2 DENR office. The team would automate data to support the resource management plan for the inventory site in Isabela Province. We concluded that the existing scale (1:250,000) is too small for direct application to resource management planning on a 2,100 hectare site. Consequently, we imported the data into separate geographic layers in the ATLAS GIS database developed to support the plan. These files may be of some use in an expanded process.

- The scope of work states that manually-prepared map overlays would be used for the Isabela resource management plan. Manually developed map overlays have been prepared. We were able, however, to design and develop the automated database. Thus, the plan is being prepared using computer-generated maps based on the database.

- The scope of work states that the consultant would make recommendations for development of a multi-sectoral, national-level spatial information system. After a thorough assessment and careful consideration of its results, we concluded that this kind of a system is, at best, premature, and may not be desirable under any conditions. A more effective means to achieve multi-sectoral planning is for each sector to develop and maintain a spatial information process suited to its needs, but compatible with the processes used by other sectors. All related sectors should make data and spatial information outputs available to other agencies.

II. NATURAL RESOURCES PLANNING AND NEEDS

A. Assessment of DENR's Planning Process

The current resource management planning process is constrained by an almost total lack of spatial information. Decisions will be made whether or not decision makers have adequate information. Consequently, development of a system to acquire and use spatial information is crucial to sustainable resource management. Until recently, the planning process was characterized by a top-down approach driven by a macro-economic planning agenda. Consequently, little priority was given to collecting and managing site specific data on the spatial distribution and relationship of physical and human characteristics.

The Local Government Code of 1991 represents a major policy expression to reverse the cost-based approach to planning by devolving functions traditionally performed by national agencies to local government units. This effort is complemented by moves to decentralize and

deconcentrate the decision making of the national agencies themselves. The mechanics of devolution, however, are still evolving and some confusion about who makes decisions and how they will make them has further inhibited sound management planning.

B. DENR's Planning Needs

The DENR planning process can be greatly strengthened by a system to supply key decision makers (the Secretary, REDs, and PENROs) with the spatial information they need to evaluate alternative management options. The planning offices at the central, regional, and provincial levels are the logical and appropriate entities to supervise information management and flows to the decision makers. The process should focus on the acquisition of spatial information at the provincial level and the use of spatial information at the central, regional, and provincial levels. DENR should develop standard procedures for data collection and management and should require their use for all data collection and management. These procedures should include:

A spatial planning process to acquire site-specific data;

A system to provide key decision makers with spatial data outputs for identifying and choosing appropriate resource management options; devising management plans; supporting implementation of these plans; and evaluating the social, economic, and environmental impact of plans;

A system to share and use data to facilitate vertical and horizontal participation in resource planning and management; and

A clear set of standards and guidelines for all aspects of spatial data management.

C. The Spatial Information Approach

A spatial information system is a manual or automated process for managing, analyzing, and displaying spatially related information and statistics. In its automated form, it is a device to create a digital database consisting of an almost limitless number of layers (or topics). By combining these layers, it produces outputs (maps, graphics, reports) designed to meet the specific needs of resource planners and managers. An automated spatial information system provides the following tools:

A data input and retrieval system for storing, updating, and processing spatial and tabular data from surveys, maps, and remote sensing;

A data manipulation and analysis system for creating map layers and executing analytical tasks;

A data output system for displaying the resulting information in report, map, and statistical formats.

III. STATUS OF SPATIAL INFORMATION FOR RESOURCE PLANNING

A number of GOP and private agencies have employed spatial information management for a variety of special projects. In addition, several plans to develop a GIS at DENR have been proposed. With the exception of the Natural Resources Management Information System (piloted under the Natural Resources Management Development Project), none of the projects or plans has much potential for replication or expansion to serve the larger needs of DENR.

A few of the spatial information databases can be used as sources of data (see Annex B for details). The team, however, does not encourage consolidation of earlier or on-going GIS efforts as a foundation for a DENR-wide spatial information system for several reasons. Outputs are project specific and many are unavailable. Databases and outputs vary widely in scale, and many are unsuitable for site-specific planning. Data collection methods and analytical methods are not well documented, and a variety of often incompatible software packages have been used. Plans to develop a DENR-wide GIS tend to propose complex, multi-sectoral systems, with minimal guidelines for developing or using the system. That kind of system is, at best, inappropriate at this time. And, in the experience of NRMDP, has "immobilized any clear thinking on the subject." Finally, these plans ignore the central issue: the profound lack of spatial data.

IV. PROPOSED SPATIAL INFORMATION SYSTEM

In contrast to the majority of plans and projects, NRMIS represents a foundation on which to build an expanded spatial information system. NRMIS introduced computerized spatial information system capacity at the PPSO,[3] the National Mapping and Resource Information Authority (NAMRIA), and in three regional DENR planning offices (Regions 2, 3, and 7). Region 2 has staff trained in spatial information management and has developed spatial information standards, databases, and maps.[4] Annex B contains details on the NRMDP GIS.

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[3]One staff member was sent to Australia for training in GIS technology. This person has resigned from DENR. Two other staff members attended a 10 day course in GIS and Arc/Info GIS software at Geodata Systems Technologies, Inc. in Manila.

[4]In addition to the basic system installed in Region 2, systems were set up in Regions 3 and 7. The system in Region 3, though potentially useful for the expansion of spatial information management, has specific objectives not linked to overall planning (i.e., hazard monitoring of Mt. Pinatubo).

The team recommends that DENR use NRMIS as a foundation to build a spatial information system. In the initial stages of system development, DENR should focus on upgrading the capacity of NRMIS at the Region 2 planning office, introduce spatial information management to the provincial planning offices in Region 2, and introduce spatial information management using traditional manual geographic methods to the Region 11 planning office.

A. System Focus

The spatial information system for DENR should focus on providing support to key decision makers to assess alternative resource management options and to evaluate the impact of these management strategies. The system should focus on acquiring and managing the basic data needed to identify and delineate existing resource management and to choose the management strategy most suitable to the physical and human characteristics in specific areas. The system should also support evaluations of the environmental implications of alternative natural resources management options.

The current information on resource management and land classification is outdated, inconsistent in scale and level of detail, and unreliable because no standards of data collection and analysis are observed.[5] In addition, criteria for choosing resource management options often are insufficient.

The spatial data system we recommend is, in many ways, simply a refinement of the existing physical framework plans. The current physical framework process operates on a macro planning level. The recommended spatial information process would shift the focus to a more detailed examination of physical and human features, while maintaining simplicity by targeting the critical variables for natural resources planning and management.

The spatial approach to resource management planning works through option evaluation phases ("what if" scenarios) to choose the most suitable use for a geographic area and to establish baseline data to measure economic, social, and environmental changes related to resource management. First, management options based on physical and biological criteria are identified. Second, social and economic factors are evaluated. A resource management plan in a forest setting is used to illustrate this process.

Phase 1: Elevation, slope, waterway buffers, and protected area map layers are combined[6] to eliminate areas where timber may not be cut.

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[5]Site specific planning will require all data to be mapped at scales no smaller than 1:50,000.

[6]Spatial information software offers a variety of ways to "combine" or analyze data, including database queries, overlay techniques, and spatial operations such as buffer creation. All of the techniques can be based on user-defined criteria.

Phase 2: User-defined queries are made to the spatial database to select and map areas where trees of a certain species meet the cutting requirement of 60 cm average diameter at breast height (dbh) and where volumes are commercially viable.

Phase 3: Human characteristics are added to evaluate the social and economic trade-offs created by alternative management options.

In addition, economic and social information can help assess management option potential. For example, the physical and biological analysis indicates that reforestation is the most suitable management option. The economic data, however, suggest that the local inhabitants are heavily dependent on the forest for both kaingin agriculture and wood products. Consequently, implementation of a reforestation program should include sources for alternative income generation. Or, the physical/biological suitability analysis indicates that an area is commercially viable for large-scale timber extraction. Implementation of the plan would require a significant input of labor. The social and economic data would help determine the numbers of people in nearby communities available for and interested in this work.

B. System Development Processes: Data Acquisition, Management, and Sharing

The DENR spatial information system will need to develop three processes:

- Data acquisition;
- Data management;
- Data provision and sharing.

1. Data Acquisition

The mechanics of data acquisition will depend in large part on the resources (both human and financial) of the involved agencies.[7] We recommend that data be collected at the provincial level and that data collection be initiated in Regions 2 and 11. In the event of limited resources, the model process can be implemented in one or two provinces in each region. The NRMP residual forest test areas are be likely choices, for example, Quirino in Region 2 and New Bataan in Region 11

[7]The REDs in Regions 2 and 11 both indicated a number of data collection efforts planned or started. These efforts are slow because of a lack of staff and financial support. In addition, the devolution process appears to have added some confusion regarding responsibilities. A systematic investigation into existing data collection plans and processes will be needed to determine if results will be useful to the development of a spatial information framework.

The system should be based on the most critical geographic, biological, social, economic, and institutional data needed for natural resources management suitability analysis. Identification of these data will require a thorough assessment. Our data evaluation indicates that some available "static" data (geomorphology/geology, some administrative boundaries, major roads, climate patterns) are adequate for the initial stages of system development. The effort to incorporate these data should focus on assembling existing data and entering (mapping/digitizing) them into the spatial database. Other data sets should be updated or, in some cases, a major acquisition process will be needed. Annex C contains a discussion of the data sets recommended to develop the spatial information system, identification of government and nongovernmental organizations (NGOs) who might implement the data collection process, and illustrative descriptions of spatial analyses suitable for natural resources management.

The team also developed a sample database and outputs to support a resource management plan for the NRMP forest inventory site in Isabela Province (Region 2). The spatial database developed for this model resource management plan includes geographic data from 1:50,000 topographic maps and a 1:10,000 map of the forest inventory site, biological data from the forest inventory, and social/economic data from a survey of barangays dependent on the forest site for their income. The database was used to generate a variety of spatial applications, including tree species distributions by volumes and dbh, timber and non-timber priority cutting models, a reforestation model, and social and economic analyses. Details on the database and outputs are presented in Annex D.

2. Data Management

Spatial information units (SIUs) should be installed or expanded at the DENR central, regional, and provincial planning offices. As indicated above, we recommend that the DENR office in Region 2 serve as the model for replication in other regions, with Region 11 as the focus for the first replication effort.

Each of the SIUs should maintain a database and set of applications developed in response to requests from the Secretary, the Red, and the PENRO. Each provincial SIU will transfer a copy of its database to the regional SIU. Each regional SIU will aggregate the provincial spatial databases and transfer the regional spatial database, including any applications developed in response to requests from the RED, to the central SIU. The central SIU will create a nationally aggregated resource management database. It will use the database, and applications done by the regional SIUs, to develop applications in response to requests from the Secretary.

The actual analysis of spatial information should be demand-driven and, thus, will require a significant effort to develop user expertise among planners and decision makers. Spatial analysis is the most difficult to acquire spatial information skill. But once these skills have been developed, the number and kind of spatial information analyses are limited only by imagination and availability of data. See Annex D for descriptions of illustrative spatial applications for resource management.

3. Provision and Sharing

Both vertical and horizontal linkages will be needed to acquire data and to make spatial analyses available to key decision makers in DENR and related GOP agencies. Figure 1 shows the relationship of the proposed spatial information units to the components of DENR and local government units.

The following mechanisms will help to develop a pattern of information sharing within DENR, as well as between DENR and related agencies.

a. Policy Group

A policy group, composed of senior decision makers, should be established. Senior status of its members is crucial to empower the group with the authority to make decisions regarding objectives, implementation plans, staffing, output goals, and to make budget requests. Figure 2 shows an illustrative composition of the policy group and the central and field user groups.

Policy group members must have a strong commitment to implementing the framework.[8] To develop this commitment, policy group members should participate in short seminars introducing the principles of spatial information management and its effectiveness in supporting resource management.

The policy group will work with central and field user groups to set and maintain standards and procedures to establish communication protocols and executive/legislative measures to develop the SIU, allocate responsibilities, and organize procedures for inter-agency coordination.

b. User Groups

User groups should be composed of mid-level planners from the agencies directly involved in developing and using the SIU. Two user groups should be established: one at the central and one at the regional level. The user groups should coordinate planning objectives and monitoring requirements; set standards for data collection procedures, mapping, and databases; identify spatial information output needs; and assure that outputs are disseminated to key decision makers (including other agencies involved in or affected by natural resources management). In addition to DENR staff, user groups should

[8]The Information Resources Management Program, begun in December of 1991, has a "steering committee" and "technical work groups" composed of some of the same persons we recommend for the policy group. These groups have experienced some coordination problems. These problems may have resulted from a lack of a clearly stated objectives for the program.

FIGURE 1. PROPOSED DENR STRUCTURE

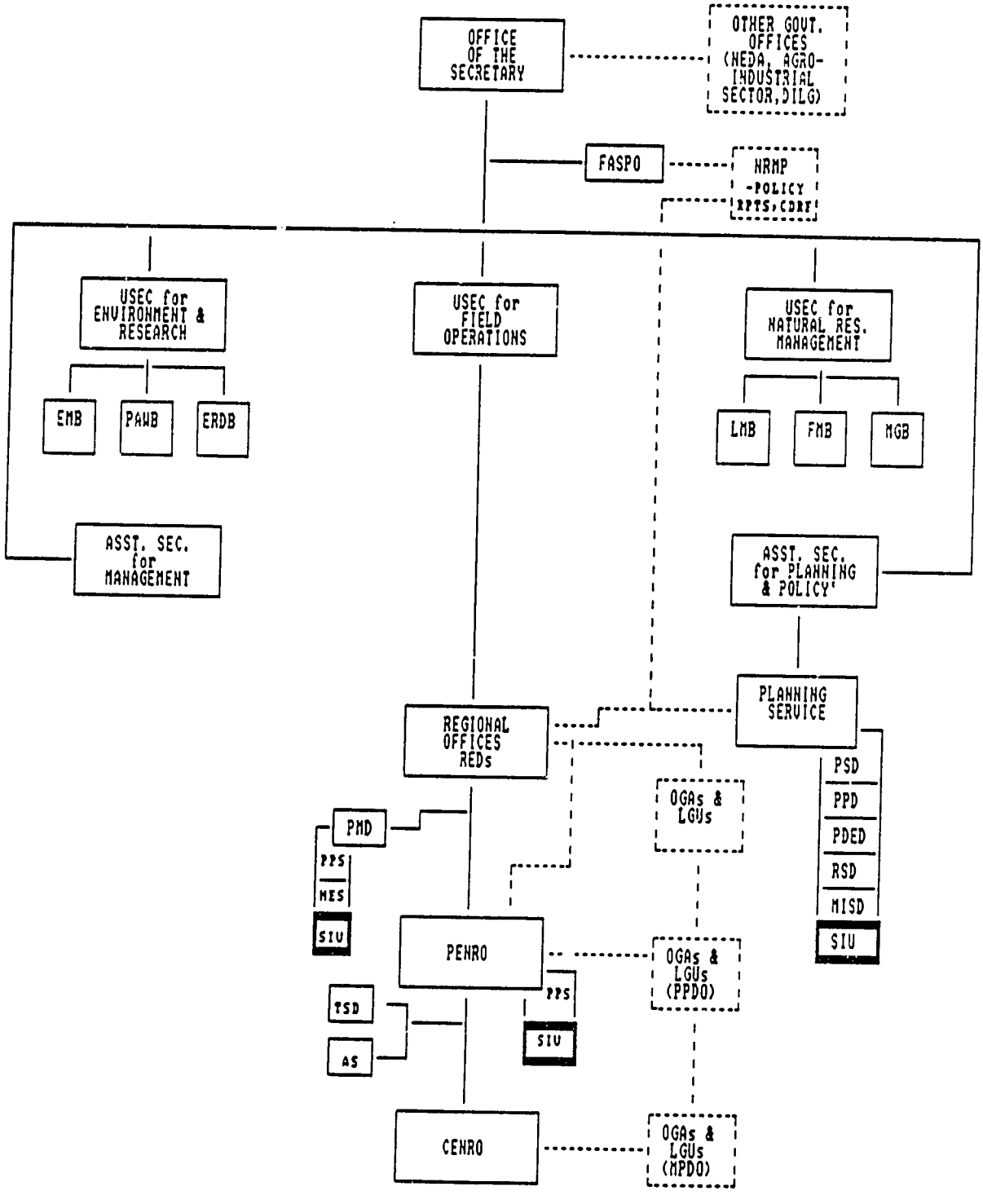


Figure 2: Recommended Composition

Policy Group

- USec for Natural Resources
- USec for Field Operations
- USec for Environment and Research
- ASec for Planning and Policy
- Assist. Director General of NEDA

User Group (Central Office)

- Director of the Policy Studies Division
- Director, Project Mgmt. and Coordination Service
- Director, Project Design and Packaging Service
- Division Chiefs of the Policy Studies Division
- Planning Officers of the Staff Bureaus
- National Land Use Committee Members

Field User Group

Regional Office:
- Regional Executive Director
- Regional Technical Directors
- Chief Planning Officer
- Sectoral Planning Group Members

Provincial Office:
- PENRO
- Planning Officer
- Sectoral Representatives

Community Office:
- CENRO
- Representatives from Technical Services

Others:
- Regional Land Use Committee Members
- Provincial and Municipal Planning and Development Offices of the Local Government Units

include representatives from NEDA and local government units for input on broader regional development planning issues.

User group members should participate in seminars and workshops to acquire expertise in the development and use of spatial information framework outputs.

c. DENR Central SIU

The DENR central SIU will be responsible for:

- Organizing workshops/seminars for the policy and user groups;
- Monitoring the activities of the regional SIUs and ensuring that outputs are consistent with data requirements for national planning goals and policies;
- Maintaining a catalogue of nationally-aggregated data;
- Coordinating with planning staff from other GOP agencies directly and indirectly affected by natural resources management.

The DENR central SIU should consist of a supervisor and at least three support staff. The supervisor should be skilled in resource management planning and should have a solid understanding of spatial information management. The supervisor should be the overall coordinator for the spatial information management effort. The support staff should have or be trained in the technical aspects of spatial information management for natural resources planning.

d. DENR Regional SIU

DENR regional SIUs will be responsible for:

- Supervising data collection;
- Aggregating data from the provincial SIUs and providing these data to the DENR central SIU;
- Maintaining databases, maps, and spatial applications for the use of the RED and the planning office;
- Assisting decision makers and planners to identify spatial data needs and applications;
- Providing spatial information training to provincial, community, and local government units.

Each regional SIU should be staffed by a planning officer, a spatial information manager, and at least three spatial information technicians.

e. DENR Provincial SIU

The main impediment to sound planning is a lack of current data. Our assessment indicates that gathering data on the provincial level represents the most efficient means to update the information base. Direct involvement of the PENRO will be crucial for developing and sustaining the spatial information framework. Consequently, the PENRO will be largely responsible for coordinating the data acquisition process needed to develop the spatial information system.

The provincial SIUs will be responsible for:

- Organizing and working with data collection teams to assure that standardized procedures are maintained;
- Developing a provincial-level spatial database;
- Preparing spatial applications for the PENRO's use;
- Providing the regional SIU with provincial spatial data and applications.

The provincial SIU should consist of a planning officer, a supervisor, and at least two spatial information technicians.

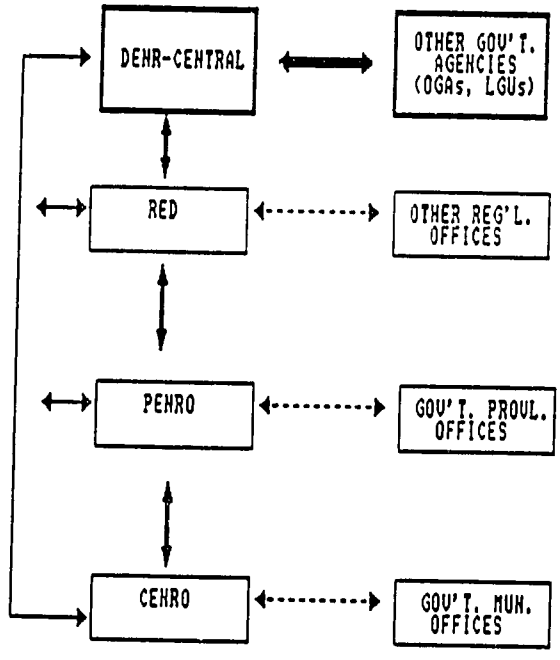
f. Related Agencies

The spatial information system should assist DENR to coordinate its plans with those of other GOP agencies. In addition to involving the local government in data collection plans and processes, horizontal linkages with GOP agencies who contribute to or are affected by natural resources management should be maintained by the policy and user groups. Figure 3 shows the relationships between these agencies and DENR.

g. Natural Resources Management Program

Some components of NRMP are engaged in activities that could contribute to the initial development of the spatial information system. They currently organize seminars and workshops for planners at the regional and provincial levels in Regions 2, 4, 10, and 11. They could assist the DENR central SIU to organize and implement training on the principles of spatial information.

FIGURE 3. INFORMATION SHARING



NRMP trains and supervises forest service organization (FSO) resource inventories in several regions, including Regions 2 and 11. The NRMP effort could assist in developing standards for and providing training in data collection.

V. TRAINING REQUIREMENTS

The development of a spatial information management capacity will require a substantial investment in training and staff development. Training in planning strategies using spatial information, as well as training in the technical aspects of spatial information management, will be needed on many levels. The emphasis of the training will vary with the responsibility of the individual or group. Training processes should focus on the responsibility each person or group will have in preparing or in using spatial information outputs.

The type and amount of technical training required will also vary. Some staff at the DENR central, regional, and provincial offices have received training in spatial information management. Other staff who will be involved in the system have not. Once the SIU staff are identified, individual skill levels can be assessed and specific training strategies can be prepared.

Three generic types of training will be required:

- Spatial information user training;
- Spatial information management training;
- Spatial information data collection training.

Descriptions of the skills needed for spatial data users, analysts, and technicians follow. See Annex E for recommended training processes and topics.

A. User Training

Users of spatial information—the planners—must understand how the system can support their task. They need to develop the spatial modeling expertise to articulate resource management problems in spatial terms and identify the information and the ways information can be related spatially to identify suitable resou .e management options. Proficiency in spatial modeling is both the most important and the most demanding of the skills needed to develop a spatial information system.

Key decision makers are busy people, with little time to spend on course work and extended seminars/workshops. Consequently, much of the burden to develop spatial modeling skills will

fall on user group members (planning staff). Seminars and workshops for user group members, using actual spatial data and planning exercises, are recommended at regular intervals.

B. Data Management Training

Two levels of spatial information managers will be required:

- Data analysts;
- Data technicians.

Spatial data analysts will assist users to develop resource management applications. They will manipulate the software to produce outputs (hard-copy maps, other graphics, and reports) to be used in planning sessions, program and project design, and monitoring/evaluation. They will supervise the work of the technicians. Analysts must be thoroughly familiar with all aspects of spatial data management.

Spatial data technicians will assist the analysts by building the databases. To do so, they will verify and aggregate data, prepare data for entry into the system, work with analysts to design databases, and enter the data (digitize or database encode). They will work with the data collection units to assure that data are registered in appropriate spatial formats.

C. Data Collection Training

The level of responsibility will vary considerably between groups of data collectors, but some knowledge of all aspects of data collection, as well as its objectives, is useful so that everyone involved becomes aware of the significance of the work.

Data collection training is needed in three areas:

- Preparation of reliable survey instruments;
- Collection of reliable data;
- Collection and registration of data in formats suitable for spatial analysis.

Each data collection unit should have a supervisor who will assure that standard collection methods are used and that the data are reliable and registered in standard formats. The supervisors will need to develop a high level of expertise in activities such as design of reliable survey instruments, sampling techniques, debriefing, and data verification.

An assessment of existing skill levels will be needed to develop a specific training program for data collection. Recent collection efforts indicate significant differences in skills, both between individuals and between kinds of data. For example, some staff have highly developed skills in collecting bio-physical data, but little experience collecting socio-economic information.

D. Training Sources

The ability to develop an effective spatial information system should depend to a large extent on local sources. Our assessment of existing spatial information expertise, however, indicates that some types of outside training will be initially required. The following training sources are arranged according to the type of training needed.

1. User Training

User training might be coordinated through a combined effort of the DENR central SIU and NRMP. NRMP can supply a short-term spatial information user specialist for support to design and implement training. For longer term training, DENR might assist the Development Academy of the Philippines to develop a spatial information user course.

DENR might consider sending DENR user group members and SIU Supervisors to the Asian Institute of Technology (AIT) in Bangkok for a one month course in spatial information for natural resources management. AIT also offers on-site courses.

2. Data Management Training

Several sources are available for training on the development of applications, spatial analysis, and software technician work. NRMP can provide short term technical applications/analysis specialists. In addition, the University of the Philippines at Diliman offers courses in GIS. Though these courses currently focus on remote sensing, they have staff who could develop spatial data application courses. Several local companies offer applications development and technician training for specific software packages (for example, Arc/Info, Genemap, and Atlas GIS). Annex B contains a list of these companies. In addition, staff at NAMRIA; the DENR offices in Regions 2, 3, and 7, and faculty/graduate students at UP can provide technical training.

3. Data Collection Training

DENR and some local government units have some data collection training mechanisms in place, primarily for physical data. NRMP, in collaboration with counterparts from PPSO and the Forest Management Bureau (FMB), could provide training in the use of standardized data

collection methods. Other agencies who collect social, economic, and demographic data may be able to provide assistance. Faculty and graduate students in universities located in the involved regions (e.g., Isabela University in Region 2) and competent NGO and private voluntary organization (PVO) personnel can assist in training on biophysical and geographic data collection methods. Faculty or highly skilled graduate students from the universities can be contracted to design and implement training for the collection of human data.

VI. TECHNICAL ASSISTANCE REQUIREMENTS

The team's assessment indicates that technical assistance will be needed primarily for spatial information training of various kinds. Recommendations for technical assistance and approximate time required include the following:

A. User Training

Spatial Information User Specialist	3 months
Applications Development Specialist	4 months
Software Technician Training	2 months
Data Collection Training	3 months

VII. ILLUSTRATIVE MONITORING AND EVALUATION SYSTEM

A comprehensive monitoring and evaluation system should be designed once decisions about the scope and foci of the initial effort are made. Annex F contains illustrative milestones, as well as verifiable indicators to evaluate progress. The annex also contains an illustrative workplan. The milestones and the workplan are based on the assumption that the spatial information system will include all the components recommended in this report. The time required to implement individual stages of development will depend largely on the levels of effort dedicated to data acquisition and management.

VIII. ILLUSTRATIVE COSTS

Actual costs for development of a framework for natural resources planning similarly would be identified after decisions are made about the levels of effort DENR is able to dedicate to the

work, as well as the extent of the geographic area to be covered in the data acquisition process. Annex G contains indicative costs for a model effort to expand the existing effort in Region 2 and to initiate a spatial data management process, using traditional geographic (manual) methods, in Region 11. These costs do not include salaries, support, and benefits for GOP staff.

ANNEX A. SCOPE OF WORK

Proper information management is crucial to the design of rational resource management plans, as well as to the acceptance of these plans by those who will be tasked with their implementation. To be rational, the plans must be based on a thorough understanding of forest phenomena (both biophysical and human). To be effective, they must apportion forest management properly between the commercial private sector, community-based groups, and other management groups (for example, government-controlled tourist and recreation facilities). To be acceptable, the plans must encourage involvement by contributing information that demonstrates benefits and facilitates implementation. And, finally, to be sustainable, the plans must be within the budgetary capability of the implementing agency and provide a basis for evaluating progress.

The existing forest planning process is deficient in its ability to incorporate and apply site specific information, as well as to consider the spatial aspects of forest phenomena. This deficiency is especially evident on the provincial and, in some cases, the regional levels of forest management. Simple spatial information management technology represents an effective tool to incorporate new data and spatial relationships, as well as for providing planners and implementors with the outputs needed to prepare, implement, and monitor the impact of resource management plans.

DENR's Natural Resources Management Program (NRMP) aims to set the stage for a sustainable forest management information capacity within DENR. It will instill the fundamentals of systematic data collection and management, focusing on residual forest management planning at the provincial level (with support from national and regional DENR offices). In the long term, an effective forest management strategy will require a systematic, national natural resource inventory and an institutionalized DENR capacity to budget and support resource information management. In the short term, the U.S. Agency for International Development (USAID) can lay the foundation for a national strategy by supplying a focus through a targeted planning effort in selected provinces.

The Conservation and Development of Residual Forests pilot work will use traditional geographic methods for managing data, and move slowly into more sophisticated automated methods in a targeted province. Once tested, NRMP will attempt to replicate these methods in the other regional and provincial DENR offices with which it works. This work will lay the foundation for a multi-sectoral standard planning information base on a national level. The foundation laying phase will deliver outputs for a targeted province and will also serve to sensitize national and local level decision makers to the usefulness of the spatial information management approach, raise awareness of the need for collaboration between agencies to develop a systematic information management capacity, gain support for longer term planning initiatives, and help to access previously inaccessible data by demonstrating the importance of these data. It will also help to identify and establish institutional homes for information management

activities and test the methods used to train staff in the target areas who will, in turn, train others in the fundamentals of planning and data management.

RESPONSIBILITIES OF THE SPATIAL INFORMATION SPECIALIST

The specialist's responsibilities will focus on spatial information for resource management planning at the provincial (PENRO) level. In addition, she will lay the groundwork for expanding the spatial information management system to a national level by providing assessments of available data and recommendations for ways to meet information and information management needs for a national multi-sectoral standard planning base. These recommendations will consider existing resource-based information management efforts.

The specialist (in collaboration with her counterparts from DENR and NRMP, as well as staff in the target province and forestry service organizations (FSOs)) will carry out the following tasks:[9]

1. Consult with DENR officers, FMB staff, and field staff; FSO staff; and other relevant organizations (e.g., World Wildlife Fund, forestry school staff) to identify information needs and establish output priorities for provincial level forest management. The establishment of priorities will focus on a phased approach beginning with traditional geographic methods and moving into automated information management and maintenance of the system.

2. Work with FSOs and DENR field staff to streamline and spatially reference the forest data collection and management process. She will assist field staff in articulating forest management issues and rational allocation of resources by demonstrating the use of the spatial information management system. She will identify the data needed to address these issues. This assessment will include a definition and prioritization of the spatial data outputs needed to inform resource management, as well as the data collection process and specific ways to improve data collection and management.

   Region 2 will be the model for developing an automated spatial data management process. In step one, a manual process will be prepared to demonstrate spatial data management techniques. In step two, the specialist will collaborate with the regional GIS staff to automate forest data for Region 2. The preparation and input of data into an automated system can be a time-consuming process. At this time, it is difficult to

[9]The spatial information effort in the target province will be presented in the form of specific outputs, including manually-produced map layers and an automated database (with data referenced to the appropriate coordinate system) containing the basic geographic and attribute layers used for the residual forest management plan. The results of the assessments and recommendations for spatial data collection and management will be included in a detailed report.

estimate the amount of time that will be required to prepare and input data. Thus, it is recommended that the residual forest management plan for Region 2 initially be based on the manual GIS exercise outputs. Revisions or information important to actual forest management processes will be added after automated outputs become available.

The specialist will also work with the FSO contracted for the Region 8 site to implement a manual spatial information management process as a basis for the residual forest management plan and for use as a training tool.

3. Develop a prioritized list of spatial information applications and outputs for the provincial-level forest management activities and an illustrative list for developing a national-level multi-sectoral natural resource information base. The list will include a description of the process and output for each application.

4. Assess existing data and their sources, as well as the availability and quality of the data. Identify additional data, as well as potential sources, needed to formulate sustainable resource management plans. Recommend collaboration for data acquisition and management with government, academic, and private agencies and organizations.

5. Recommend progress indicators and a progress report schedule for monitoring and evaluating the implementation of spatial data management systems at the provincial level.

6.1 Assess spatial information systems currently being used for natural resources management, including existing hardware and software. Make recommendations for coordinating and supporting provincial level activities. Make recommendations for the possible installation of hardware and software required to implement local level spatial information plans. Make recommendations for hardware and software support to agencies/organizations who may participate in a national level effort to develop spatial information systems for resource management.

6.2 Make recommendations for technical assistance needed to implement a provincial-level spatial information system for resource management. Make illustrative recommendations for a national coordinated effort to manage spatial information for resource management.

6.3 Define costs for hardware, software, and technical assistance for a provincial-level spatial information system for resource management. Provide an illustrative budget for training, staffing, and implementation of an operational system on the provincial level. Define costs for hardware, software, and technical assistance for a national level system. Provide an indicative budget for the level of effort required to establish and maintain this system. These recommendations will carefully consider budgetary restrictions, as well as compatibility of systems.

ANNEX B. SPATIAL INFORMATION MANAGEMENT

In the last ten years, a relatively large number of GOP agencies have experimented with spatial information management. These activities commonly are referred to as GIS. In few cases, however, has an actual geographic (or spatial) information system been developed. Most of these exercises have focused on developing spatially-referenced databases to address issues related either to a project or to an area of the country. A wide variety of software packages have been used to manage data from sources such as remotely-sensed data (satellite imagery and aerial photographs), topographic maps, and some social and economic information. A few GOP agencies (for example, the Department of Health and the Department of Public Works and Highways) have developed, or are in the process of developing, systems.

Several of the project-generated "systems" were designed to be replicated in other areas. Only one of these efforts—the spatial framework developed under NRMDP—appears to have potential for replication and expansion. Weaknesses of methods used or outputs from other work include: objectives targeted to a project-related activity, inaccessibility of outputs, lack of standards in data collection, map scales too small for use in site-specific planning, minimal primary data, and incompatible and often customized software.

The data used and some outputs from these efforts may be useful for a spatial information framework for natural resources planning at the regional and provincial levels. A good spatial information system for natural resources management, however, should be demand-driven. That is, it should manage information that is directly germane to natural resource issues. Experience indicates that attempts to integrate disparate spatial data and outputs are rarely successful and often obstructive because they divert energies. Thus, with the exception of the NRMDP and NAMRIA efforts, the following descriptions of selected spatial information efforts are to illustrate the typical kinds of spatial information work being done or planned. A few of these efforts represent potential sources of spatial information.

I. SPATIAL INFORMATION PROJECTS

A. Natural Resources Management and Development Project

This project was implemented by DENR, with support from the Australian International Development Assistance Bureau (AIDAB), between November 1988 and March 1993. The project had two main foci: implementation of a national geodetic survey and institutional strengthening for DENR in three pilot regions (2, 3, and 7).

The geodetic survey consisted of installing 474 stations, training NAMRIA staff in survey techniques, densification of monuments to 5 km spacing in the three pilot study regions,

calculating a geoid model, and development of a geodetic records database. The geodetic survey work will be very useful for purposes of ground truth collection.

The institutional strengthening work covered the three pilot regions and the DENR central office. It focused on developing planning and management capacity for policy formulation and establishing vertical and horizontal linkages to support the devolution process. The project established sector planning groups (SPGs) for environment and natural resources planning at the central, regional, and provincial levels. The SPGs act as vehicles for strengthening management linkages for policy formulation, planning coordination between DENR and related GOP agencies, project development, and performance monitoring. The SPGs are active in the overall NEDA planning process, especially in the preparation of the physical framework medium-term development plans.

Other NRMDP activities relevant to spatial information management include improvements in performance monitoring; an Integrated Land Records System model in Region 3, a natural Resources Management Information System (NRMIS), and a model environmental monitoring system.

Through NRMIS, NRMDP established computerized spatial information capability in the three target regions, with a link to a "mother" system at NAMRIA. Staff from all three resource centers received training in Australia and on-the-job. The training and the centers use pc-Arc/Info software.

B. NAMRIA

NAMRIA has been given a variety of spatial information systems hardware, software, and training from foreign-assisted projects. None of the work appears to have developed into an overall spatial information system for DENR. Some of the hardware and software, as well as the training, is being used to produce outputs on a request bases from DENR and other GOP agencies.

Examples of spatial information projects implemented by NAMRIA, in addition to NRMIS, include the following:

1. ENR Provincial Planning System: This work was part of the Statistical Mapping Project, covering Tarlac (Region 3). The project developed two macro-level tools for planning: environmental conservation land use and agricultural production land use. NAMRIA hopes to use the model to support the Regional Physical Framework planning process.

2. Research on Applications of GIS Technology for Soil Erosion Mapping (1989-90): Under this project a remote sensing facility was funded by AIDAB. GOP agencies can order remote sensing products and resource data analysis. Specific tasks include land classification (on a case by case basis), aerial photo interpretation and mapping, satellite

imagery interpretation, and virgin and residual forest mapping. Processes for dealing with automated interpretations of remotely-sensed data are not very well developed. In addition, a wide variety of often incompatible spatial information software are used, including a raster system created by the Japanese.

3. Land Evaluation and Classification Database Project

The Remote Sensing and Resource Data Analysis Department created a digital database (at a scale of 1:50,000) for land evaluation purposes. The database contains themes (layers) from the 1:50,000 topographic map series.

C. Technical Assistance to the Department of Public Works and Highways for an Integrated CAD Mapping and Data Management System

This project is being implemented by DENR, with technical assistance from Louis Berger International, Inc. and Certeza Surveying and Aerophoto Systems, Inc., with funding from USAID. The objectives of the project are to computerize maps of the road transportation network, to install the hardware and software to computerize the maps, and to train Department of Public Works and Highways (DPWH) staff to use the system. In addition to ArcCAD (a computer assisted drafting package developed as a counterpart to Arc/Info), the project plans to use GIS software (probably MapInfo) for spatial analysis of road attribute data.

D. Department of Transportation and Communication

The Department's Engineering Center, with technical assistance from Cybersoft Information Technologies of Manila, has created a Traffic Monitoring Database. This digital database contains all features from the maps of Metro Manila. The Department plans to use the database to assess clogged road intersections, road obstructions, excavations, and traffic routes.

E. Philippine Groundwater Databank

This ongoing project is jointly supported by the Local Water Utilities Administration, the United Nations Development Program, and the United Nations Department of Economic and Social Development. The objective of the project is to develop a national GIS groundwater databank (using Computer Assisted Design (CAD) and micro-station Intergraph software) to demonstrate how existing groundwater data can be used for rationalization of groundwater exploration, assessment of groundwater potential, and planning the development and conservation of groundwater resources. The project has completed development of a groundwater databank, based on existing information from various GOP agencies and project-collected data from a site in Baguio. It also has trained 26 staff (from several GOP agencies) in CAD and GIS hydrogeologic data management.

F. Growth Plan for South Cotabato-Sarangani-General Santos City

This program, jointly funded by the Department of Agriculture (DA) and USAID, has developed a digital database from the 1:250,000 topographic maps (enlarged to 1:75,000), using Arc/Info software. The database contains physical features such as road networks, shorelines, river systems, administrative boundaries, vegetative cover, land use, and slope. The project is using the database to support development of a comprehensive master plan for the South Cotabato area. The project also plans to do crop and land use suitability analyses.

The spatial information management being done by this project is similar to the process we recommend for resource management at DENR. However, we strongly suggest that a reliable system must be based on updated information with a level of detail sufficient to produce large scale maps for site-specific planning.

G. Defense Mapping Agency

The Defense Mapping Agency is preparing a series of reportedly high quality 1:250,000 maps based largely on aerial photographs from the late 1980s. The agency may make these available in digital formats. The scale of 1:250,000, however, may not be useful for most issues involved in natural resources planning at the regional or provincial level.

H. Philippine-German Integrated Rainforest Management Project

This ongoing project at DENR is administered by the Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ), through the Deutsch Forstserve GmbH. It focuses on long term management of dipterocarp forests. Project components include advice to DENR on forest policy, laws, regulations, and organization; community-based integrated forest management to improve local organization and self-help activities in five upland barangays in Quirino Province; integration of community forestry in Timber License Agreement (TLA) replacement areas; preparation of barangay development plans; and establishment of sustainable forest management systems for natural forest under timber concessions in Cantilan, Surigao (SUDECOR).

In support of these efforts, the project plans to use a GIS to manage data from new aerial photographic coverage of Quirino. The focus of this work will be on delineation of forest boundaries and a change analysis.

I. Industrial Forest Plantations Program

This DENR-FMB project, with technical assistance from SGS Silviconsult, will support industrial forest plantation loans. It focuses on unified forest management for industrial

purposes, e.g., by identifying areas where forest exists or where land is denuded. Private companies will be expected to pay a bond in order to ensure adequate performance in harvesting, timber stand improvement, and reforestation operations.

The terms of reference call for improvement of Industrial Forest Management Agreement (IFMA) information management at FMB. FMB has sketch maps of industrial plantation areas, but little reliable idea of origin or accuracy. In most cases, the investor provides the sketch maps and maps verifying improvements. DENR is mandated to examine improvements, but finds this work difficult because it has no clear indication of location.

The Industrial Forest Plantations Program plans to use a simple spatial information system to develop a national map showing available land and lands suitable for specific kinds of forest management. It will use a TLA base map from the 1970s and a CLIPPER-based management tool. Arc/Info may be used to digitize IFMA locations.

J. World Wildlife Fund Integrated Protected Areas

The World Wildlife Fund is using Arc/Info to update Integrated Protected Areas System (IPAS) maps and to identify areas fulfilling the criteria for IPAS. The Protected Areas and Wildlife Bureau is also developing a database to help manage and monitor IPAS sites.

K. Synagraphic Mapping Process

This project was based at the Technology Resource Center, under the Task Force on Geography. The project staff digitized some of the Ministry of Human Settlement maps produced in the late 1970s. The Presidential Management staff are the custodians of these maps and data files.

L. Land Use and Land Use Information Systems

This NEDA-AIDAB project, implemented from 1985-87, installed a microcomputer-based facility at the NEDA central office, Region 7 office, and Provincial Development Office in Bohol (Cebu). Some equipment also was installed at the NAMRIA Remote Sensing Center and the Resource Data Analysis Department.

Australian Land Information System (LIS) experts trained 45-50 GOP staff in land use and land use information system technology. A database management software (KMAN) was used to organize land use planning data, focusing on crop suitability. The project developed demonstration land use information databases for Zamboanga, Bohol, Cebu, Negros, and Siquijob. Databases include location (coordinates to the barangay level), geology, slope, climate, land use, and land status. Demographic, social, and economic data cover population, road access, electrical power, health and educational facilities.

M. Land Resource Management Information System

This subcomponent of the 1988-91 Technical Support Project for the Comprehensive Agrarian Reform Program focused on the use of remote sensing to identify suitable agricultural sites, adequate basis for land valuation, and land use planning. A microcomputer GIS and image processing facility was set up at NAMRIA.

N. Soils Research and Development Center

The center was established under a grant from the Japan International Development Agency to the DA Bureau of Soils and Water Management (BSWM). The center's work included soil survey, land evaluation, soil conservation, research, and agricultural extension and training. The center is equipped with an IBM mainframe computer, 16 microcomputers, 10 terminals, GIS workstations using Arc/Info software, and an image processing system.

O. Second Palawan Integrated Development Project

This land resource information system was developed to track land patent applications. The system was implemented by DENR with funding from the Asian Development Bank. Between 18-20,000 titles are stored in dBase III+. The outcome of a plan to input these data to GIS format is unclear.

P. Bataan Project

This project, funded by the Canadian International Development Agency, was the precursor to the Forest Management Support System proposal (see GIS proposals below). It provided technical assistance to demonstrate the use of GIS technology at the provincial level. The project developed a database to support land use planning and identify forestland management priorities and resource domains.

Q. National Forest Resource Inventory

This 1985-86 pilot project demonstrated the methodology for storing, integrating, and manipulating forest resource data extracted from topographic maps, aerial photographs, satellite imagery, and administrative documents. It produced a 1:50,000 topographic database and map of Mapaland, using Arc/Info software.

R. Preparation of Forest Information in Wide Area for Forest Management Planning

The objective of this Japan International Cooperation Agency-funded project was to collect, analyze, and compile data on the natural and social environment of the Cagayan River basin in Northern Luzon and to formulate a forest management plan for a model area of about 50,000 hectares. The project produced an environmental map (1:1,250) and a forest management plan map (1:25,000) for the model area. The maps are based on aerial photographs and Landsat Thematic Mapper images. The maps were produced using Arc/Info and a raster software written in BASIC. Most of the work was done in Japan.

S. Appraisal Selection Study

This Asian Development Bank-funded project is a component of the National Forestation Program. Initial phases were focused on determining the suitability of using satellite data for forest monitoring. The study concluded that satellite imagery is too costly and difficult to acquire for the Philippines to be useful in forest monitoring.

T. Department of Health

The Department has developed several spatial databases. Its projects include Palawan, the Family Planning GIS in Cebu; Red Tide Monitoring at Manila Bay; and a public health GIS in Palawan.

U. Philippine Long Distance Telephone Company

The Philippine Long Distance Telephone Company is using a mainframe GIS system (System for Mapping and Recording Techniques or "SMART") supported by Integraph GIS software in a pilot phase to manage national communications information.

II. SPATIAL INFORMATION PLANS/PROPOSALS

Several proposals have been prepared to develop spatial information systems for DENR. The majority of these proposals are not detailed enough to warrant a serious assessment. The most comprehensive proposal, the Forest Management Support System (FMSS), was prepared by Macdonald Dettwiler Technologies LTD for DENR with funding from the Canadian International Development Agency.

FMSS is designed to support the implementation of the Master Plan for Forestry Development. It would install spatial information technology in the DENR central and regional offices to

manage data for use in the formulation and implementation of projects in the Second Forestry Sector Project. It would also serve as an information base for forest related projects. See the attached bibliography for sources of information on FMSS.

The Canadian International Development Agency proposed to fund the development of FMSS through a loan. At present, GOP has not approved FMSS because a cost benefit analysis concluded the system could not support itself through the sale of outputs. A second cost benefit analysis indicated that the system is sustainable. The fate of FMSS has not yet been decided. We believe that complete financial support for an information system from the sale of outputs is not an acceptable standard. In any case, we judge FMSS to be too an ambitious for DENR to undertake at present. In addition, the plan relies too heavily on NAMRIA as its source of information and for implementation. The proposal, in fact, confuses "source" with "management." Whether NAMRIA is capable of managing large quantities of spatial data or not, it cannot be a major "source" for a reliable system because the necessary data do not exist; an issue not addressed in the FMSS plan.

A feasibility study of creating a coordinating body for GIS was done under the auspices of NRMDP. It likewise places too much emphasis on the role of NAMRIA. Earlier studies by NRMDP concluded that a national coordinating body for geographic information is needed. The feasibility study contends that NAMRIA should be the coordinating body. We do not dispute the need for a GIS coordinating body. However, we do not encourage development of a national spatial information system, nor do we agree that NAMRIA represents an effective umbrella for a spatial information system at DENR. NAMRIA is a support service and, as such, does not have regulatory powers. A coordinating body (such as the policy group we recommend) must have the necessary regulatory authority to impose information standards.

III. SPATIAL INFORMATION COMPANIES

Company	Expertise
Cybersoft Information Technologies, Inc.	ATLAS, Genemap
GEODATA Systems Technologies, Inc.	ARC/INFO
Project Consultants Groups	ARC/INFO
SGV	digitizing
Software Ventures International Corporation	microstation rep.
PACER (PASCO Certeza) Computer Mapping Corporation	remote sensing
Certeza Surveying	surveying

ANNEX C. SPATIAL DATA COLLECTION AND MANAGEMENT

A spatial information system allows planners and managers to integrate and use large quantities and types of data to inform their decision making. It is an automated or manual system for managing, analyzing, and displaying spatially-related information and statistics. In its automated form, it is a device to create a digital database consisting of an almost limitless number of layers (or topics). By combining these layers, it produces outputs (maps, graphics, reports) designed to meet the specific needs of resource planners and managers. An automated spatial information system provides the following tools:

- A data input and retrieval system for storing, updating, and processing spatial and tabular data from surveys, maps, and remote sensing sources;
- A data manipulation and analysis system for creating map layers and executing analytical tasks;
- A data output system for displaying the resulting information in report, map, and statistical formats.

The development of a spatial information system is initially time-consuming. But in the end, it saves time and provides a unique planning tool for organizing space.

The primary objectives of the spatial information system for natural resources planning are to: (1) identify suitable resource management options; and (2) to evaluate the physical and human characteristics of areas to determine appropriate management processes. The discussion below is divided into the three categories of spatial information tasks: data identification, data acquisition, and data analysis. Each of these tasks is given sub-categories. For collection, sub-categories represent the data needed. For analysis, sub-categories are illustrative examples of specific spatial data analytical techniques. Each sub-category is given a priority rank from 1 to 4 (1 being first priority).

A. Data Identification

The following recommendations for data are based on the assessment of needs and available data undertaken for this report. These data represent minimal sets for developing a spatial information system for natural resources planning and management. The assessment process should continue as development of the system evolves.

1. Land Cover

Priority 1

An accurate knowledge of land features and their extent represents the foundation for land classification and management. A land cover inventory will identify and delineate features such as forest, irrigated and rainfed cropland, scrub, rangeland, barren land, bodies of water, field patterns, industrial areas, settlements, and road patterns. A properly conducted land cover inventory can also contribute information on quality, quantity, and other characteristics of vegetation cover. A good quality, easily updatable land cover map provides a major portion of the information needed for natural resources planning.

Existing land cover information is dated and inadequate. The scale of the national land cover map series (1:250,000) is too small for site-specific planning. These maps are based mainly on SPOT imagery from 1987. Major changes in land cover have occurred in the Philippines since that time. In addition, insufficient ground truth was collected to refine the land cover classification to acceptable standards.

The approach used will depend on the extent of land to be covered and the amount of financial resources dedicated to the development of a spatial information system. An update of the national land cover inventory, using a combination of satellite imagery and ground survey (ground truth and survey), is the most efficient approach because it will provide a multi-purpose/multi-user product. However, an inventory using only those satellite scenes covering the model area (Region 2) might be considered. The inventory process could expand as the spatial information management system is begun in other regions. Or, if the model will cover only one or two provinces, land survey teams could update the existing land cover maps using GPSs. This last method is time-consuming and will not be as accurate as a combination of remotely-sensed and ground data. In a small area, however, the ground survey approach might be cost effective. Since an inventory using remotely-sensed data will take time to organize (procuring imagery at the optimal times), survey teams should begin ground data collection early.

Accomplishing a land cover inventory based on satellite inventory and ground truth includes the following steps:

- Acquisition, processing, and georeferencing of current Landsat Thematic Mapper data. Georeferencing should use the regional 1:50,000 topographic maps.

- Interpretation of satellite imagery (isolation of signatures for each of the land classifications to be included, and grouping these signatures to reveal the area of land cover types.

- Collection of ground truth, using GPS devices to achieve an accurate interpretation of the features shown on the satellite imagery.

- Addition of ground truth to imagery classifications.

- Automated overlay of interpreted image data onto existing map layers (road networks, irrigation systems, political boundaries).

- Acquisition of SPOT multispectral imagery for isolation of specific signatures (e.g., closed canopy forest).

- Collection of ground truth to enhance interpretation of SPOT imagery.

- Addition of SPOT classification to land cover interpretation.

- Acquisition and interpretation of aerial photographs where appropriate, for example, to prepare detailed forest classification.[10]

- Preparation of enhanced image products (false color contact prints) and hard-copy maps for planning purposes.

- Acquisition of supplementary data (e.g., climate, demographic, socio-economic) and entry of these data into attribute databases to be associated with the geographic data.

2. Land Use and Land Status/Tenure — Priority 1

Land use maps are available from BSWM at scales of 1:250,000 based on a survey conducted from 1975-85. Maps at a scale of 1:50,000 exist for some provinces. These maps, however, are outdated, focus on lowland areas and lack documentation. Land use maps, available from DENR, include some information on recent TLA management practices.

Categories of land use should include the following:

- residential/settlements
- croplands/farmlands
- commercial/industrial
- recreation areas
- forest lands
- mineral lands/mining areas
- tourism areas
- range/grazing lands
- denuded and marginal lands
- IPAS sites

[10]Aerial photographs of the NRMP CDRF and CFM sites and portions of the virgin forest in Regions 2, 3 (Subic), 5 (Bicol National Forest), and 11 will be produced. Ground demarcation of virgin forest should begin soon in Regions 2, 4, 8, and 10. In addition, the geodetic network and densification survey done by the NRMDP will greatly facilitate ground survey work.

Cadastral survey maps for land status and use are available from the Land Management Bureau, NAMRIA, and from the Department of Interior and Local Government. In addition, maps at scales between 1:20,000 and 1:30,000 are obtainable from the regional DENR offices. These maps contain disaggregated land use and land status (including some tenure instruments), city and municipality zoning plans, timber license area maps, and proposed and ongoing development planning areas affecting public lands. NAMRIA has a program underway to aggregate these maps to a scale of 1:50,000.

A reliable land classification will require land use and status maps at a minimum scale of 1:50,000, preferably with supporting data at larger scales (1:20,000 or 1:10,000). Spatial information units at the provincial level should examine existing maps to identify gaps and outdated information. Survey teams should update the maps by identifying and delineating land status and use categories in each province as indicated on the existing maps. The survey teams should use the basic land status categories of private land and public land as a framework. Specific categories of land status/tenure should be mapped. These would include locations and extent of remaining TLAs, Forest Land Management Agreements (FLMA), Community Forest Management Agreements, Timber Processing Sharing Agreement (TPSA), and indigenous cultural community lands.

3. Topography

Priority 1

The current criteria used to establish land classification are based primarily on topographical features: elevation, slopes, stream systems. Although a proper land classification system requires additional criteria, these topographic criteria remain important. In addition, topographic maps will be needed for georeferencing satellite images and aerial photographs.

Topographic maps are currently available from NAMRIA at scales of 1:250,000 and 1:50,000. Topographic information is also held at the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA), BSWM, and the National Irrigation Administration. The larger scale of 1:50,000 is the most appropriate for deriving land classification criteria on a regional level. Maps at this scale are available for Region 2. Some updating of these maps will be required as the system expands because the 1:50,000 maps are not available for the whole country.

Most of the existing topographic maps are based on aerial photographs from 1953 or earlier. Basic structure (elevation/slope, river/stream systems and watersheds, location of headwaters, river drainage systems) probably is accurately portrayed. But features such as coastlines and human structures (roads, settlements) have changed. Other features, such as groundwater systems, vulnerable ecosystems (coral reefs, mangroves, wetlands, lowland forests, wildlife habitats), and hazard areas (flood prone areas) will also need to be updated for an accurate understanding of land cover.

4. Geomorphology/Geology

Priority 1

Maps at a scale of 1:250,000, based on 1964 data, are available from the Bureau of Lands. The information needed is relatively static: landforms, rock types and formations, location of commercial mineral resources, active fault zones and areas of volcanic activity. Consequently, these maps could be enlarged for use in the classification framework.

5. Soils

Priority 3

Soils and land capability maps are available from the Bureau of Lands at a scale of 1:250,000 based on data from 1964. The maps contain information on soil types, soil bearing capacity, and road standards. The soil units are based on geology and physiography. The BSWM has soil erosion maps, as well as soil maps (based on the old USDA classification system and land capability ratings) at various scales in reports done between 1955-70. Some municipalities have soil maps (usually at 1:20,000) focusing on agricultural potential in mapping units related to broad land utilization types.

Existing soils data are adequate for a basic land use classification. Soils data, however, are inadequate for detailed analytical purposes, for example, for crop (including tree species) suitability modeling or reliable land capability analysis. Existing soil information tends to define soil types in terms such as "clayey-loamy," but includes few or no details on chemical and physical properties, pH levels, or erosivity/erodability characteristics.

All the available data on soils should be composited to develop a baseline soils map at as large a scale as possible, given the scales of the existing maps. This map should be analyzed to select representative areas for soil sampling. The NRMP forest inventory teams collect soil samples for simple tests such as permeability. An expanded forest inventory effort could include more sophisticated soil analyses.

6. Climate

Priority 3

Mapped and tabular climate data are available from several agencies, including PAGASA, the National Institute for Climatology, and the National Irrigation Administration. The 1:250,000 and 1:50,000 (where available) topographic maps are used as the basic mapping unit for climate data. Some tabular data are available in digital formats. Climate data include rainfall, temperatures, relative humidity, number of days without rain, required road standards, and drainage characteristics. In addition, a project is underway to establish a receiving station to access data from the Advanced Very High Resolution Radiometer and NAMRIA has access to data from the U.S. National Oceanographic and Aeronautical Administration.

Existing data are adequate for the initial land classification effort. Additional information will be needed to do advanced spatial analysis, such as crop (agricultural and tree species) suitability and habitat analysis. These data might include rainfall patterns, minimum temperatures during coldest month, maximum temperatures during hottest month, wind speed and direction, characteristics and times of cyclonic activities, and drought patterns. More detailed climate information is best procured through the national efforts already underway, though weather stations in target regions could be tasked to supply some information in the near future.

7. Biological Data — Priority 1-4

Biological data should be collected for natural resources management plans. An effort should be made to compile any existing mapping data from current forest, marine, and agricultural projects. Other data can be collected on an as-needed basis for planning exercises in specific areas. Illustrative biological data include the following:

- Timber species by volumes/diameters (with locations)
- Non-timber species by marketable length (with locations)
- Wildlife habitat locations & characteristics
- Marketable fauna by location (stocking levels, market prices)
- Marketable flora by location (stocking levels, market prices)

8. Infrastructure — Priority 1 & 3

No particular agency is responsible for maintaining maps showing all physical infrastructure. The first priority will be to include all primary and secondary roads in the basic classification. Basic road information can be obtained from existing land cover and topographic maps, as well as from a current DPWH road mapping project. More details on roads (tertiary, forest paths, skid roads) can be obtained as needed for analysis.

Other infrastructure (for example, health and educational facilities, utilities) are important to development, but not a top priority for natural resources planning. Thus, they can be added later.

9. Administrative Boundaries — Priority 1

The maps from NAMRIA that show administrative boundaries to the provincial level are adequate. Barangay boundary maps are questionable. The basic framework, however, can function without detailed barangay boundary maps.

10. Demography — Priority 1-3

Very little demographic data is available in mapped form. The spatial information database should include basic population statistics to estimate growth rates, evaluate food needs and dependence on various natural resources (forest, agricultural land, water), and available labor pools. The optimal approach is to combine these demographic data with relative locations and associated socio-economic data. For example, an assessment of the best location for a forest-related industry might combine (in addition to forest and topographic data) population numbers at specific locations with socio-economic information such as age, gender, current income and source.

Information from the National Census and Statistics Office and the Inventory of Forest Occupants (IFO) can be used initially to give a general picture of population distributions and characteristics. More detailed demographic information can be collected during the socio-economic surveys of individual settlements at later stages of the classification effort. This effort should focus on the spatial distributions (or arrangements) within and between settlements.

The expanded forest inventories, conducted by FSOs under NRMP, will consider spatial distributions in and between settlements. A serious analysis will require a social scientist (population geographer or sociologist) to assess spatial behaviors such as association and disassociation, as well as factors related to settlement behaviors (i.e., ethnicity, education, religion, and migrant versus indigenous status).

Migration in itself is an important consideration. Migrants from lowland and urban areas, for example, will have different skills than indigenous populations. Indigenous populations may have traditional ways of managing the land and its resources. Factions may develop between migrants and indigenous populations or other groups who have been in an area for a long time. These, as well as other similar factors, can be expected to affect the implementation of resource management projects.

Simple identification of the percentage of migrants versus indigenous peoples in each province should be done during the early stages of data collection. The residual forest inventories are collecting data on migrant versus indigenous population.[11] A more detailed study of migrants,

[11]For the purpose of the inventories analysis, a migrant is defined as someone who moved to a barangay within the last ten years.

their behavior, and their impact on natural resources management is recommended in the later stages of spatial information system development.

11. Locations and Types of DENR Projects — Priority 1

The Foreign-Assisted and Special Projects Office (FASPO) has maps of some current projects and information on the locations of other projects. A process to continuously update and accurately define the extent of projects should be established. This work should form part of the land status mapping.

12. Social and Economic Data

Planning for natural resources management should be based on human, as well as physical, factors. Social and economic data are needed to understand the community, its requirements and attitudes. Available mapped or mappable social and economic data are inadequate for purposes of spatial analysis. For example, the Department of Interior and Local Government is preparing a profile for each province. The profiles contain some data for barangays, but the data are aggregated at the provincial level.

In most cases, raw data from social and economic surveys must undergo various kinds of statistical manipulation before they can be used in a spatial information system. The results of these analyses become layers in the spatial database and can be combined with physical data layers to answer questions, such as: do people living on steep slopes depend more on forest products than people living on gentle slopes?

Examples of spatial analyses using social and economic data are included in the spatial analysis section below. As spatial analytical needs are articulated by users, the specific kinds of analyses can be defined. Also see Annex D for a discussion of social and economic information.

We recommend that the collection of social and economic data be tied to specific objectives, e.g., a residual forest management plan. The list below contains suggestions for the kinds of social and economic data commonly needed to develop natural resources management plans.

Social Data

Religion:	Dominant religious affiliations
Ethno/Linguistic:	Ethnic affiliations and languages
	Ethno-cultural resource management practices (agricultural, forest)

Education: Education levels

Locations and types of educational facilities

Health: Mortality/morbidity, malnutrition rates (ages important for women and children)

Locations and types of health facilities

Potable water supplies

Economic Data

Income Sources: Occupation types

Actual sources of income (e.g., forest products/type, crops cultivated, marine resources, laborer types)

Levels of income from each source

Cost and sources of inputs

Seasonality of income

Locations and amount of agricultural land

Tenure or ownership arrangements for agricultural land

Locations of forest product extraction

Locations of marine product extraction

Locations of other sources of income (labor, services)

Market types and locations

Locations of industries

Transport: Relative and effective distances

Road conditions

Product source/destination locations

B. Data Acquisition

The extent and characteristics of some classes of land cover (forest, agriculture), as well as social and economic conditions, change quickly. Thus, the acquisition of data to develop a spatial information database for resource planning should ideally be completed as quickly as possible. This effort would require either permanent or temporary additions to existing DENR and local government unit (LGU) staff. Another, and perhaps more efficient, approach would involve contracts for specific data collection tasks to NGOs, PVOs, and university faculty/graduate students. These contracts might focus on specific, technical tasks not easily accomplished by the involved government agencies, e.g., social and economic inventories/analyses and participatory rural appraisals.

Potential sources for data collection include the following:

1. Land Cover	Land evaluation parties; forest guards; DENR regional forest mgmt. specialists; survey, mapping, and planning teams (contracted by DENR regional offices)
2. Topography	NAMRIA, land evaluation parties, FSOs
3. Biological Forest	FSOs in cooperation with FMB staff; FMB residual forest inventory division; DENR regional forest mgmt. specialist/staff; university forestry staff; TLA holders/staff
4. Coastal/Fragile Zones	DENR regional environment/research field staff
5. Land Use/Tenure	DENR regional land management survey officers/teams; field network survey teams; DENR regional and community extension officers; forest guards[12]; municipal & community development officers/support staff (local govt.)
6. Soils	BSWM agricultural officers and FSOs
7. Climate	PAGASA staff
8. Roads	DPWH Mapping Project staff (technical assistance to the DPWH for an integrated CAD mapping and data management system)

[12]The number of forest guards in the country is expected to rise from approximately 3,000 to 9,000.

9. Demographic	Regional staff to assemble census data; LGU project development officers/staff; LGU planning unit (Provincial Planning Development Office, Municipal Development Office)
10. Social/Economic	DENR regional community development officers/staff and planning & management statisticians, desk officers, planning officers; university social scientists: NGOs/PVOs; FSOs

C. Illustrative Spatial Analyses

Spatial analysis tends to fall into four types of processes:

- Composite overlaying;
- Change detections;
- Siting exercises;
- Modeling.

1. Composite overlaying is the simple process of combining selected layers or features of layers to answer a question. For example, the database for the ground cover inventory might be asked to create a new layer (composite overlay map) showing only the physical criteria for timber cutting: residual forests on elevations below 1,000 m, slopes less than 50 percent, and not within 20 m of a river or 5 m of a stream. Or, a database containing socio-economic layers might be asked to create a map showing all areas where inhabitants belong to the Ilocano group, have eight or more years of education, and depend for more than 50 percent of their income on kaingin agriculture.

2. Change detection is a process to compare the same area at two different times to measure changes occurring during the interval. Change detections are most easily done using remotely-sensed data (aerial photographs and satellite imagery). For example, a previous and a current satellite image of a forested area at the same time of the year are compared to identify changes in extent of the forest cover. An automated process is used to estimate the amount and location of change. A composite change detection "map" (usually a color contact print of the image) shows the area of change. Changes in quality of vegetation also can be identified. The changes can be overlaid on other data layers, such as road and irrigation networks, to help evaluate relationships between change and other characteristics of the area. This procedure is particularly useful for monitoring and evaluating the progress of development projects.

3. Siting exercises combine layers or features of layers to select the optimum locations for an activity or a facility (conservation areas, project target areas, agro-processing plants,

recreation parks, education and health facilities, roads, and irrigation systems). The database is queried to select the optimum site based on user-defined criteria. For example, to site a paper mill, the database might be asked to select locations having sufficient available labor, access to raw materials and passable roads, and close to markets.

4. Spatial modeling is a process for analyzing trends and predicting the consequences of alternative ("what if") strategies. A typical "what if" model might examine demand for forest products, as well as the impact on forest product supply of an agro-forestry project. Or, spatial modeling might be used to identify the best locations to cultivate a particular tree species or the best tree species to grow in a particular location.

Spatial modeling requires reliable and detailed data, as well as expertise in posing the appropriate questions (natural resources issues) and identifying the criteria to answer these questions. Thus, most modeling probably will not be possible until database development is well underway. At this stage, it is possible only to describe some analytical procedures commonly used for natural resources planning and management and to assign suggested priorities. See Annex D for examples of spatial analyses used for a residual forest management plan.

D. Examples of Standard Analyses

Examples of standard analyses used for natural resources management include the following:

1. Topographic Cutting Requirements — Priority 1

Data: Land cover, topography

Process(es): Overlay, database query, buffer generation

Criteria: Under 1,000 m elevation, under 50% slope, and not within 20 m of a river or 5 m of a stream

Output(s): Map showing areas acceptable for timber cutting, database layer to combine with other layers for other analyses

2. Species Cutting Restrictions — Priority 1

Data: Species distributions

Process(es): Overlay, database query, buffer generation

Criteria: Almaciga and narra

Output(s): Map showing locations of almaciga and narra stands, database layer to combine with other layers for other analyses

3. Impact of Timber Cutting on Forest — Priority 2

Data: Land cover; land use; pattern/extent of timber extraction (survey, aerial photographs, or satellite imagery); local forest utilization practices, level of dependence on forest

Process(es): Change detection, statistical analysis, overlay

Output(s): Change detection images showing impact of cutting, tabular estimates of impact, overlays to support assessment of relationships between cutting and social and economic factors

4. Quality/Quantity Analysis — Priority 1

Data: Land cover; forest inventory (species distributions, dbh, marketable volumes)

Optional: For large commercial ventures or a national assessment of a reforestation program, use satellite imagery from a land cover inventory, complimented by Advanced Very High Resolution Radiometry to apply the Normalized Difference Vegetation Index to derive forest quality.

Process(es): Overlay, thematic ranging, database query

Output(s): Maps showing distributions of individual species by average dbh and actual volumes per hectare, database layers for use in other analyses

5. Timber Cutting Prioritization — Priority 1

Data: Distributions by species of average dbh and total volume per hectare (or other unit), market demand data, infrastructure (roads, processing facilities, markets)

Processes: Thematic ranging of distributions, database query, overlay, analysis

Criteria: Trees over 60 cm dbh, user-defined marketable volume ranges (e.g., 0-29.999, 30-59.999, 60-89.999)

Outputs: Maps showing areas where individual or aggregated species meet 60 cm dbh legal cutting requirement and total marketable volumes meeting specifications for

priority cutting (first, second, third, and so on); maps showing spatial relationships to processing facilities, roads, markets, and market demand

Comment: This approach is much more effective than the methods used by most TLA holders. They determine cutting based solely on average dbhs and some impressionistic ideas of the volume for the entire TLA. This "method" is inefficient because an average dbh reveals little about actual volumes.

6. TLA Second Growth Cutting — Priority 2

Data: Land cover, forest inventory, timber volumes

Process(es): Database query, thematic ranging, overlay

Criteria: Areas where actual volumes are equal to or exceed 68 cm^3 per hectare

Output(s): Map showing areas fulfilling criteria

7. Non-Timber Cutting Prioritization — Priority 1

Data: Distributions by species (e.g., palm, rattan, bamboo) in merchantable lengths (meters); market demand data, infrastructure (roads, markets, processing facilities)

Process(es): Thematic ranging, database query, overlay, analysis

Criteria: User-defined ranges of volumes (total marketable lengths)

Output(s): Maps showing areas where individual or aggregated species meet user-defined ranges of marketable volumes; maps showing spatial relationships to processing facilities, road, markets, and market demand

8. Reforestation Query — Priority 1

Data: Land cover, forest inventory, demographic and socio-economic data

Process(es): Thematic ranging, database query, overlay

Criteria: Areas where per hectare volume of all species is less than 30 m^3

Output(s): Maps showing areas needing reforestation, overlays showing characteristics and forest practices/dependency of communities. They can be used to identify the best approach, and other interventions needed to expedite reforestation

9. Assisted Natural Regeneration — Priority 2

Data: Land cover, forest inventory

Process(es): Thematic ranging, database query, overlay

Criteria: Timber diameter ranges

Output(s): Maps showing where and what silvicultural methods are needed to improve stocking

10. Tree Species Suitability Model — Priority 2

Data: Topography, climate, soils, land cover, forest cover by species and volume/quality, socio-economic/demographic

Process(es): Overlay, database query, analysis. Two processes can be used: query the database to select (1) areas with conditions duplicating those found in ideal cultivation areas for a species or (2) areas fulfilling the optimal conditions for a particular species.

Criteria: Elevation; slope; aspect; rainfall (annual, regime, dry season length), temperatures (mean annual, mean maximum of hottest month, mean minimum of coldest month); soil (type, depth, nutrient content)

Output(s): Maps outlining the optimal locations or maps showing ranges of locations (optimal, medium, poor). Combined with community characteristics and dependency on forest products, can assist in selecting species most suited to the needs of people.

11. Integrated Social Forestry Potential — Priority 2

Data: Topography, land use/status, land cover, forest inventory, social, economic, and demographic data

Process(es): Overlay, database query, buffering

Criteria: Forest areas with less than 10 percent stocking levels, below 50 percent slope and 1,000 m elevation, and covered by former projects (Forest Occupancy Management, Family Approach to Reforestation, Communal Tree Farms) or within other old forest management schemes (TLAs, Pasture Lease Agreements, industrial Tree Plantations).

Output(s): Maps showing optimal areas for Integrated Social Forestry Program sites, combined with demographic/socio-economic information to assess areas with the greatest potential for successful projects.

12. Land Management Agreement Potential — Priority 2

Data: Topography, land cover, land use/status, forest project maps,

Process(es): Overlay, database query

Criteria:

FLMA: Lands forested or otherwise developed by reforestation contractors under a DENR program; lands designated as watersheds, parks or preserves

IFMA: Bare, open, denuded, or grass-covered forestlands, brushlands, inadequately stocked areas within or outside timber concessions; areas covered by grazing/pasture leases needing immediate reforestation; areas of existing TLAs and TPSAs; minimum of 100 ha, but not exceeding 20,000 ha

Output(s): Maps showing optimal locations for specific land management agreements and maps indicating the appropriate forest management activities.

13. Wildlife/Animal Habitat Assessments — Priority 3

Data: Topography, land cover, land use, climate, animal inventories

Process(es): Overlay, database query

Criteria: Total area available; competition for land, elevation (maximum, minimum, averages); spatial arrangement of mountains and valleys; vegetation, animal population densities and locations, water quality and availability

Outputs: Maps to identify areas suitable for wildlife habitats, information for reserve management and habitat conservation (water area development, road closure siting)

14. Timbershed Siting — Priority 3

Data: Topography, infrastructure, land cover, land use, facilities maps

Process(es): Cost friction surfaces (impediments to movement), overlay, cost analysis

Criteria: Skidding distance from source to potential timbershed area, friction factors (slope, elevation, road quality, water barriers)

Output(s): Maps and tabular reports estimating the cost to move timber from source to potential timbershed sites.

15. Infrastructure Siting — Priority 4

Examples: Road corridors, road closures, skid trails and landings, deforestation cuts, saw and pulp mills

Data: Topography, land cover, land use/status, demographic, road networks, other infrastructure

Process(es): Overlay, buffering, database query

Criteria: Geometric design standards; settlement locations/labor pools; water availability and barriers; drainage patterns; protected areas; distance/access to raw materials; distance/access to markets and mills. Road corridor siting example: design standards might require x meters above and x meters from streams, x number of stream crossing (as few as possible), and suitable changes in slope to avoid long sustained grades and permit proper drainage.

Output(s): Maps showing locations/routes suitable for proper physical placement and cost-effective operations.

16. Erosion Modeling — Priority 4

Data: Topography; soil; climate; land cover; existing conservation practices; demographic

Process(es): Overlay, database query

Criteria: Slope, soil erodability, rainfall erosivity levels, locations and types of soil conservation practices, agricultural lands, downstream settlement locations

Output(s): Maps showing downstream erosion potential to support decision making, for example, for upstream hydro-projects to avoid excessive erosion and accumulation of sediment

17. Fire Modeling — Priority 4

Data: Topography, climate, land cover/use

Process(es): Overlay, spatial modeling

Criteria: Fuel types, elevation, aspect, mean and high temperatures in hottest season, rainfall regimes, existing fire control measures

Output(s): Damage caused by possible wildfires, determination of possible outbreak times, characterization of fire behavior under specific conditions

18. Tourism Potential — Priority 3

Data: Topography, land use/status, climate, road networks, other infrastructure, demographic, socio-economic

Process(es): Overlay, database query

Criteria: Potential tourist attractions (mountains, hot springs, beaches, coral reefs); good access (roads, airports); accommodations, local saleable items, sufficient trainable workforce

Output(s): Maps identifying locations with good tourism potential

ANNEX D. SPATIAL INFORMATION SUPPORT FOR RESOURCE MANAGEMENT PLANNING: MODEL EFFORTS IN ISABELA AND SAMAR

This exercise focused on the introduction of spatial information management methods to support preparation of NRMP resource management plans. The team worked with NRMP and FSO staff to test both manual and automated spatial information techniques. The FSO (UPLB Foundation, Inc.) was instructed in the use of traditional geographic methods (e.g., manual map overlays) to analyze the inventory data and prepare the plan for the inventory site in Samar (Region 8). The team developed an automated spatial information database and outputs to support preparation of the plan for a residual forest site in Isabela Province (Region 2).

As a result of this work, NRMP now has a model resource management database and has worked through the process of developing the database, identifying the outputs useful for resource management planning, and using the outputs to develop a prototype plan. In addition, NRMP has tested a plan to teach spatial information management to FSOs. We recommend that NRMP continue to develop spatial information management in the expanded forest inventory effort. A suggested approach is described in the Recommendations section below.

I. THE PROCESS

The process to develop spatial information outputs to support resource management planning includes the following steps:

- Data identification;
- Database development or manual overlay preparation;
- Applications design;
- Applications generation.

A. Data Identification

The team worked with NRMP, DENR planning, and FSO staff to evaluate the minimal set of data needed to prepare a sound management plan. These included the physical features of the area, the biological distributions and spatial relationships of the forest flora and fauna, and spatially differentiated human characteristics of the communities who depend for their livelihood wholly or partially on the forest.

B. Database Development

The data were manually plotted for the Samar exercise. For the Isabela site, geographic data were digitized.[13] Attribute data (biological and social/economic) were given unique identification codes to associate them with geographic features. Biological data were associated with a grid representing the actual location where trees species were identified and measurements taken. A process called Thiessen polygonizing was used to interpolate distributions of tree measurements. Social and economic data were associated with the barangay where the data were collected.

C. Software

A combination of spatial information and database management tools were used to develop the database and to generate applications. The team used ATLAS GIS as its primary spatial information tool. ATLAS GIS is a relatively user-friendly pc-based GIS software package. It is easily compatible with most other standard GIS packages, including the Arc/Info system used by the NRMDP-trained staff of DENR. Like Arc/Info, ATLAS GIS uses dBase III+ as its relational database management tool. We also used GENEMAP GIS software for digitizing and grid generation, the FoxPro database manager for some measurements, and ATLAS Mapmaker for social and economic data displays.

D. Contents of the Database

The database stores data sets in separate geographic layers (e.g., topography, administrative boundaries, and settlements) and attribute data in separate fields. A layering system is used so that information on one feature can be added, subtracted, or edited without affecting other layers, as well as to enable the combining of user-defined data sets for spatial analysis.

1. Geographic layers in the Isabela database include the following:

   a. From the 1:50,000 base map:

      - Rivers and other bodies of water (1:50,000);
      - Elevation contours (100 m intervals);
      - 50 percent slope;
      - Road network;

[13]Digitizing involves computerized encoding of map data through the use of a digitizing tablet and mouse.

- Settlements;
- Barangay boundaries.

b. From the inventory map (1:10,000):

- Inventory site boundaries;
- Inventory site land uses.

c. From the 1:250,000 Region 2 Arc/Info digital files;[14]

- Land classification map;
- Land use;
- Wilderness areas;
- Potential tourist areas;
- Agro-climatic zones;
- DENR programs/projects.

2. The attribute file contains the following fields:

a. Biological data from the residual forest inventory:

- Tree species aggregated into common hardwoods, common furniture woods, other hardwoods, total hardwoods, and non-timber species;
- Total volumes per hectare in cubic meters (for each sample unit);[15]
- Total volumes for non-timber forest products in meters;
- Average diameters (dbh) (in centimeters per sample unit).

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[14]The scale of these data is too small to use for the residual forest inventory plan. We included the data because they cover topics (soils, climate) unavailable at larger scales. Thus, they may be useful in the future for guiding data collection efforts.

[15]The model database contains tree species information for the fixed method of data collection. Please see recommendations section below for comments on mixing data collection methods.

b. Demographic data from the Bureau of the Census:

- Population for each of the three barangays surveyed by the FSO;
- Number of households for each of the barangays.

c. Social and economic data from the barangay surveys:

- Ethnic affiliations;
- Education levels;
- Number who depend on forest products for income;
- Number who practice kaingin agriculture;
- Income from forest products;
- Income from kaingin;
- Income from labor;
- Perception of land tenure arrangements;
- Number of migrants;
- Number of indigenous people.

E. Spatial Applications Development and Outputs

The team worked with NRMP and FSO staff to identify spatial information applications to support residual forest management plan development. This process (both manual and automated) focused first on looking at distributions and spatial relationships. Where, for example, are the largest volumes of hardwoods? Or, where are the people most dependent on forest products and what other characteristics of these people (ethnicity, education) might help develop a suitable management plan?

1. Samar Manual Spatial Applications

The evaluation of spatial distributions and relationships formed the basis for the Samar resource management plan. The process was an interesting one because it demonstrated the tendency to

choose management options based on only a few criteria. The FSO prepared map overlays of physical features (slope, elevation, waterway buffers, and road networks); distributions of aggregated tree species, volumes, and average dbh; existing land uses; and settlement locations. They also prepared graphic displays of social and economic factors to assist in evaluating management options based on forest dependence and characteristics of the communities.

The FSO's first attempt to define suitable management options ignored all the information, except the physical criteria required by law (slope, elevation, and waterway buffers). They decided, for example, that a large area should be maintained as a tree reserve, irrespective of the densities, species, or biological characteristics of the forest. They also recommended that all kaingin areas be reforested, without considering the level of community dependence on income from kaingin or ways to replace that income.

The team held several lengthy sessions with the FSO, during which we role-played our way through the spatial planning process. The FSO now is developing a plan based on a variety of spatial considerations.[16] This process revealed, however, that expertise in using spatial information is minimal and will require a serious training effort. It also indicated that the manual process has analytical limitations. Nonetheless, the manual process is a useful one to introduce spatial information management.

2. Isabela Automated Spatial Applications

The second stage of spatial analysis concentrates on combining data sets in different ways to look at "what if" scenarios. For example: if we reduce the average dbh requirement, would the volume of hardwoods in a particular area be commercially viable? "What if" analysis (also called spatial modeling) is difficult using manual cartographic methods. This function, in fact, is the true strength of computer-assisted spatial analysis. Even given the limitations of the data available for the Isabela exercise, we were able to generate useful applications using automated methods.

Each application consists of combinations of data sets (geographic layers and biological tree attribute fields). Because of the lack of locator information, we were unable to do any genuine spatial analyses using social or economic factors. Nonetheless, some mapped graphic displays that are useful for evaluating relationships between the community and the forest were generated. The sample applications for the Isabela plan include the following:

a. Locator Maps

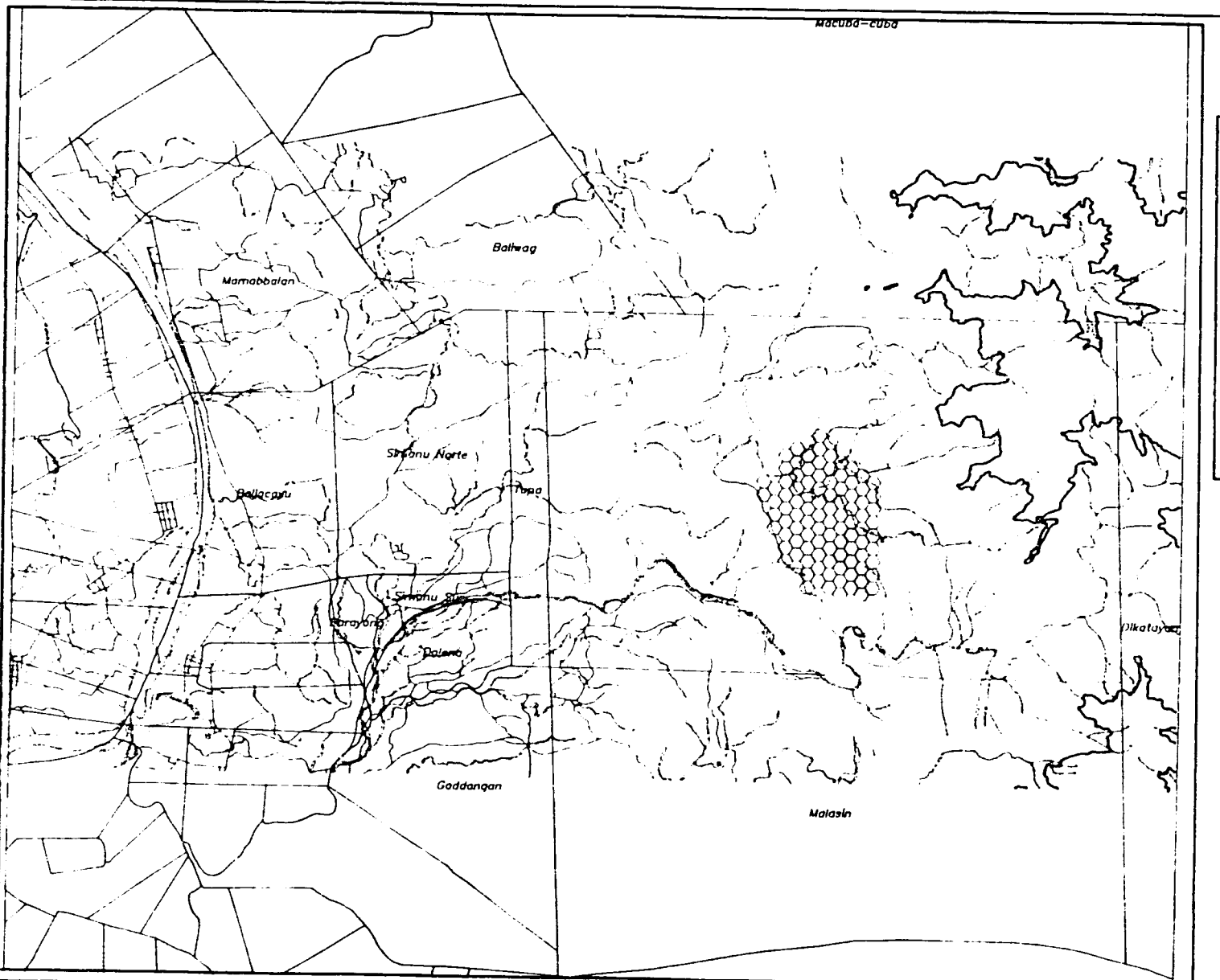
Figure 1 shows the location of the forest inventory site in relationship to the surrounding area, including road systems, waterways, and settlements.

[16]Because the maps are large, they are not included in this report. They are available at the NRMP office.

FIGURE 1

INVENTORY BLOCK SHOWING SETTLEMENTS, ELEVATION, SLOPE & RIVER BUFFERS

REGION II MODEL : ISABELA



LEGEND :

- BARANGAY BOUNDARY
- FIXED INVENTORY SITE
- RIVER BUFFERS
- SLOPE 50% UP
- ELEVATION 1000m
- PROJECT INV. SITE
- ROADS

Kilometers

0 1 2 3 4 5

Figure 2 shows the location within the forest inventory site of the fixed inventory method, as well as relationships to the barangay and provincial boundaries.

b. Land Use Map and Topographic Cutting Requirements

Figure 3 shows the current land use pattern in the residual forest inventory site. These data are important to determine where timber may or may not be cut (elevations above 1,000 m, slopes above 50 percent, and buffers around waterways). The map shows that there are no areas within the site over 1,000 m, though there are three relatively small areas above the 50 percent slope limitation. There appear to be no major roads into the inventory site.

The extent and location of the burned (fallow) and kaingin areas suggest that dependence on forest lands for agriculture is not a major issue. The map also indicates that the use of forest land for agricultural purposes is greater in the northwestern portion. See socio-economic information below for a possible explanation.

c. Species Distributions

The distribution of aggregated species by sample unit form the basis for the majority of the applications. Figures 4a, b, c, & d show distributions of common hardwoods, common furniture woods, other species, and total species volumes by cubic meters per hectare. Figures 5a, b, c, & d show distributions of average dbh per sample unit. A standard ranging method, based on frequencies, was used to generate these distribution maps.

The ability to view the distributions of tree species and their per hectare volumes and average diameters is valuable in itself for a general picture of forest characteristics. Distribution data, when combined with other forest management criteria, were used to identify forest lands falling under additional pro- and prescriptions.

d. Timber Cutting Prioritization

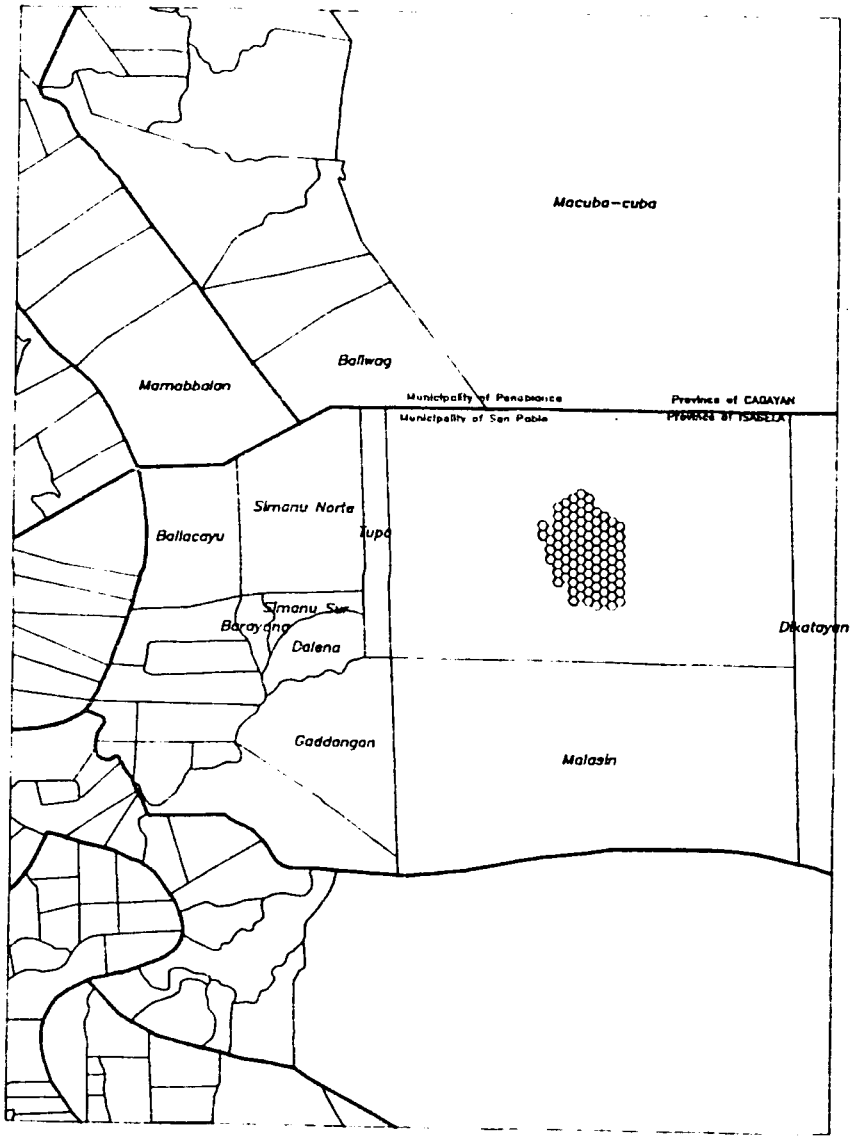
TLA holders commonly base cutting priorities on the dbh requirement (average dbh 60 cm and above) and qualitative estimates of timber volumes for a whole area. This approach provides no clear idea of where volumes are highest, nor does it give sufficient information to adequately address the dbh requirement. An average diameter, for example, might represent only a few trees.

Figures 6a & b and 7a & b show a timber cutting priority model for common hardwoods and total species based on user-defined criteria. The maps clearly indicate that the inventory site has limited potential for large scale commercial timber projects.

FIGURE 2

BARANGAY, MUNICIPAL, INVENTORY & PROJECT INVENTORY SITE BOUNDARIES

REGION II MODEL , ISABELA



BOUNDARIES :

BARANGAY BOUNDARY

FIXED INVENTORY SITE

MUNICIPAL BOUNDARY

PROJECT INV. SITE

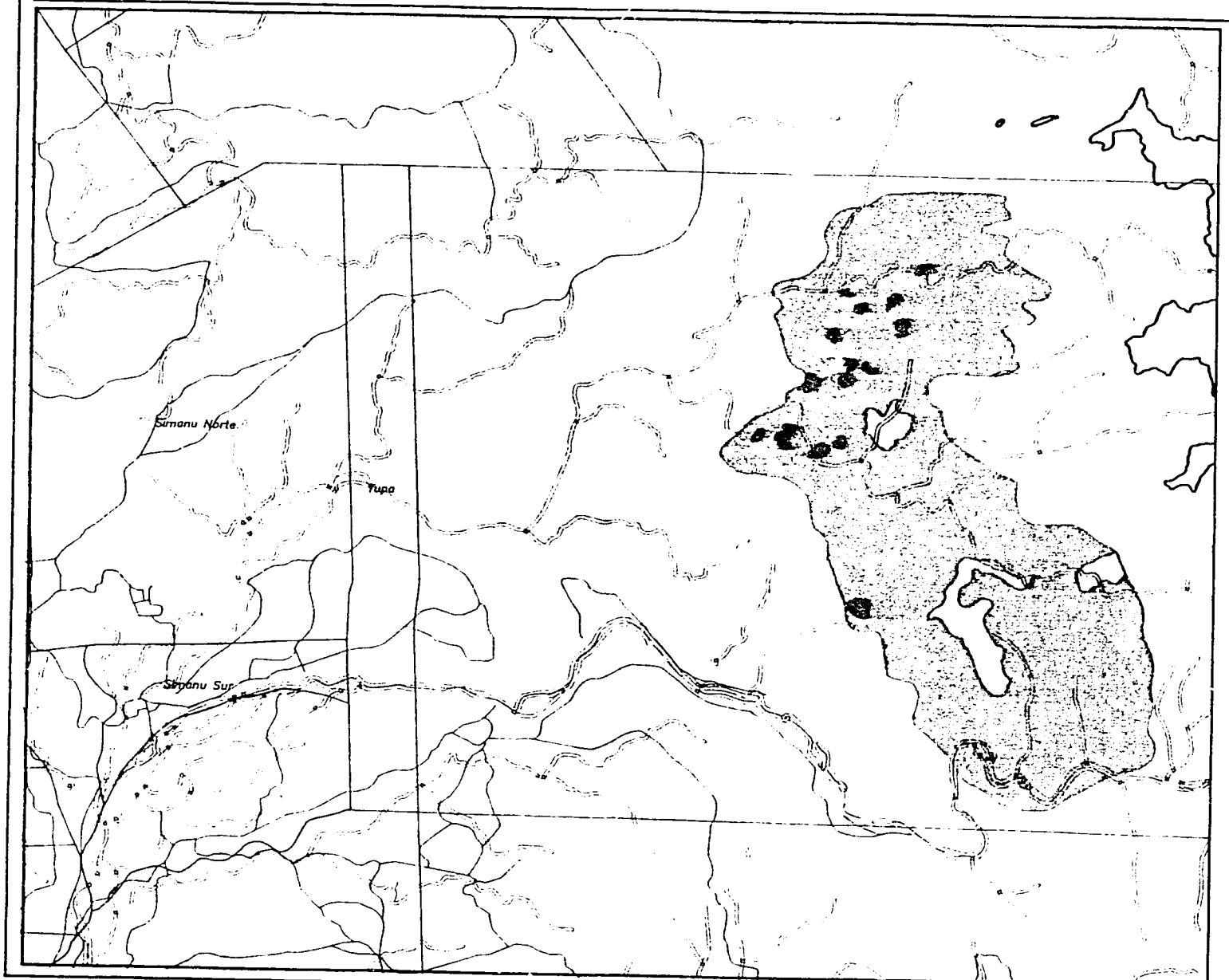
Kilometers

0 2 4 6 8 10

FIGURE 3

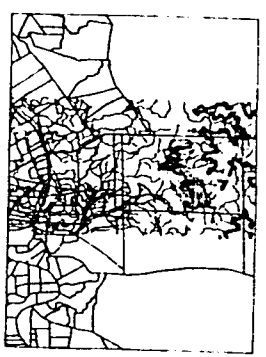
LAND-USE MAP (San Pablo, Isabela

REGION II MODEL : ISABELA



LEGEND :

- BARANGAY BOUNDARY
- BURNED AREA
- KAINGIN
- RESIDUAL FOREST
- RIVER BUFFERS
- SLOPE 50% UP
- ELEVATION 1000m
- ROADS



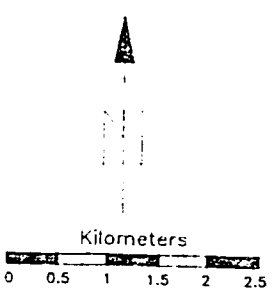


FIGURE 4A

DISTRIBUTION OF SPECIES VOLUMES

REGION II MODEL : ISABELA

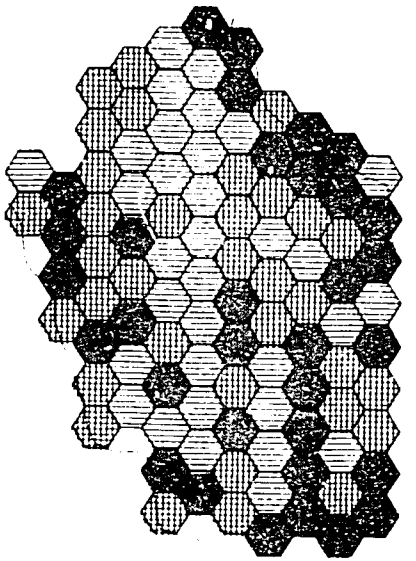
LEGEND :

BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE

STRIP METHOD



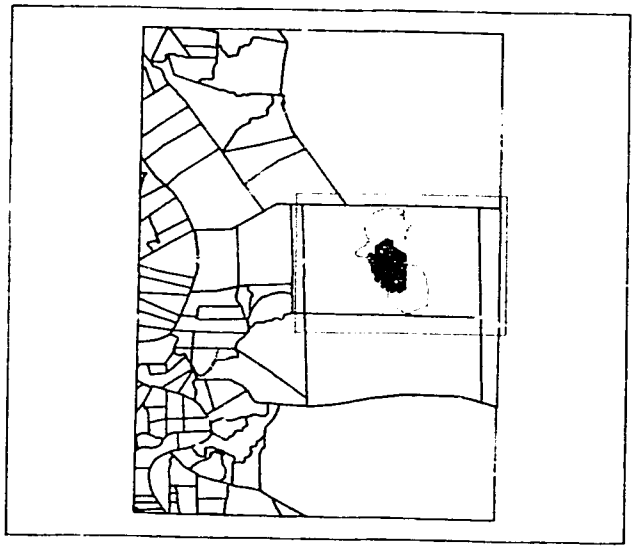
FIXED METHOD

HARDWOODS

0 TO 11.9 cubic meters per ha.

11.9 TO 33.5 cubic meters per ha.

33.5 TO 112.8 cubic meters per ha.



VARIABLE METHOD

N

Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 4B

DISTRIBUTION OF SPECIES VOLUMES

REGION II MODEL : ISABELA

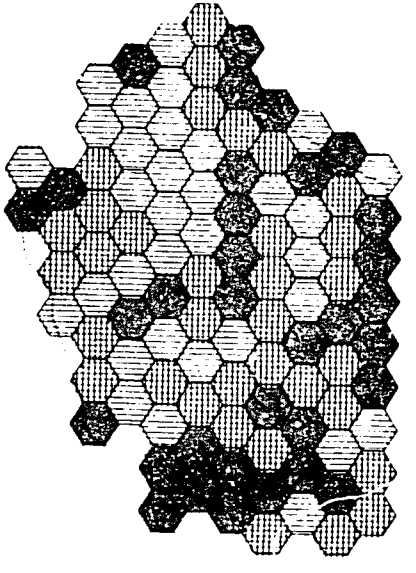
LEGEND :

BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE

STRIP METHOD



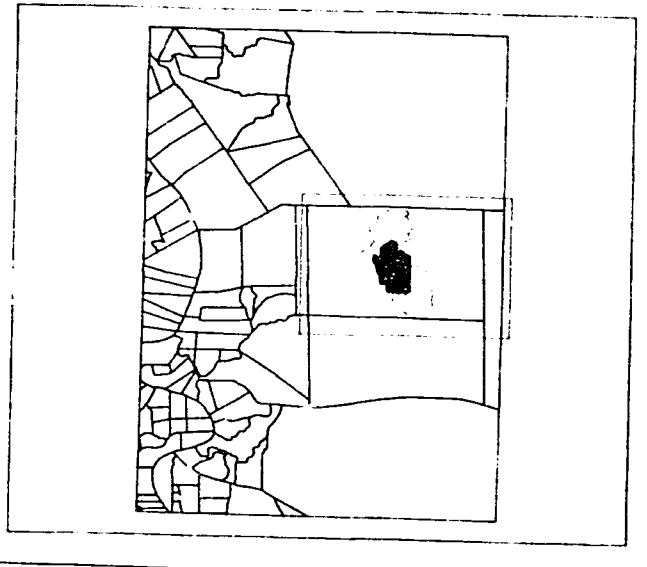
CONSTRUCTION WOODS

0 TO 11.3 cubic meters per ha.

11.3 TO 31.5 cubic meters per ha.

31.5 TO 65.2 cubic meters per ha.

FIXED METHOD



VARIABLE METHOD

Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 4C

DISTRIBUTION OF SPECIES VOLUMES

REGION II MODEL : ISABELA

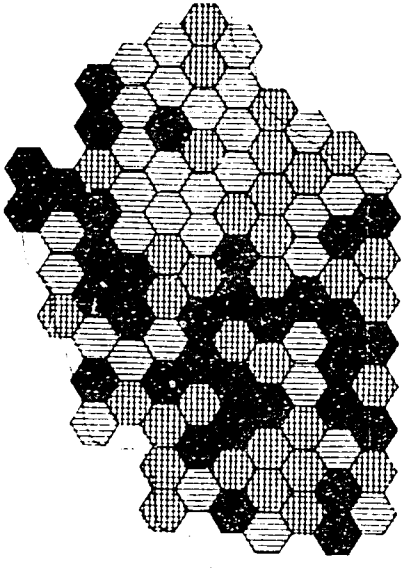
LEGEND

BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE

STRIP METHOD



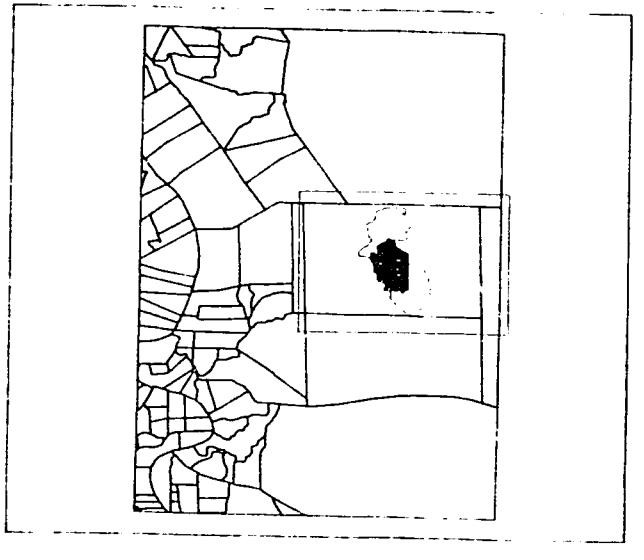
OTHER WOODS

0 TO 5.2 cubic meters per ha.

5.2 TO 14.9 cubic meters per ha.

14.9 TO 67.9 cubic meters per ha.

FIXED METHOD



VARIABLE METHOD

N

Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 4D

DISTRIBUTION OF SPECIES VOLUMES

REGION II MODEL : ISABELA

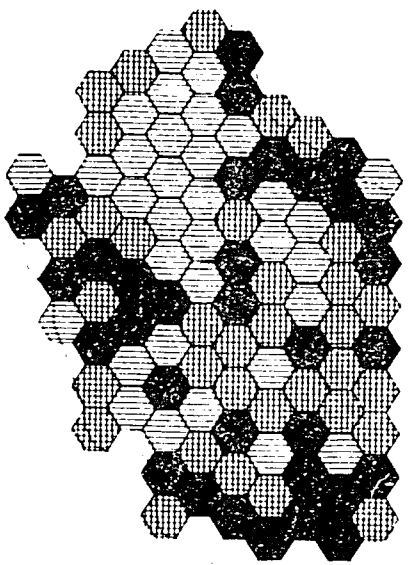
LEGEND :

BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE

STRIP METHOD



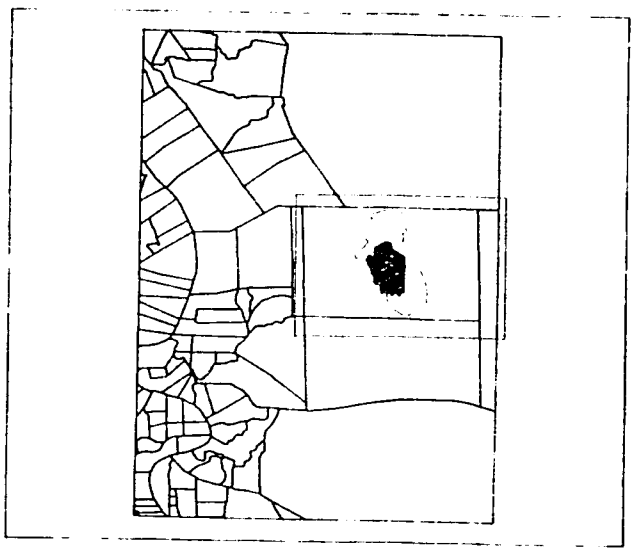
ALL SPECIES

0 TO 42.9 cubic meters per ha.

42.9 TO 79.4 cubic meters per ha.

79.4 TO 163.4 cubic meters per ha.

FIXED METHOD



VARIABLE METHOD

N

Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 5A

DISTRIBUTION OF DBHs

REGION II MODEL : ISABELA

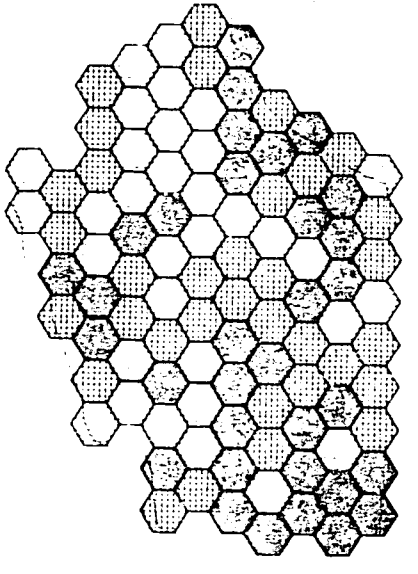
LEGEND :

BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE

STRIP METHOD



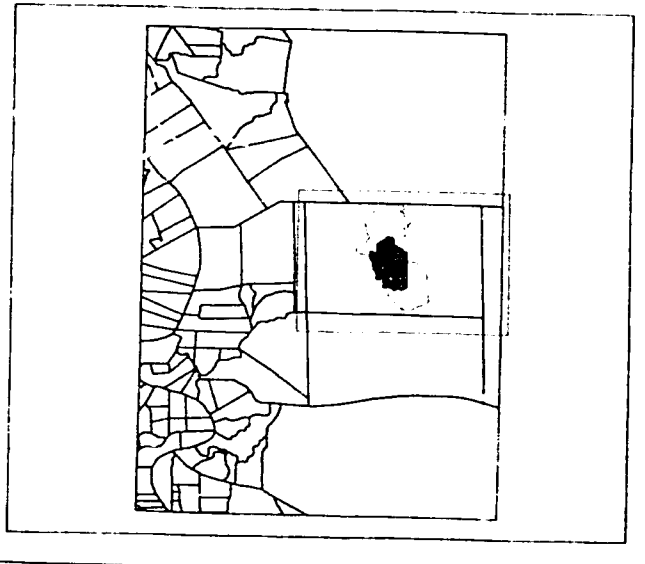
HARDWOODS

0 TO 24.4 cms.

24.4 TO 31.1 cms.

31.1 TO 68.4 cms.

FIXED METHOD



VARIABLE METHOD

N

Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 5B

DISTRIBUTION OF DBHs

REGION II MODEL : ISABELA

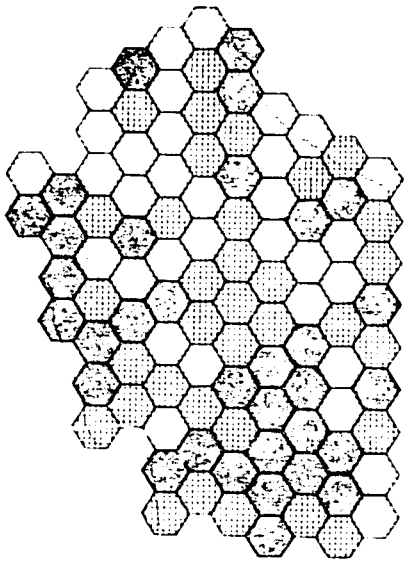
LEGEND :

BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE

STRIP METHOD



FIXED METHOD

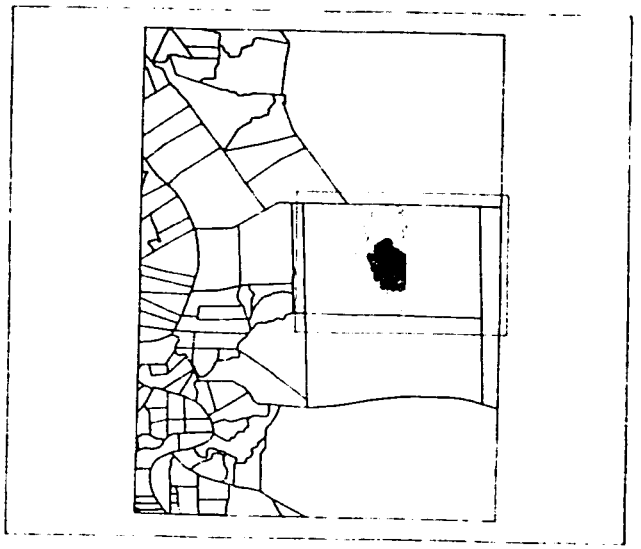
VARIABLE METHOD

ONSTRUCTION WOODS

0 TO 26.4 cms.

26.4 TO 32.5 cms.

32.5 TO 70.1 cms.



Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 5C

DISTRIBUTION OF DBHs

REGION II MODEL : ISABELA

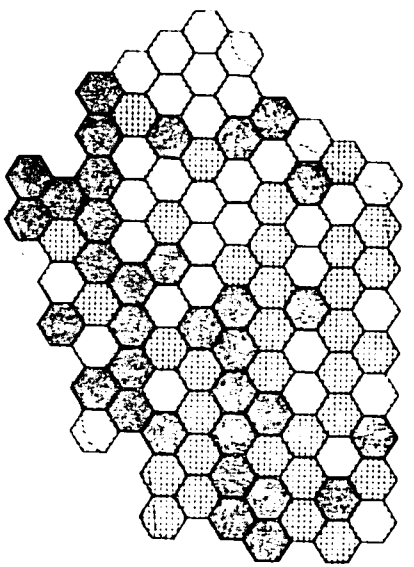
LEGEND :

BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE

STRIP METHOD

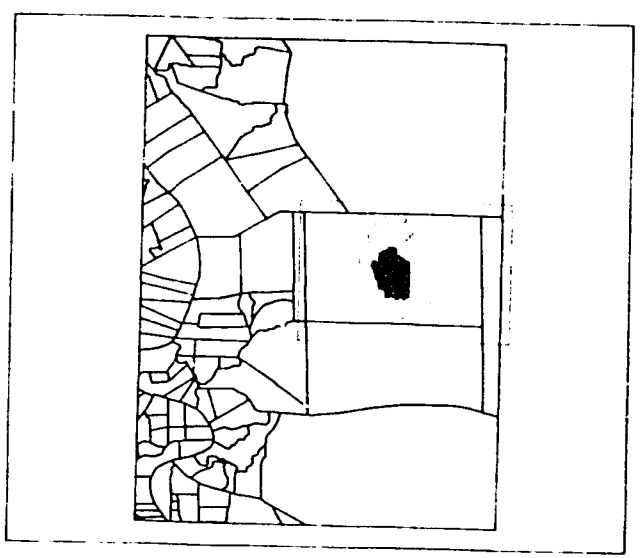


FIXED METHOD

OTHER WOODS
0 TO 23 cms.

23 TO 28.9 cms.

28.9 TO 84 cms.



VARIABLE METHOD

Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 5D

DISTRIBUTION OF DBHs

REGION II MODEL : ISABELA

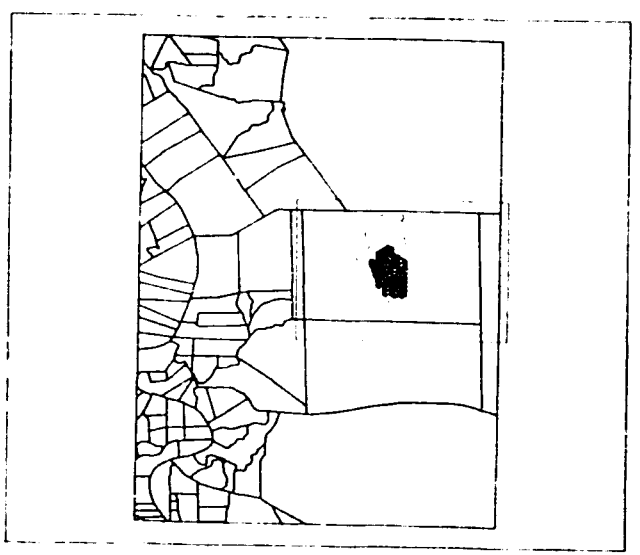
LEGEND :

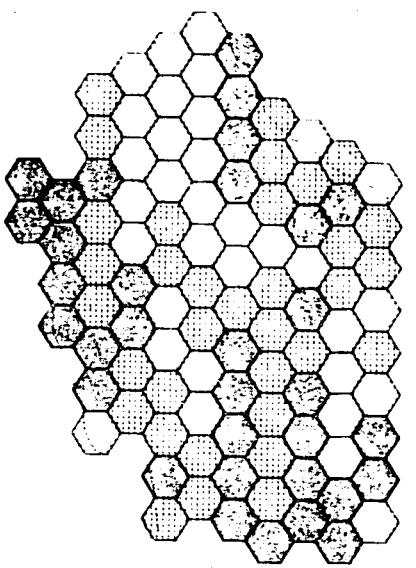
BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE

STRIP METHOD





ALL SPECIES

0 TO 26.5 cms.

26.5 TO 29.9 cms.

29.9 TO 55.4 cms.

FIXED METHOD

VARIABLE METHOD

Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 6A

TIMBER CUTTING PRIORITIZATION (Hardwoods)

REGION II MODEL : ISABELA

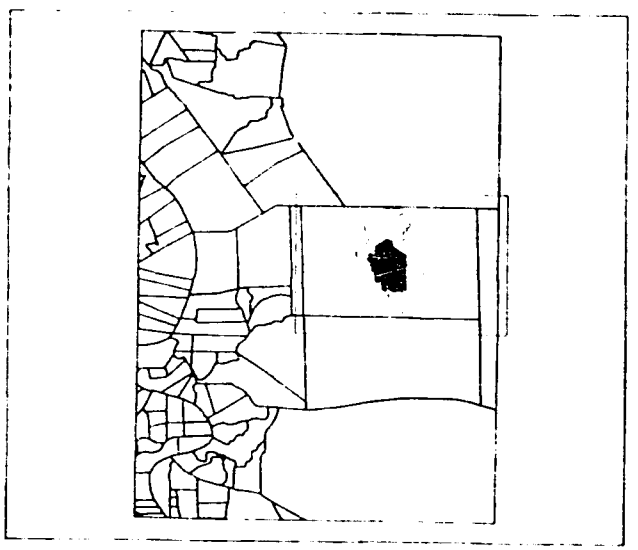
LEGEND :

1ST PRIORITY
(Average DBH over 80 cms. and Volume over 60 cubic meters per ha.)

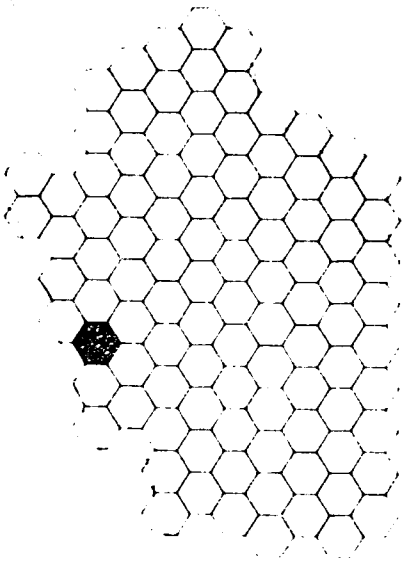
BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE



STRIP METHOD



FIXED METHOD

VARIABLE METHOD

Kilometers

0 0.5 1 1.5 2 2.5

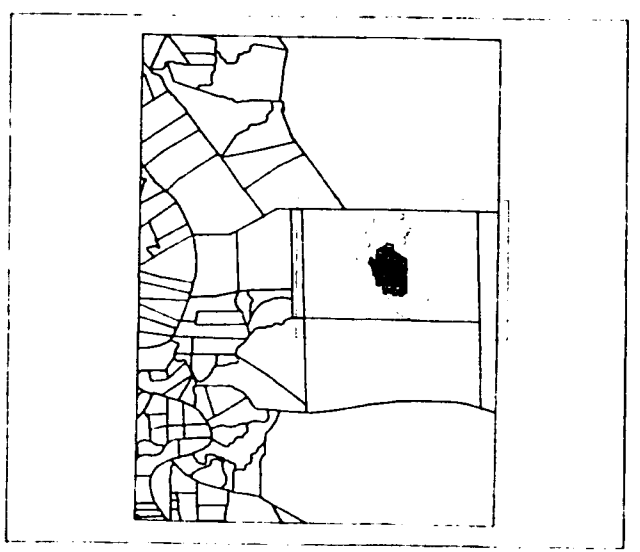
FIGURE 6B

TIMBER CUTTING PRIORITIZATION (Hardwoods)

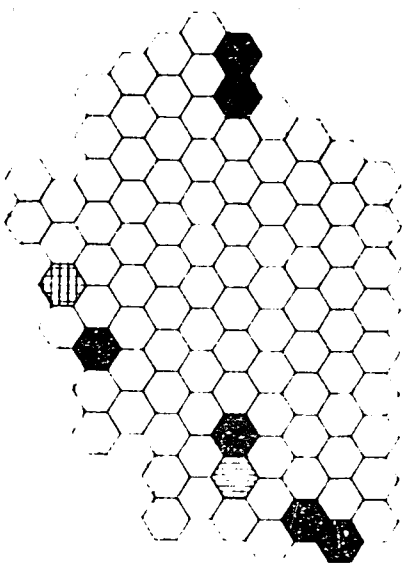
REGION II MODEL : ISABELA

LEGEND :

- 1ST PRIORITY (Average DBH over 45 cms. and Volume over 80 cubic meters per ha.)
- 2ND PRIORITY (Average DBH over 45 cms. and Volume 41–59.9 cubic meters per ha.)
- 3RD PRIORITY (Average DBH over 45 cms. and Volume 0–40.9 cubic meters per ha.)
- BARANGAY BOUNDARY
- FIXED INVENTORY SITE
- PROJECT INV. SITE



STRIP METHOD



FIXED METHOD

VARIABLE METHOD

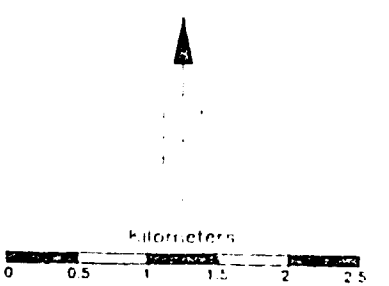


FIGURE 7A

TIMBER CUTTING PROPORTIONALITY (All Species)

REGION II MODEL : ISABELA

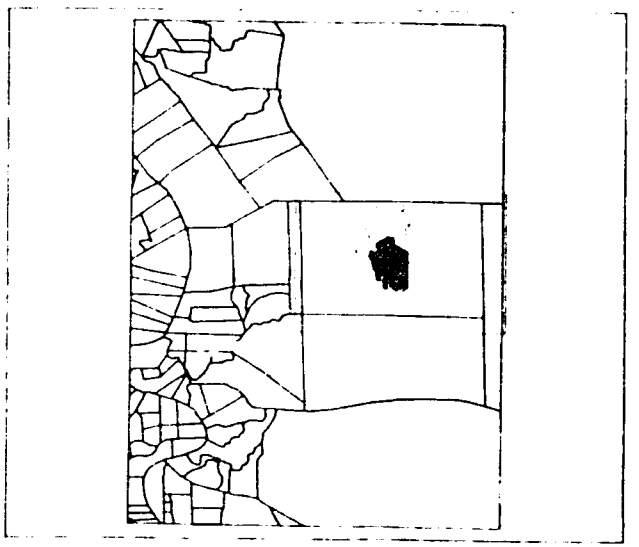
LEGEND :

1ST - PRIORITY
(Average DBH over 60 cms. and Volume over 60 cubic meters per ha.)

BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE



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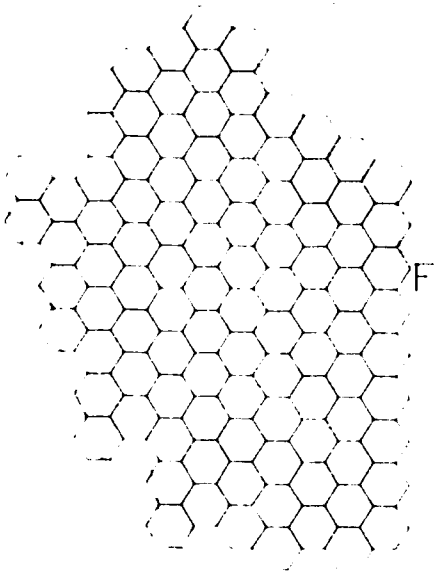


FIXED METHOD

VARIABLE METHOD

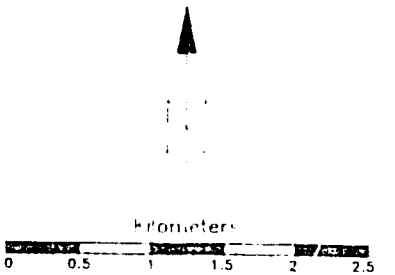


FIGURE 7B

TIMBER CUTTING PRIORITIZATION (All Species)

REGION II MODEL : ISABELA

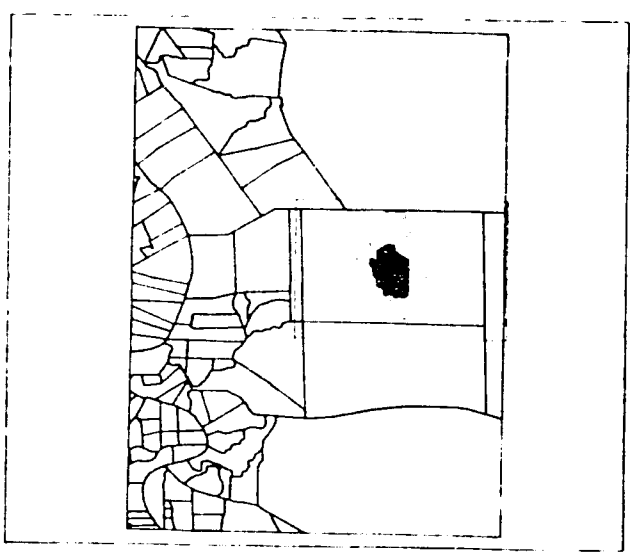
LEGEND :

1ST PRIORITY
(Average DBH over 45 cms and Volume over 60 cubic meters per ha.)

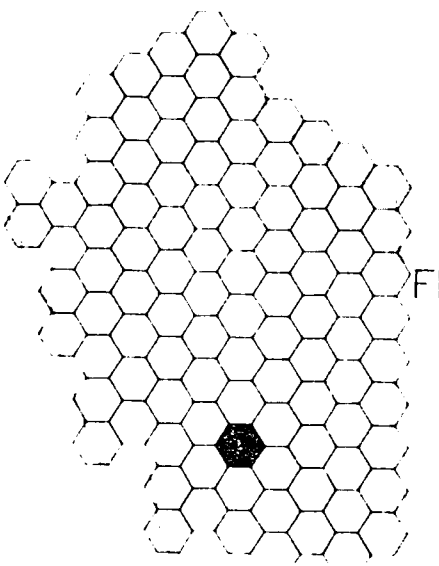
BARANGAY BOUNDARY

FIXED INVENTORY SITE

PROJECT INV. SITE



STRIP METHOD



FIXED METHOD

VARIABLE METHOD

Kilometers

0 0.5 1 1.5 2 2.5

Figures 6a & b show three levels of cutting priority (first, second, and third) based on a constant average dbh of 60 and above cm per sample unit. The first query used descending volumes. None of the sample units with hardwoods over an average of 60 cm, however, had volumes less than 60 m^3 per hectare. And only one sample unit met the first priority criteria. The database was queried a second time, dropping the dbh requirement to 45 cm. This query, shown in Figure 6a, identified three levels of hardwood cutting priority.

Figures 7a & b show the same process for all tree species. No sample units meet the average 60 cm dbh and total 60 m^3 per hectare volume criteria (Figure 7a). Only one sample unit, shown in Figure 7b, meets the reduced diameter requirement of an average of 45 cm.

e. Non-Timber Cutting Prioritization

Figure 8 shows the results of a similar process used to determine the areas of the forest best suited to the extraction of non-timber forest products. The criteria used are sample units where combined volumes of palm, rattan, and bamboo exceed 100 m The results indicate that a relatively large number of mostly contiguous areas have non-timber cutting potential. The same process can be used with any criteria and for any level of aggregation of non-timber forest products.

f. Reforestation Model

Figure 9 shows the output from a model to determine where reforestation is needed. The criteria for the query were based on the "stocking level" in the different areas of the forest. Stocking level was operationally defined as the total volume of timber in cubic meters per sample unit. There are a number of equations for determining stocking levels. GOP focuses on open and denuded areas, defined as below 10 m^3 per hectare, for reforestation efforts. We used a stocking level of 30 m^3 for all hardwood species. The results are consistent with the land use pattern shown in Figure 3: areas needing reforestation occur where kaingin and burned (fallow) land are the greatest. The reforestation areas indicated in the southern portions of the inventory site may be related to the relatively heavy dependence on forest products by the Ibanag living in Simanu Sur (see discussion of social and economic data below).

This same process can be used to determine the need for other silvicultural activities. Diameter criteria, for example, can be added to the query to identify forest parcels needing silvicultural treatments such as timber stand improvement.

g. Map and Tabular Combinations

A variety of methods can be used to analyze spatial information. The examples above are basically geographic queries. Statistical queries also can be combined with

FIGURE 8

NON-TIMBER CULTURE IDENTIFICATION

REGION II MODEL : ISABELA

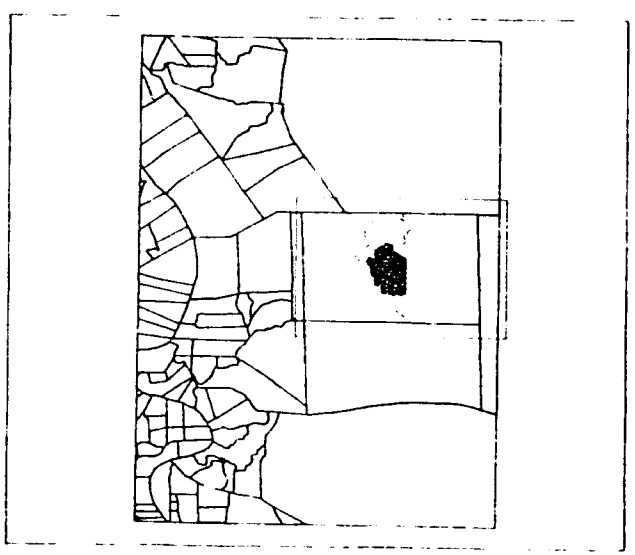
LEGEND :

BARANGAY BOUNDARY

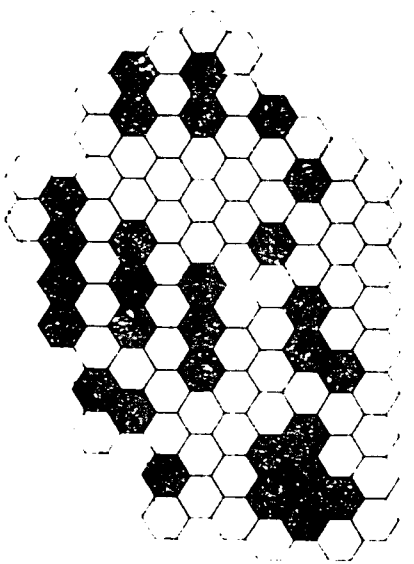
FIXED INVENTORY SITE

NON TIMBER
Linear meters per ha in each cluster
for rattan, palm & bamboo (combined) exceeding 100 meters.

PROJECT INV. SITE



STRIP METHOD



FIXED METHOD

VARIABLE METHOD

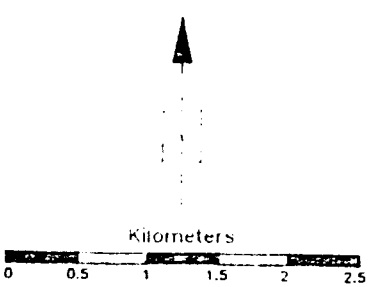
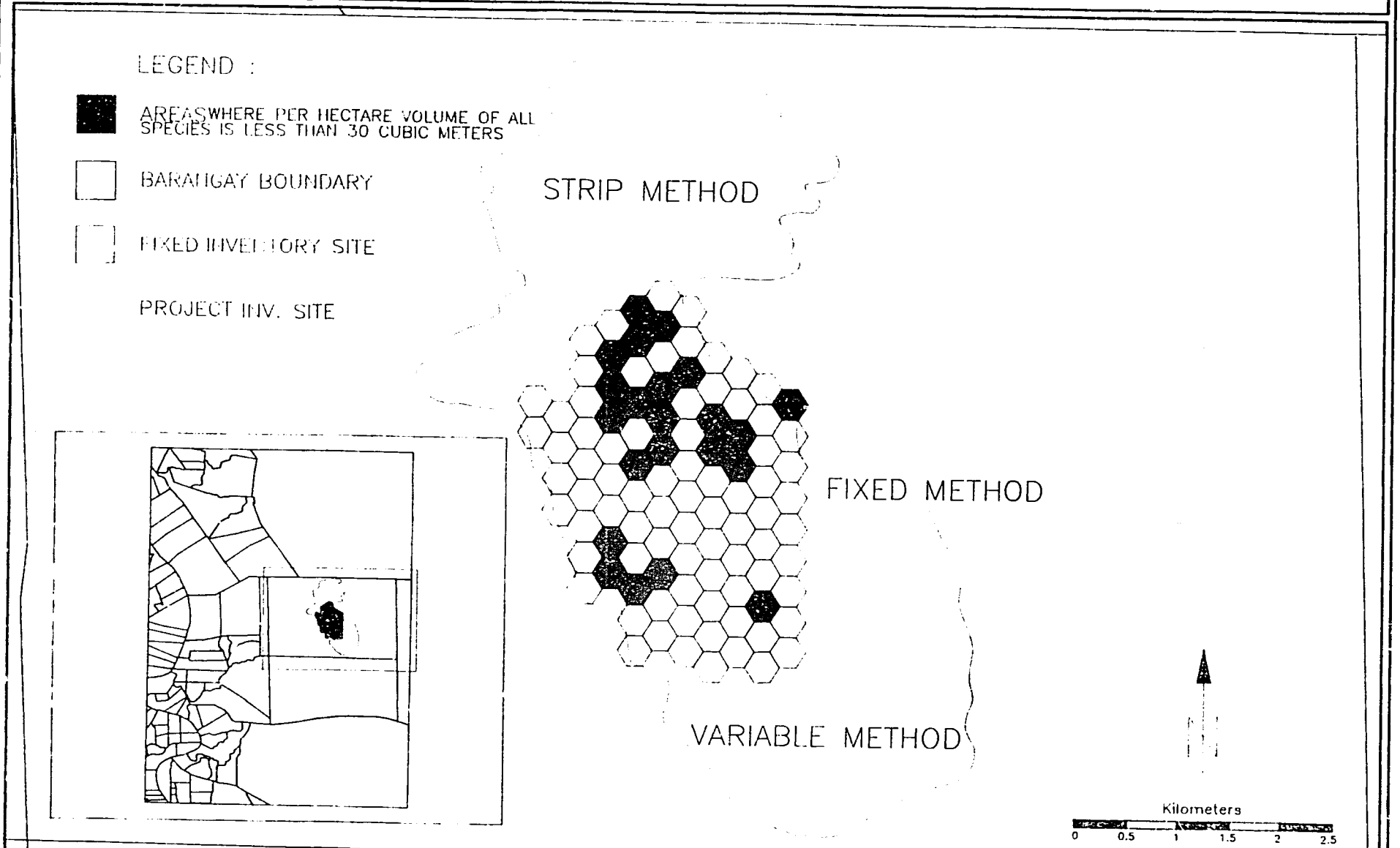


FIGURE 9

REFORESTATION PRIORITY AREAS

REGION II MODEL : ISABELA



geographic data to produce a variety of mixtures of tabular with spatial information. Figures 10a & b, 11a & b, and 12a & b show the results of a production query useful for planning a commercial timber project: if, for example, we cut hardwoods only in areas fulfilling the average 60 cm or above dbh requirement, how much volume per hectare will we get? And, if we drop the dbh requirement to an average of 45 cm, how much will we increase the volume?

The results, in addition to identifying the locations where trees meet the dbh requirements, show a substantial increase in the volumes of hardwoods, construction, and other hardwood species by reducing the dbh requirement.

F. Social and Economic Information

Not all social and economic data lend themselves well to spatial analysis. In many cases, statistical analyses, such as correlation statistics, are used to analyze the data. The results can be mapped, as long as they can be associated with a geographic location. In addition, the initial survey methods resulted largely in data that are not spatially differentiated in any meaningful way. Consequently, we were unable to generate the kind of applications using socio-economic and demographic data that are described in Annex C.

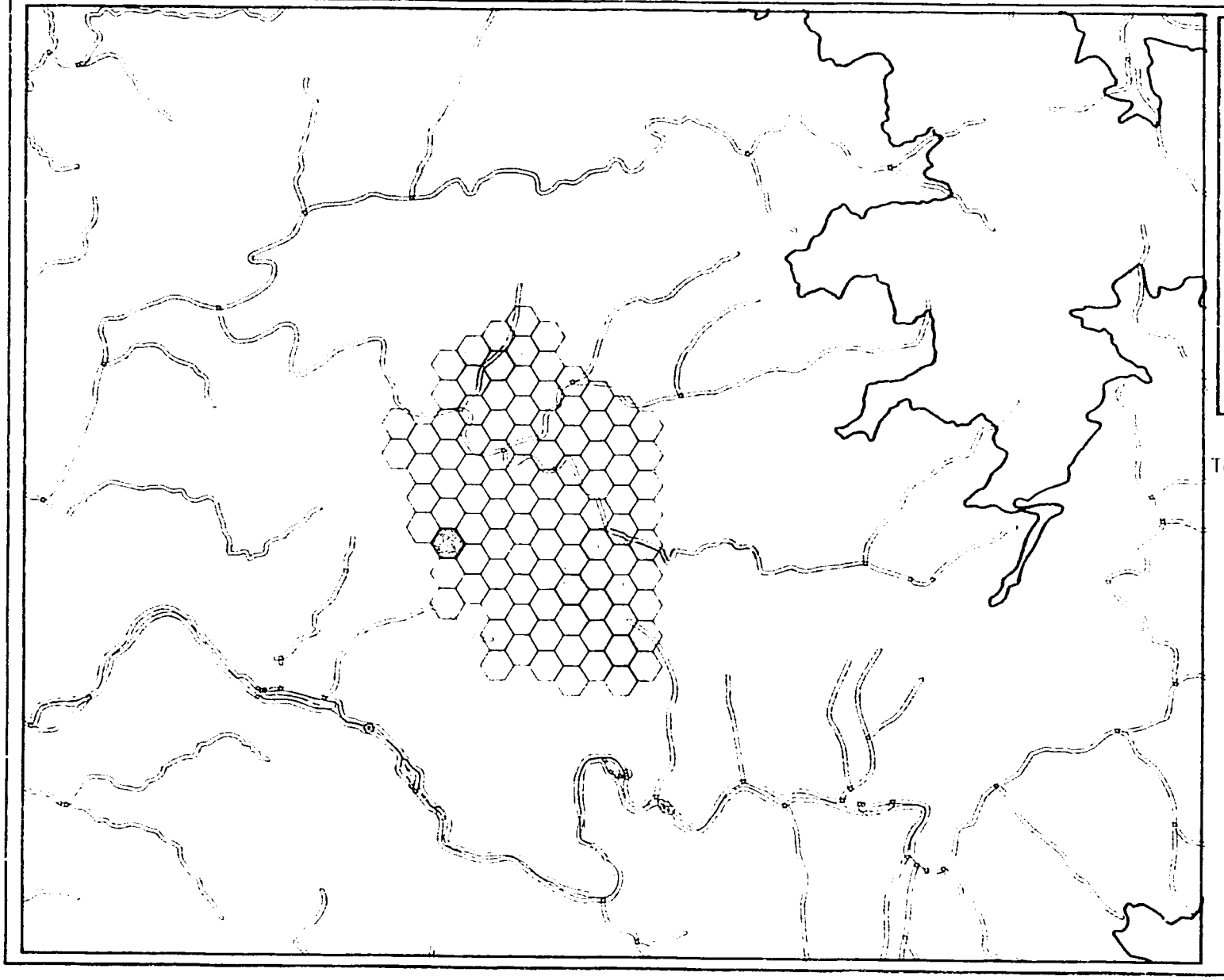
In the absence of data conducive to spatial analysis, we generated pie charts showing the percentages of the population in each barangay that fall into various categories of demographic, social, and economic groups. The charts include the following:

Data Category	Example of Potential Use
Figure 13: Population/No. Households	Total numbers potentially dependent on natural resources, population differences between communities, potential labor pools
Figure 14: Ethnicity	Dominance of an ethnic group, traditional forest and agricultural practices, associative and disassociative behaviors
Figure 15: Migrants/Indigenous	Land use perceptions, differing skill types and levels, social relationships
Figure 16: Education	Skill levels, world view, leadership ability, extension services needed

FIGURE 10A

MARKETABLE VOLUMES FOR HARDWOODS

REGION II MODEL : ISABELA



LEGEND :

- 60+cms–DBH
- FIXED INVENTORY SITE
- RIVER BUFFERS
- SLOPE 50% UP
- ELEVATION 1000m

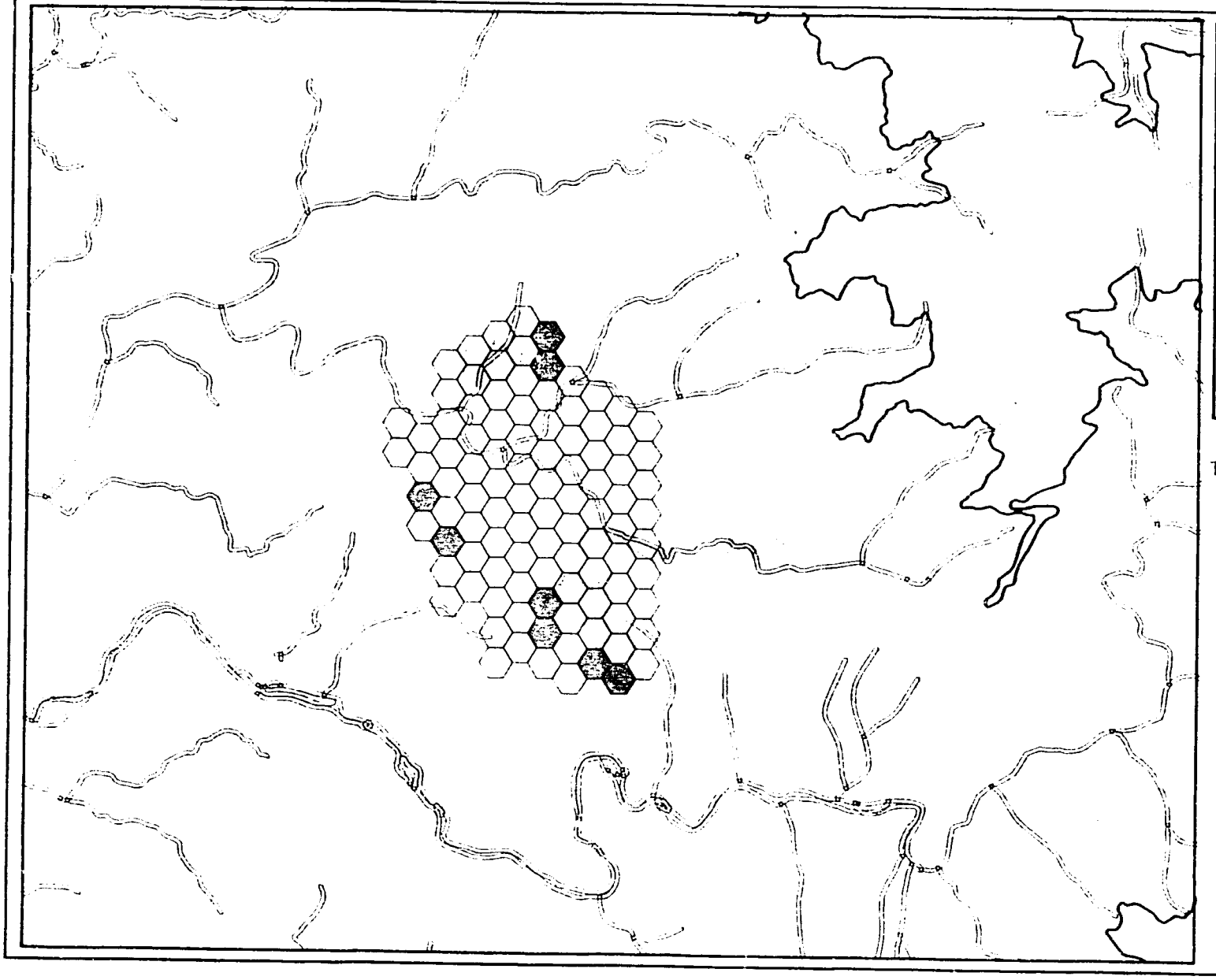
Total Volumes for 60+cms. :
98.7 cubic meters

Kilometers
0 0.5 1 1.5 2 2.5

FIGURE 10B

MARKETABLE VOLUMES FOR HARDWOODS

REGION II MODEL : ISABELA



LEGEND :

- 45+cms–DBH
- FIXED INVENTORY SITE
- RIVER BUFFERS
- SLOPE 50% UP
- ELEVATION 1000m

Total Volumes for 45+cms :
855.5 cubic meters

N

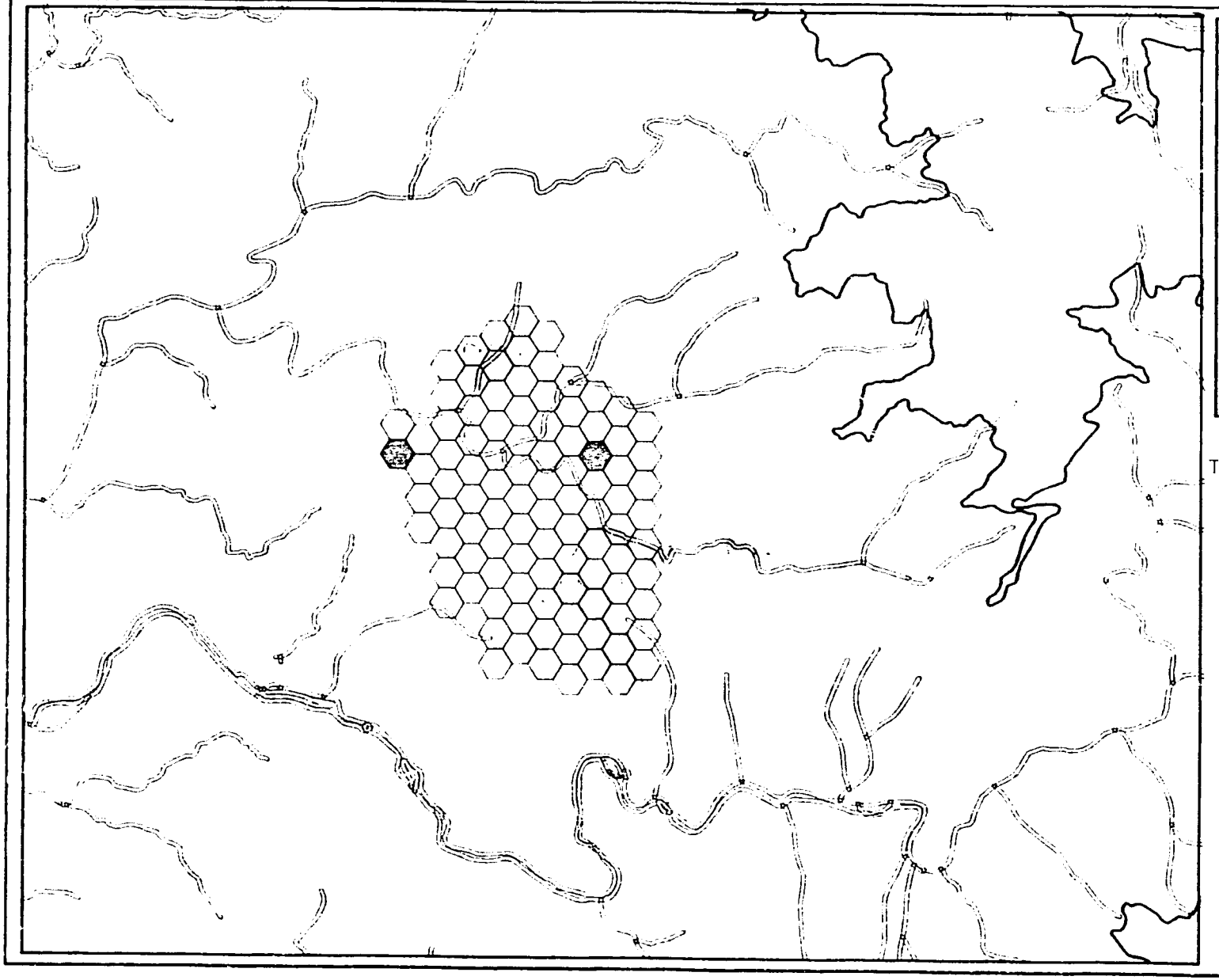
Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 11A

MARKETABLE VOLUMES FOR CONSTRUCTION WOODS

REGION II MODEL : ISABELA



LEGEND :

- 60 +cms.–DBH
- FIXED INVENTORY SITE
- RIVER BUFFERS
- SLOPE 50% UP
- ELEVATION 1000m

Total Volumes for 60+cms. :
118.7 cubic meters

N

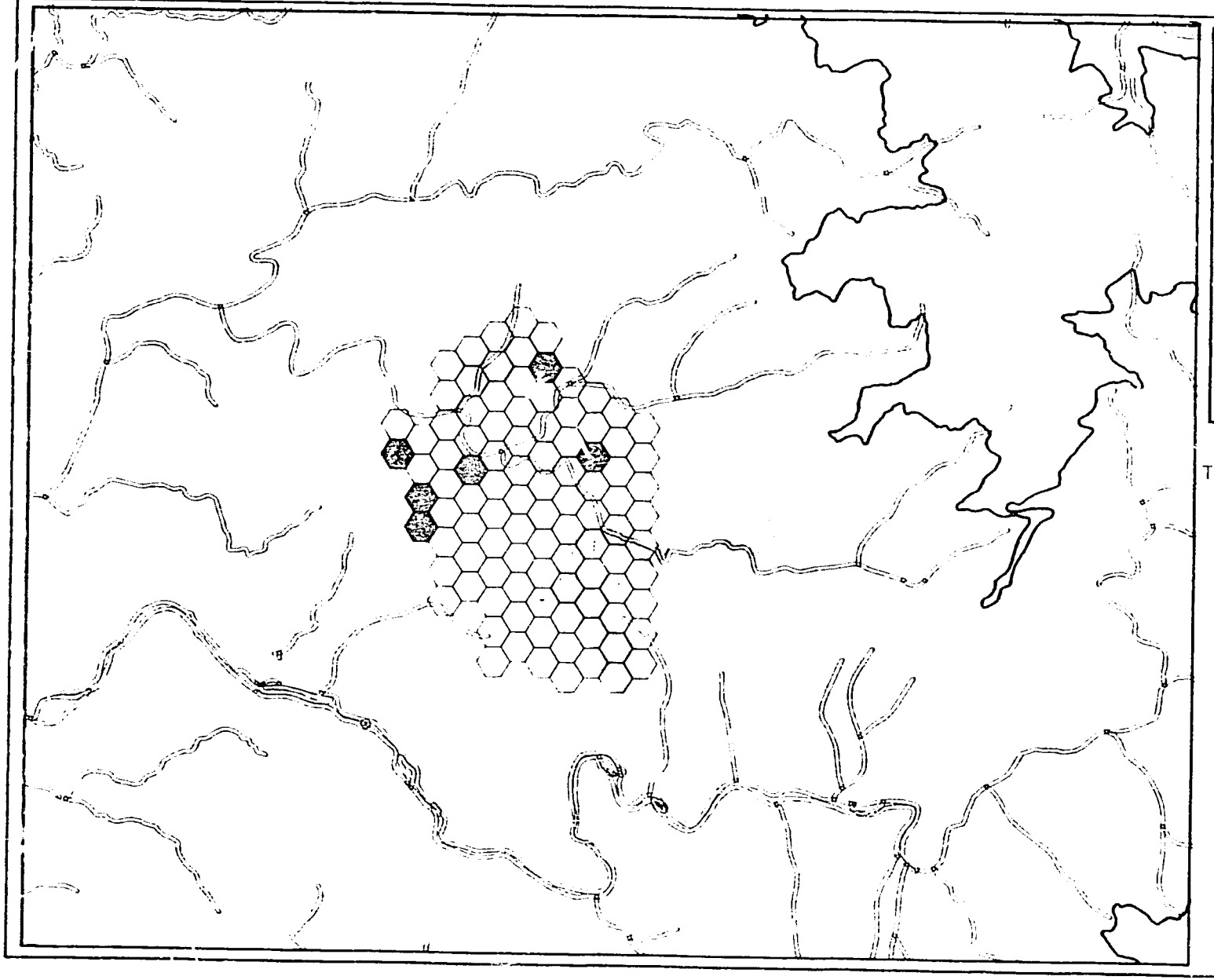
Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 11B

MARKETABLE VOLUMES FOR CONSTRUCTION WOODS

REGION II MODEL : ISABELA



LEGEND :

- 45+cms–DBH
- FIXED INVENTORY SITE
- RIVER BUFFERS
- SLOPE 50% UP
- ELEVATION 1000m

Total Volumes for 45+cms. :
432.3 cubic meters

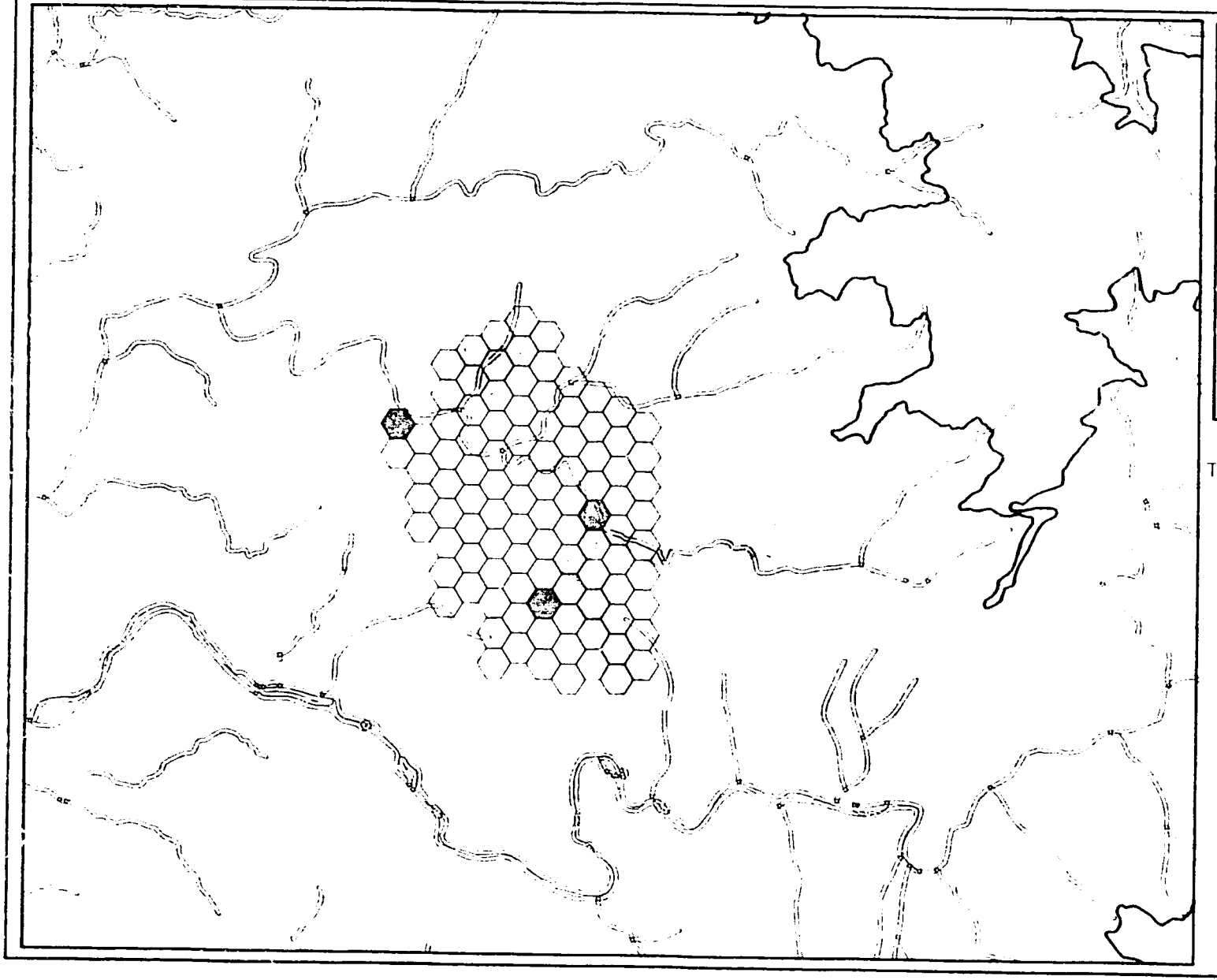
Kilometers

0 0.5 1 1.5 2 2.5

FIGURE 12A

MARKETABLE VOLUMES FOR OTHER WOODS

REGION II MODEL : ISABELA



LEGEND :

- 60+cms--DBH
- FIXEDINVENTORY SITE
- RIVER BUFFERS
- SLOPE 50% UP
- ELEVATION 1000m

Total Volumes for 60+cms. :
344.2 cubic meters

Kilometers
0 0.5 1 1.5 2 2.5

FIGURE 12B

MARKETABLE VOLUMES FOR OTHER WOODS

REGION II MODEL : ISABELA

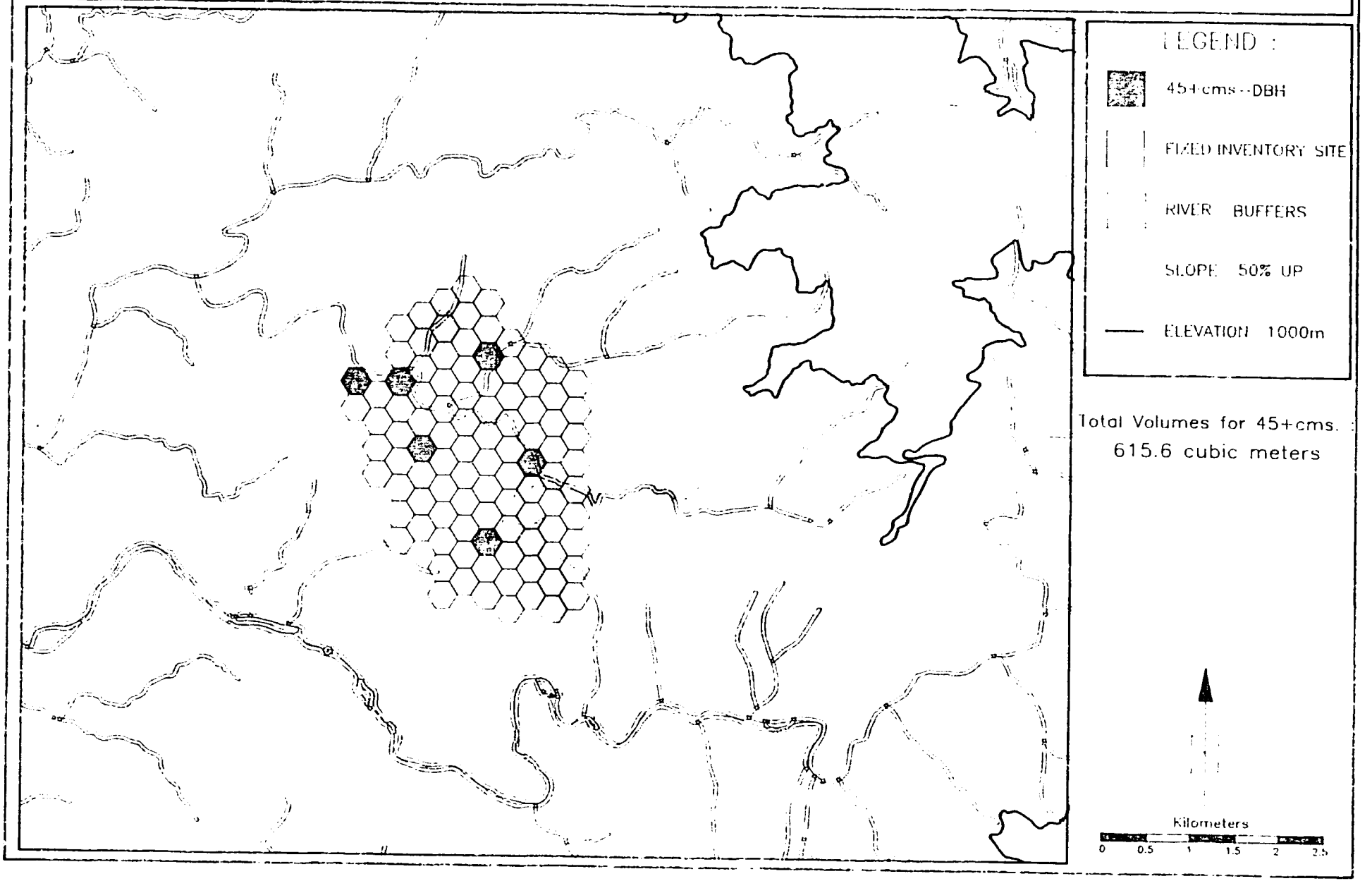


FIGURE 13

REGION II MODEL : ISABELA

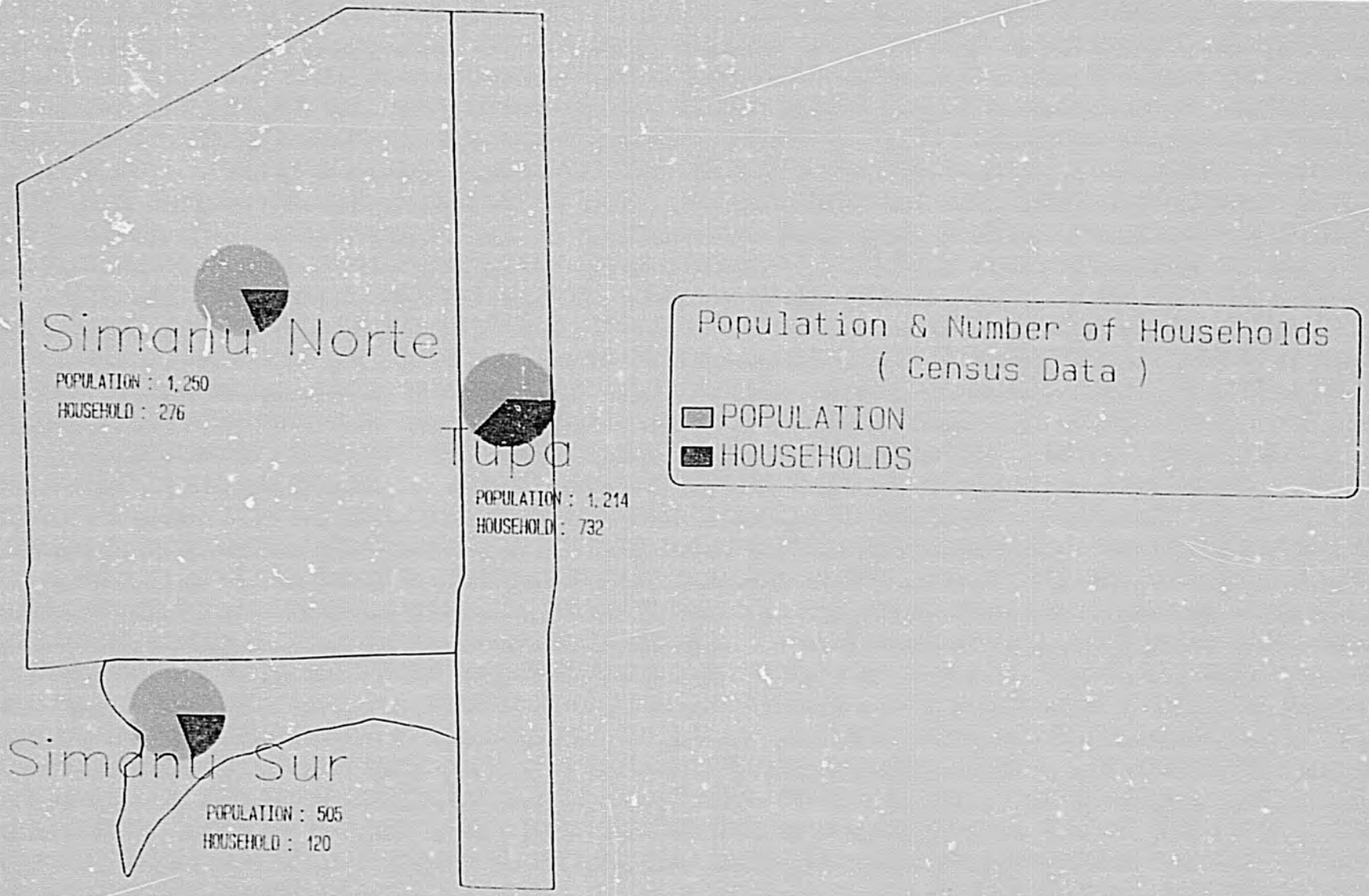


FIGURE 14

REGION II MODEL : ISABELA

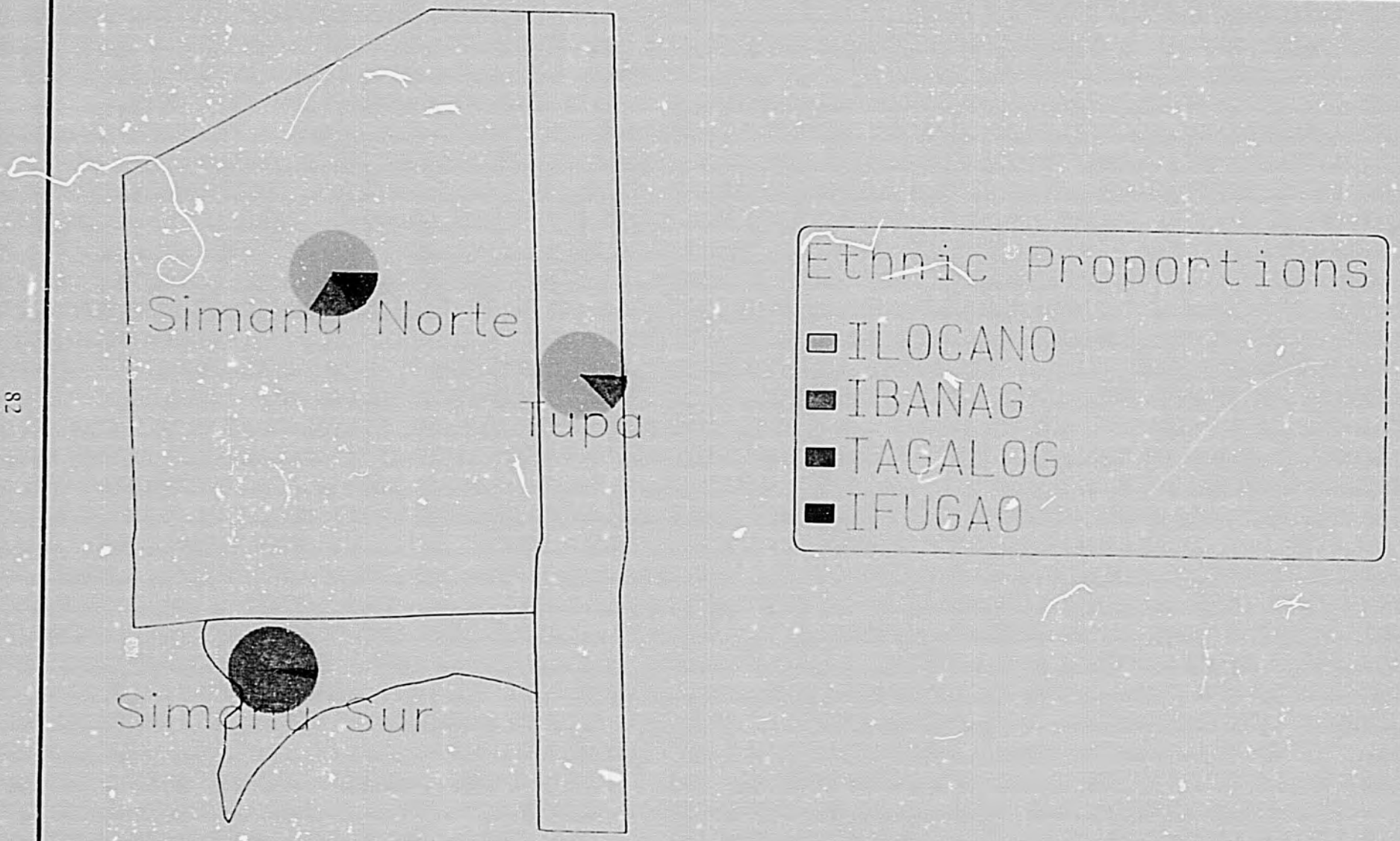
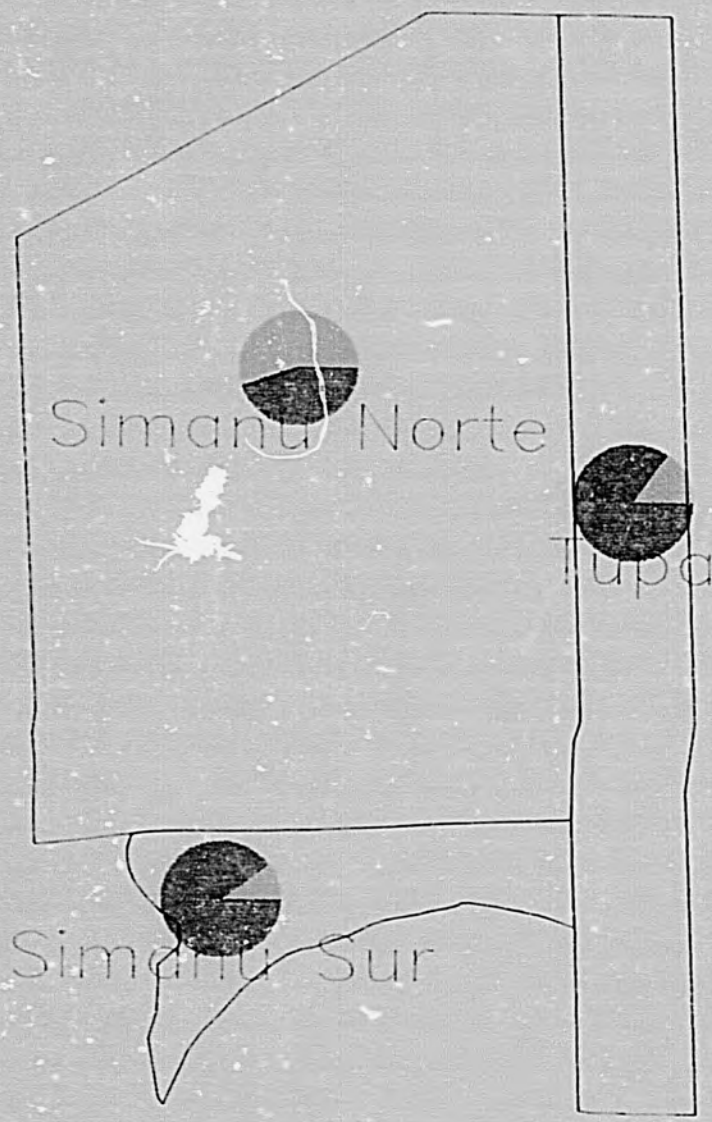


FIGURE 15

REGION II MODEL : ISABELA



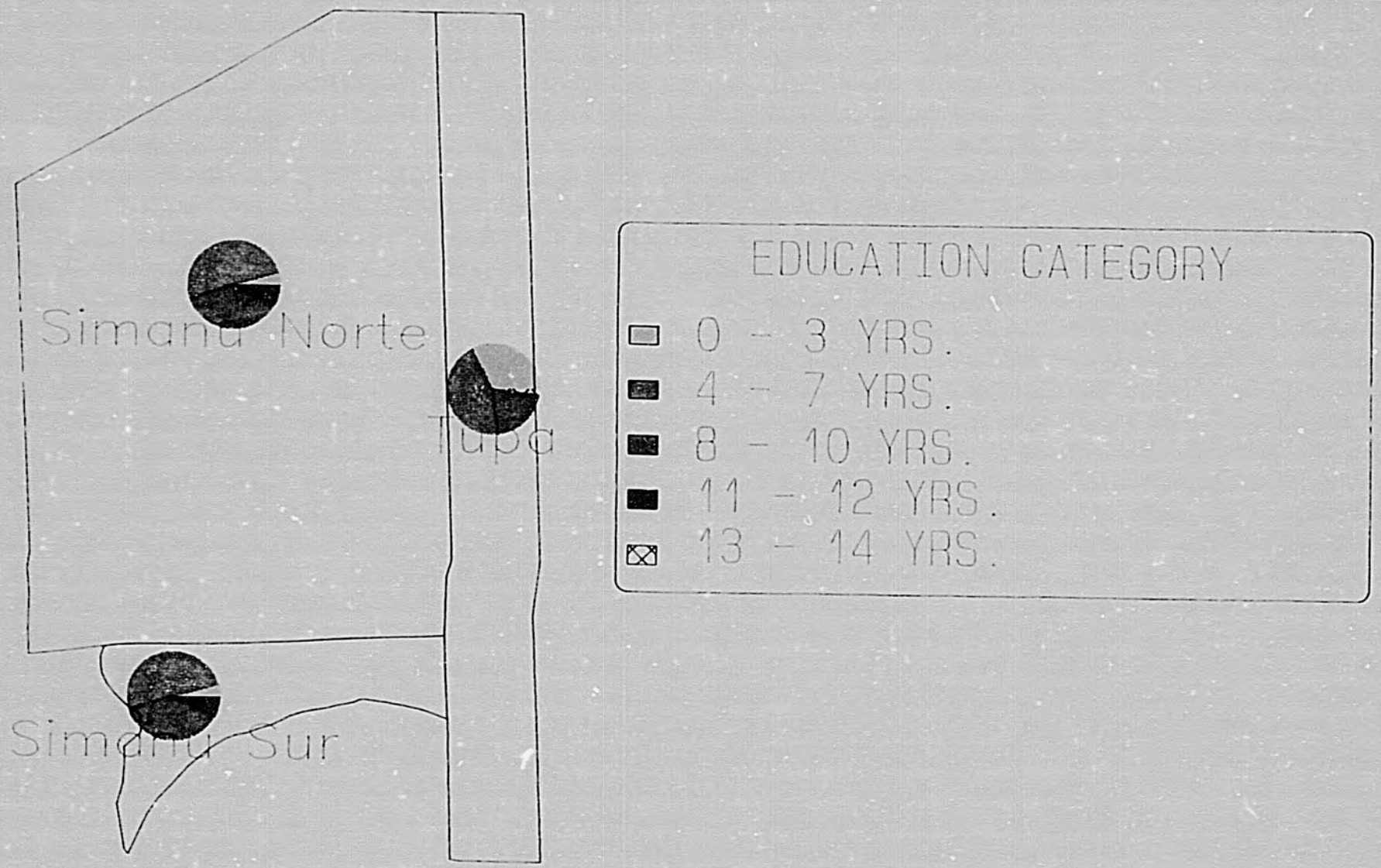
PERCENTAGE OF MIGRANTS

< 20 YRS. MIGRANT

> 20 YRS. NON-MIGRANT

FIGURE 16

REGION II MODEL : ISABELA



Land Tenure Perceptions	Community forest project organization, "political" difficulties
Figure 18/18a: Kaingin Income	Economic dependence on forest, community forest project organization, livelihood and income comparisons between spatially differentiated groups
Figure 19/19a: Forest Product Income	Economic dependence on forest, community forest project organization, type of commodities taken from the forest, livelihood and income comparisons between spatially differentiated groups
Figure 20: Labor Income	Economic dependence of forest based labor, livelihood and income comparisons between spatially differentiated groups, potential labor pools

Demographic, social, and economic information are important to understand the human characteristics and behaviors of communities near the forest so that a management plan suitable to these characteristics can be devised. Non-spatial statistical methods (like the pie charts) can help us understand a great deal: to what degree do people in the communities depend on forest products and kaingin, what ethnic groups are characterized by particular livelihood patterns, what are the education levels of people who practice kaingin versus those who collect forest products, how many migrants are there and to what ethnic group do they belong?

This type of information is also important because it helps devise the means to implement plans. If, for example, large numbers of people currently depend on kaingin agriculture, some agro-forestry methods will be required to accomplish the objectives of reforestation, as well as to replace income. Similarly, inhabitants who depend heavily on forest products will need guidance in choosing where to harvest and acceptable methods. Community forestry projects will depend on social factors such as skill levels and traditional practices. If an area is inhabited largely by migrants from the lowlands, extension services may be needed to train them in sound forest management.

Standard statistical analysis provides information on the characteristics of the people who will be affected by resource management plans. But it does not reveal anything about their spatial relationships to each other or to the forest. Spatial analysis adds the "where" to the exercise. The data from the three Isabela barangays, for example, indicates statistically that there may be a relationship between ethnicity and dependence on kaingin agriculture and forest products: the indigenous Ibanag practice no kaingin, while the Ilocano ethnic group earn most of the kaingin-related income. A spatial view of these two groups indicates that the areas of the forest closest

FIGURE 17

REGION II MODEL : ISABELA

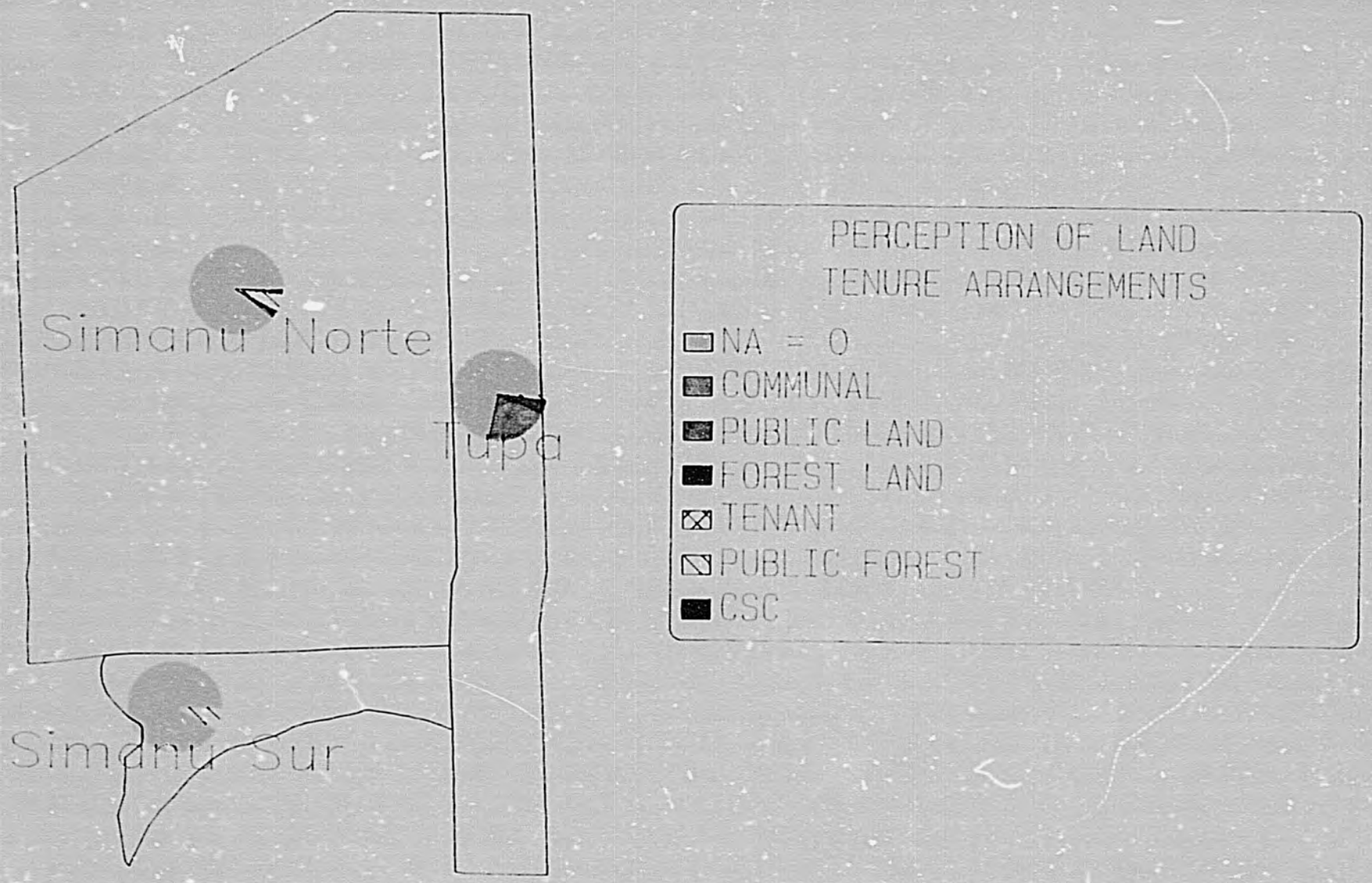


FIGURE 18

REGION II MODEL : ISABELA

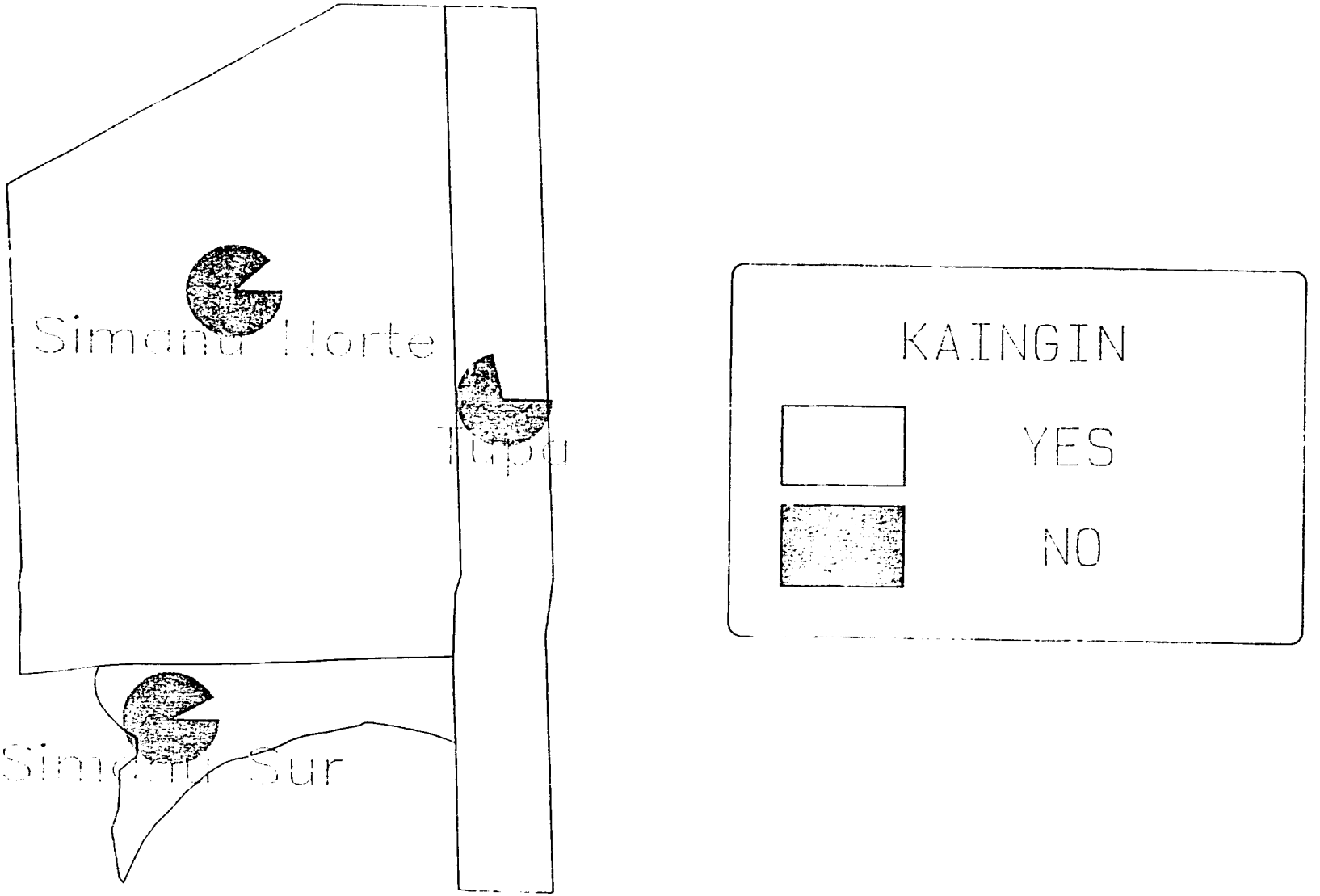


FIGURE 18A

REGION II MODEL : ISABELA

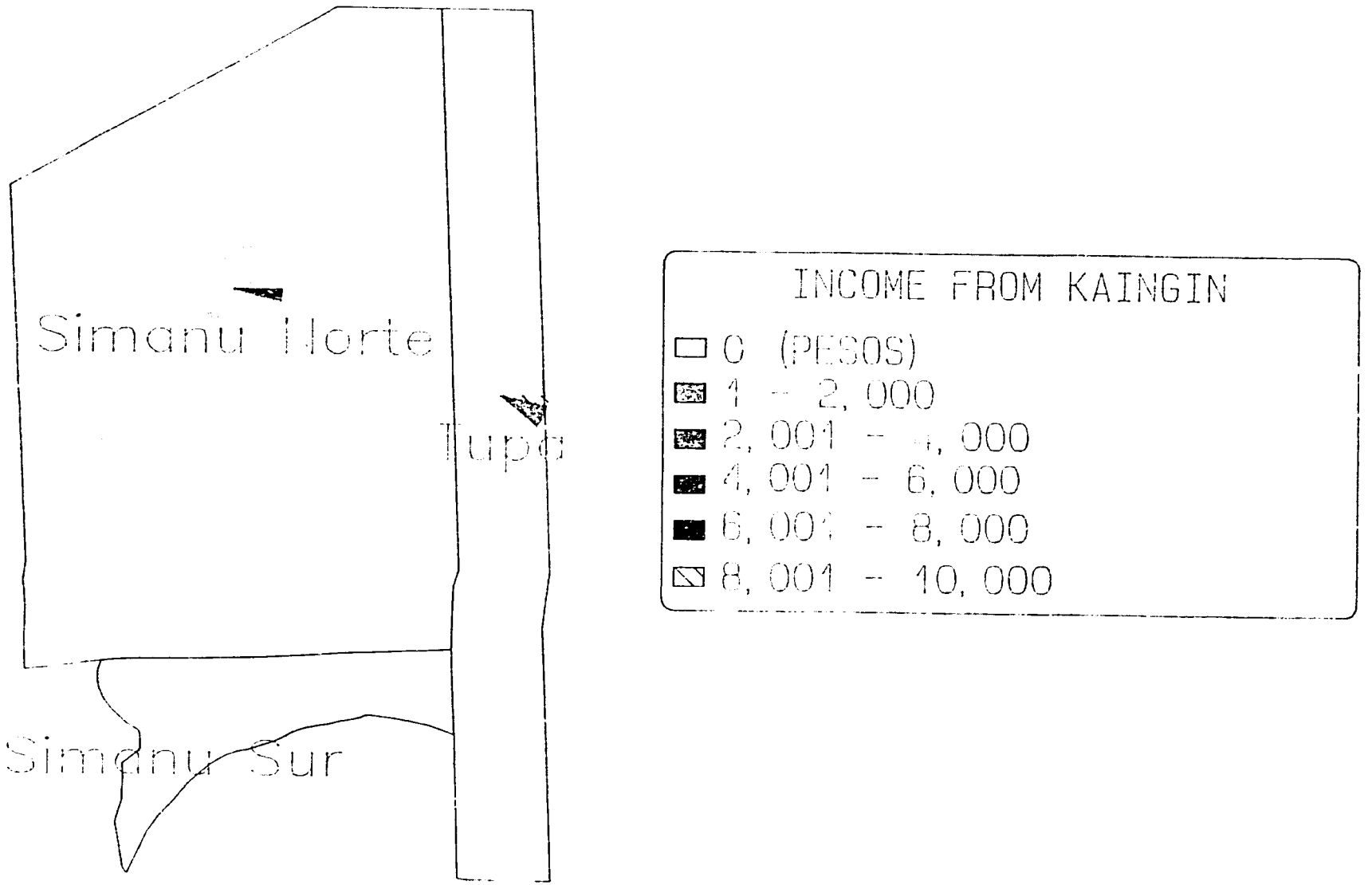


FIGURE 19

REGION II MODEL : ISABELA

FIGURE 19A

REGION II MODEL : ISABELA

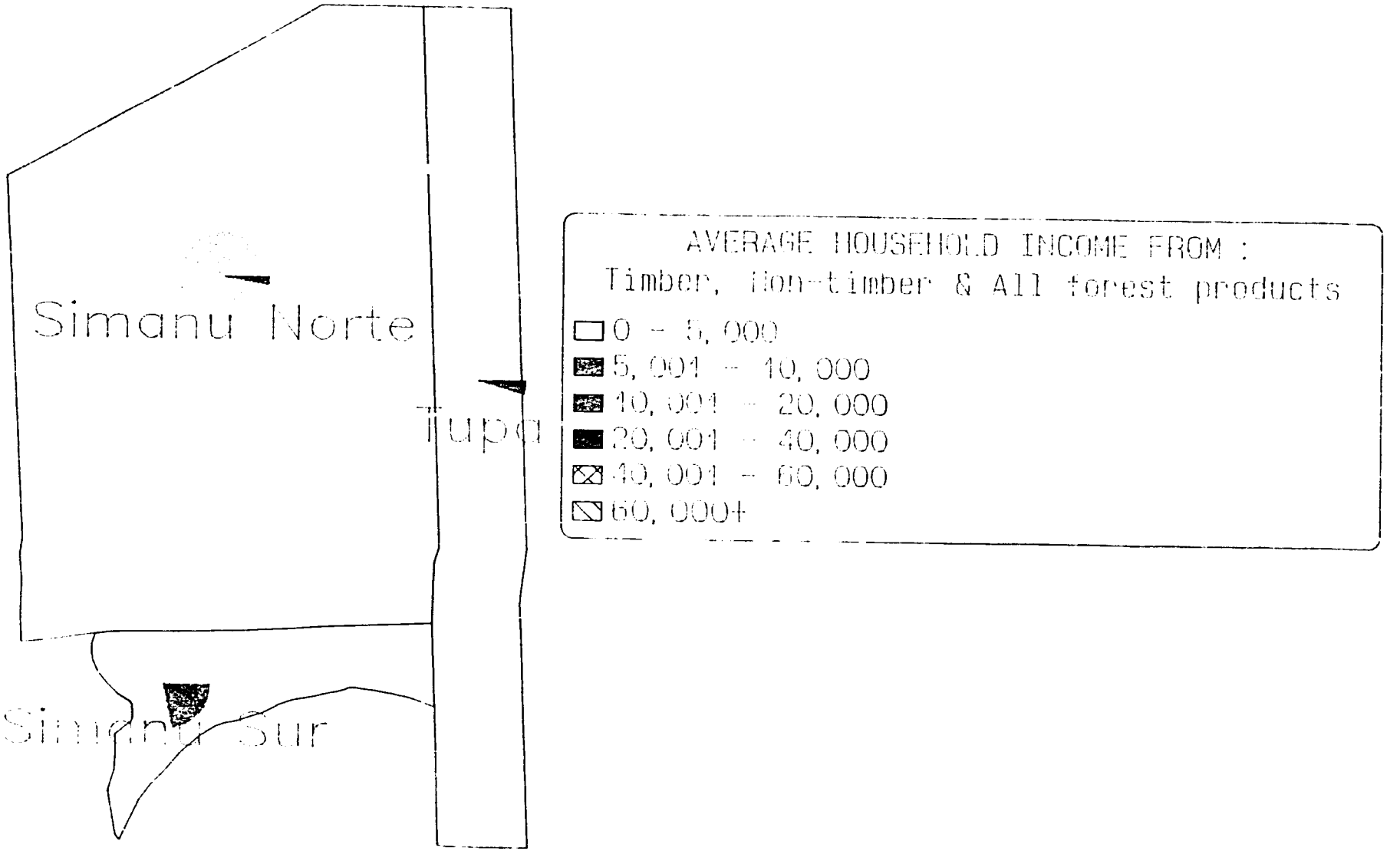
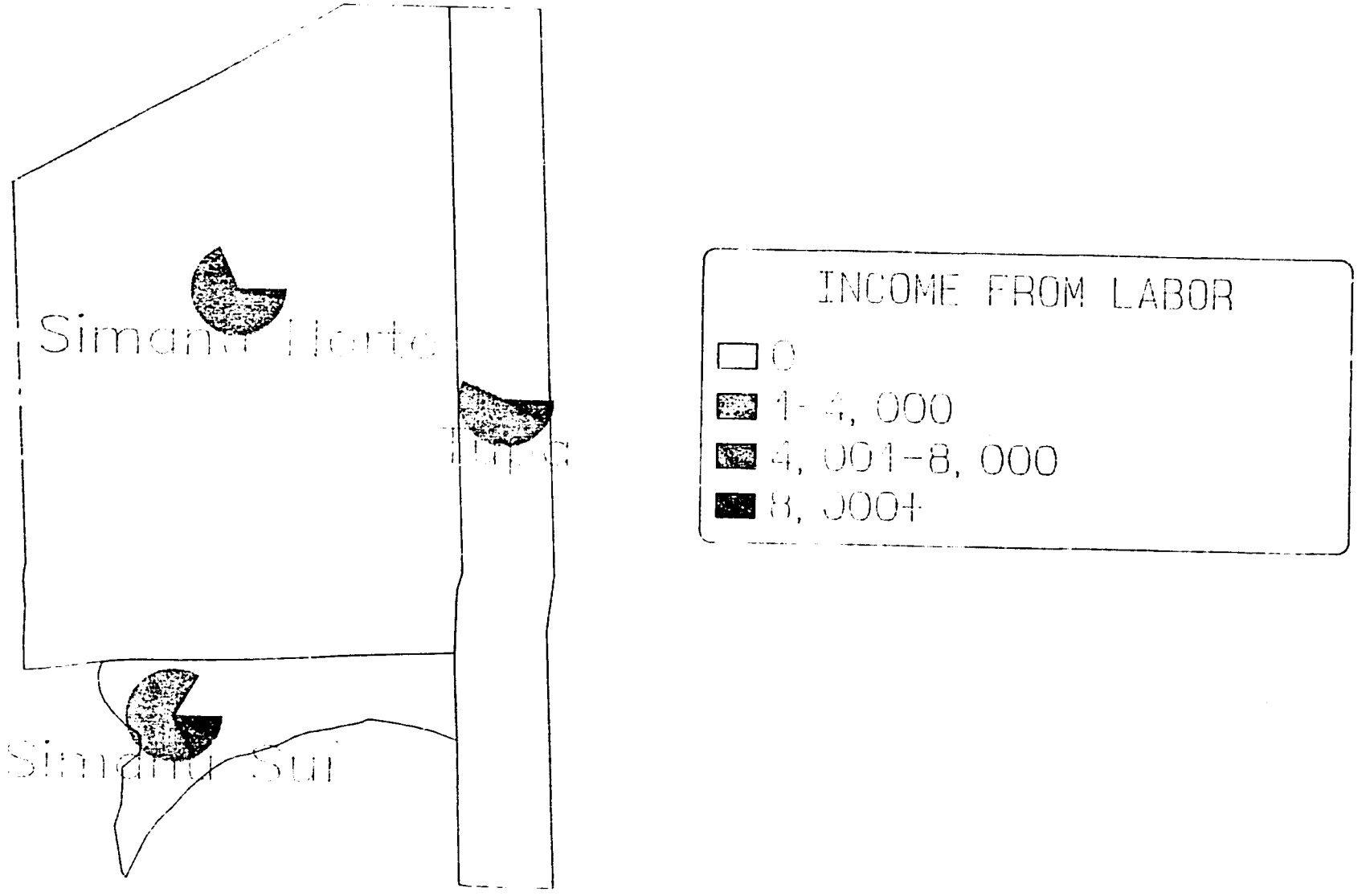


FIGURE 20

REGION II MODEL : ISABELA



to Simanu Sur are largely inhabited by Ibanag peoples and have almost no kaingin areas. In contrast, the Ilocano constitute the largest population in the two barangays located near most of the kaingin areas (Simanu Norte and Tupa).

This kind of spatial analysis, however, will require more geographic specificity than our current data permit. For example, we are probably safe in concluding that there is a relationship between ethnicity and livelihood practices. And we can conclude that there is a relationship between settlement location and ethnicity and between kaingin and settlement location. But location information at the barangay level is insufficient to take this analysis further, e.g., to evaluate income sources of different ethnic groups within a settlement.

In addition, information on how the people in the communities in general, as well as individual groups, manage their space will be important for predicting the success of alternative resource management options. We know that spatial behavior varies a great deal from place to place. Indigenous cultural communities, for example, often have special income "niches." In-migration of outsiders may cause competition for available resources. Management plans will have to consider the potential for competition, as well as entrenched practices that will not be easy to change. A sound plan must weigh alternative management options based on physical and biological criteria against available resources, traditional ways of managing these resources, and the ways people relate to each other in an area. The ways people manage their space can reveal a great deal about their needs and how they will respond to resource management options.

II. RECOMMENDATIONS

The following discussion contains recommendations for strengthening the spatial aspect of data collection, as well as some general guidelines for the collection of residual forest inventory data. The expanded NRMP forest inventories will include these changes in data collection and management. These recommendations are given in three sections:

- Recommendations for collection of bio-physical data;
- Recommendations for collection of social and economic data;
- Recommendations for development of an automated spatial information database and outputs for the inventory in Quirino (Region 2) and introduction of a manual system for the inventory in New Bataan (Region 11).

A. Biological Data

The inventory teams should use a pre-formatted grid to enter the measurement data. The grid should be based on a 1:10,000 base map. Each grid cell will represent a sampling unit. Ideally,

the teams would use GPSs to record the coordinates at the perimeters of the inventory site and frequently throughout the data collection area. In the event GPSs cannot be used, a grid can be devised for each area by registering it at regular intervals with the base map and by using the monument system upgraded by NRMDP.

Reliable resource management plans depend on comparable data across the inventory sites. Thus, only one method of biological inventorying should be used for all of the inventory sites. The current mix of three methods results in data with different frequencies and intervals. These data are difficult to analyze both spatially and statistically. Unless a very complex analytical process is used, the data from the different inventory methods must be analyzed separately and the results will not be comparable. Since the pilot phase established the fixed method as the most cost-effective method of resource inventorying, it should be used throughout the testing phase.

Using a single, standard inventory method for all sites will not only simplify data comparison but will also reduce the complexity of data management and interpretation. The current configurations for the GIS and computerized databases were developed for the fixed area inventory method. To introduce another inventory method will require reconfiguration of and training DENR personnel in all the relevant computer programs. Such an increase in the level of effort and the complexity of data management will reduce the likelihood of DENR accepting and institutionalizing these new approaches.

Flora and fauna can be significant sources of income, especially in areas where commercial timber cutting is not a viable option. More attention should be paid to the collection of data on flora and fauna. Separate grid sheets could be used to record occurrences. In addition, a number of other issues related to flora and fauna need to be addressed: market values and return rates, inputs needed for marketing, labor demand, market demand, and sustainability levels.

Habitat assessments should be done for areas identified by the inventory as being rich in flora and fauna (especially wildlife). Annex C suggests ways habitat assessments can contribute to natural resources management.

B. Social, Economic, and Demographic Data

Ideally, concrete guidelines for social and economic data should be used to evaluate management options in the same way physical and biological criteria are applied. For example: if more than 60 percent of the people depend for more than 50 percent of their income on wood products, an agro-forestry management plan would be adopted. But the uses of social and economic data for resource management planning are not yet well understood in the Philippine context. We have identified basic kinds of data on the human characteristics of communities that are useful for resource management planning.

Surveys in the expanded residual forest inventories will collect data in formats suitable for spatial analysis. As the process evolves, additional data and analytical processes will be developed. The following recommendations for social and economic data collection are arranged in two categories: steps for spatial data collection and general recommendations to improve data collection.

1. Spatial Data Collection Steps

Information on the social and economic characteristics of communities and their spatial arrangements within communities assist in developing appropriate survey instruments and choosing representative samples. A preliminary assessment of a community will show the topics to be stressed in the interview process, sample sizes relative to the spatial arrangements in the community, and the need to do additional interviews (e.g., primary processor). Data collection, therefore, should be an iterative process, beginning with a preliminary analysis of the community.

The following steps are recommended for social and economic data collection:

Step 1: NRMP staff will train the FSO in barangay identification and data collection methods.

Step 2: The FSO will identify the barangays dependent on the residual forest site.

Step 3: The FSO will prepare sketch maps of each barangay, using the barangay boundary map as a guide to show spatial relationships between the barangays and between the barangays and the residual inventory site. Information for the sketch maps can be gathered through observation and short interviews with key informants. The maps should give a general picture of the community by showing distributions of dwellings with characteristics (e.g., ethnicity, livelihood practices), bodies of water, roads, settled agriculture outside the forest, and facilities such as utilities, schools, clinics, and government buildings.

Step 4: NRMP and the FSO will evaluate the preliminary analysis and sketch map to customize the interview and identify the sampling sizes and locations to be used in each barangay. NRMP will provide additional training indicated by the preliminary process.

Step 5: The FSO will return to the barangay to implement the remainder of the interview process. The FSO will also prepare two additional maps during the interviews. One map will add details to the preliminary barangay map, including the location of respondents. The second map will be an income source map for each barangay showing where respondents gather products, cultivate, or do forest-related work. These maps should also show land claims. These locations should be plotted on

the same kind of base map (with grid) used for the biological data. Each feature should be associated with the appropriate respondent(s) in the barangay survey.

The sketch maps will be digitized. An attribute database to associate social and economic information with map locations will be developed.

2. General Recommendations for Survey Methods

a. There are currently two major criteria for identifying target communities: a stable peace and order situation and significant reliance on forest products. An operational definition of "significant reliance" needs to be devised. For example, do more than 60 percent of inhabitants depend on forest products for the majority of their income?

b. Spatial analysis requires a geographically-based sampling technique. For previous interviews, names were drawn. A better approach is to select the head of household from every x number of dwellings. As indicated above, the actual sampling technique may change for a given settlement. A good sample collects information from a representative sample of the population and sub-populations. A sub-population might be a cluster of dwellings inhabited by one ethnic group. The technique should be based on the spatial distribution and intensity of different groups within the settlement. Once the data collection teams have completed the preliminary assessment of the community and prepared a sketch map, they will be able to identify the appropriate sampling distribution and intensities.

c. The survey instrument should be simplified.[17] Respondents often are tired of being interviewed and the FSO staff may not be highly skilled interviewers. Consequently, only the most critical questions should be asked. For example, we probably do not need to know where schools are located, whether or not children attend school, or why they do not attend school. The original instrument has been simplified. It will be tested in the next inventory to determine whether additional simplification is required.

d. Survey questions should be closed-ended and responses pre-aggregated, where appropriate. For example, we do not need to know exactly how many years of education a respondent has finished. We need to decide, rather, what levels of education will affect natural resources management. An individual with a college degree will have very different skills than an individual with three years of primary school. Responses can be aggregated into groups. Both the interviewer and the data entry person will save time, as well as provide more useful information, by using pre-aggregated responses.

[17]The survey instrument now being used in the Region 2 training is a simplified version of the original. In the new version of the questionnaire, many questions have been rephrased to elicit more reliable responses.

Space for "other" information and comments should be provided only where absolutely necessary. In most cases, "other" information is not useful because frequencies are too small. In addition, comments entered into databases rarely are assessed.

e. Operational definitions should be devised for terms used in the interviews. The definitions should be based on how the information will assist in the management plan to assure that the questions elicit the appropriate response. For example, the previous interview schedule defined anyone who moved to the barangay at any time a migrant. Migrant status is important to understand issues such as skill levels, perceptions of land use, and acceptability of other inhabitants. Consequently, a person who moved only a short distance from his original home or who moved to a barangay 40 years ago, probably does not constitute a migrant. The new instrument defines a migrant as someone who relocated from outside the barangay within the last ten years.

f. In order to evaluate dependence on the forest for income, more attention needs to be paid to overall sources of income. The current questionnaire only looks at income from forest products, kaingin agriculture, and labor. The survey should identify all sources and related income for each household.

g. Attitudinal and perception of needs interviews should be done separately from the basic interview. The FSOs should hire skilled staff to do these interviews. The staff should have experience in participatory rural appraisal techniques. This approach will both simplify the main interview and result in more accurate information on attitudes and perceptions.

h. Each data collection team should have a team leader who conducts frequent debriefing sessions. The standard approach involves a trial interview period of five or six interviews, a debriefing session to identify misunderstandings or improper recording of data, and a resumption of interviews. Subsequent debriefing should follow no more than two days of interviews.

i. The teams should be provided with standard units of measure and product values (see flora/fauna above). They should re-record data from each interview onto a clean interview sheet after each day's interviews. At this time, they can change reported units to the standard units. In addition, daily reviews of interviews will reveal unclear information needing clarification.

j. A standard method for analysis of data should be institutionalized. The present trend is either to ignore the data completely or to attempt statistical analyses inappropriate to the nature of the data. The standard methods should focus on the spatial analysis techniques used in this model (done either manually or with a simple automated system), supplemented by qualitative and simple quantitative assessments of socio-economic data.

C. Expanded Spatial Information Model

The model spatial database developed for the NRMP resource management plans represents an excellent opportunity to demonstrate the usefulness of spatial planning methods. We recommend that NRMP continue to refine the automated process by developing a spatial information database and outputs for the Quirino (Region 2) resource management plan and introduce manual spatial information management methods to support preparation of the New Bataan (Region 11) plan. The work should be a joint effort of the DENR planning offices (central, regional, and provincial), FMB, NRMP, and the FSOs. DENR counterparts should be assigned to work with the NRMP and FSO staff.

The expansion phase will serve several purposes, including opportunities to:

- Demonstrate to DENR decision makers and planners the usefulness of the spatial approach;
- Initiate spatial information management and user training;
- Further identify the data and specific spatial applications useful for resource management;
- Generate a better understanding of the ways data collection and management support planning;
- Set a precedent for data collection and management standards.

The FSOs will be required to produce a standard set of outputs following the model outputs developed for the Isabela and Samar plans. They will work with their DENR and NRMP counterparts to identify other useful applications and to prepare a management plan that reflects the use of the outputs in choosing suitable management options.

The existing GIS unit at the Region 2 DENR planning office can assist in developing the automated database and outputs. We recommend that both Arc/Info and ATLAS GIS be used to develop the database. Arc/Info can be used for digitizing and complex analyses. This software, however, has a steep learning curve. Consequently, an analogous database in ATLAS GIS should be created to permit the NRMP and FSO staff to manipulate the data. ATLAS GIS support is available in Manila on a contract basis.

A course in the principles of spatial information management and manual overlay techniques is already planned by DENR for regional and provincial planning staff in Region 11. Ms Yolanda Gomez, who participated in preparation of this report, and Mr. Ralph Pablo, who is the supervisor of the GIS unit in Region 2, will be the instructors. They will work with NRMP to develop a course outline that follows the process used for the Region 8 plan.

ANNEX E. TRAINING RECOMMENDATIONS

The training processes described below are intended to be illustrative. A detailed training scheme can be structured once an assessment of skills is completed.

A. User Training

Policy Group	One-day seminar (every three months) on the principles of spatial data management for planning (Manila)
Central User Group	Two to three-day seminar and workshop (every three months) on the principles and use of spatial data management for planning (Manila). Workshops should use real spatial data outputs in an actual planning exercise.
Field User Groups	Two-day seminars and workshops (every three months) on the principles and use of spatial data management for planning (regional DENR office). Workshops should use real spatial data outputs from the region in an actual planning exercise.
Data Analysts	One-day introduction to spatial management principles at the beginning of a spatial data analysis course.
Data Collection Units	One-day introduction to spatial data management principles at the beginning of a data collection methods course.

B. Analyst and Technician Training

1. Topics

Both analysts and technicians will need expertise in the following subjects:

- Introduction to the principles of spatial analysis;
- Cartographic methods (cartographic and automated);
- Data verification and preparation;
- Spatial data entry (map digitization methods);
- Hardware and software configuration;

- Database design;
- Software use and analytical methods.[18]

Analysts will need to develop additional skills to carry out their work. These include:

- Spatial data analytical techniques;
- Aerial photograph interpretation;
- Applications development;
- Output design and utilization (data reporting).

2. Process

Acquisition of these skills will require a combination of formal coursework and on-the-job training. Formal training allows the trainees to focus on difficult concepts such as the principles of spatial analysis and spatial applications development. On-the-job training is important because the trainees are able to work with the actual data and the common methods they will be expected to use in the course of their work.

In addition, manuals containing step-by-step spatial information procedures for a basic set of applications should be developed for the technicians and analysts at each level (DENR central, regional, and provincial SIUs).

The following initial training processes should be followed by an assessment of skill acquisition. Subsequent training should focus on weak areas. Schedules for initial formal courses include the following:

Analysts: 2-week course

Technicians: 2-week course

On-the-job training should occur only when actual data are available and the initial formal coursework has been completed. An interval of approximately one month after formal training is suggested to allow staff to identify the functions for which they most need additional training. The subsequent on-the-job training should focus on weaknesses by building databases and

[18]A spatial information system requires the use of various kinds of software: special spatial information software, database management packages, statistical analysis packages. See Annex G (budget) for details on recommended software combinations.

developing and outputting real applications for planning. A recommended on-the-job training process would include the following activities.

DENR central SIU staff should work for approximately three weeks, under the direction of a spatial information applications specialist and a technical specialist, to develop a database and a set of basic applications and outputs for use in national level resource management planning. Finalization of these outputs should be undertaken during the second sessions of seminars/workshops for users (planners and decision makers) at the national level.

SIU regional and provincial staff should work together for approximately three weeks, under the direction of a spatial information applications specialist and a technical specialist, to develop a database and a set of basic applications and outputs for use in the provincial- and regional-level resource management plan.[19] These outputs should be used during the second sessions of seminars/workshops held for users at the regional and provincial levels.

Region 11 spatial information staff, under the direction of a spatial information specialist, should participate in a one week on-the-job training focusing on the preparation and use of manual map overlays for planning. These maps can be prepared from existing data. The overlays should be used as instructional materials in the regional user seminar on spatial data for planning. Participation in this seminar by PENRO planning officers should be encouraged.

All coursework and on-the-job training should be reviewed after a period of approximately six months. Weaknesses should be evaluated and formal courses, workshops/seminars, or on-the-job training sessions should be given to upgrade skills.

C. Data Collection Training

All staff involved in data collection should receive training in the following:

- Introduction to the principles of spatial analysis;
- Cartographic methods (including overlay processes);
- Preparation of inventory and survey instruments;
- Sampling techniques;
- Use of GPSs;

[19]DENR has authorized a training on the principles of spatial information management, map reading, and the manual overlay process. The training will be given by Ms Yolanda Gomez of PPSO and Mr. Ralph Pablo of the Region 2 planning unit. Mr. Pablo was trained in spatial information management under NRMDP. The training will begin this summer and will focus first on Region 11 regional and provincial planning staff.

- Ground truth collection;
- Data registration methods;
- Units of measure;
- Self and group debriefing methods;
- Data verification;
- Interview techniques (e.g., key informant, group, individual).

We recommend that a two-week training workshop be held at the regional office. An assessment of skills in each of the areas should follow the introductory seminar. Trainees should be divided into groups based on skill levels. Subsequent sessions can target the weaknesses of each group. We strongly recommend that training include role playing for socio-economic surveys and field training for bio-physical data collection (including the use of GPSs).

Certain types of data may require skills beyond those that can be developed among existing staff. Assessments of the needs of communities, for example, are best accomplished using sophisticated participatory appraisal techniques. Dependence of communities on forests and agricultural products is bes assessed by economists. We recommend that NGOs/PVOs (e.g., the FSOs) who can demonstrate expertise, as well as univeristy faculty or graduate students, be contracted to collect these kind of data.

ANNEX F. MILESTONES AND ILLUSTRATIVE WORK PLAN FOR A REGION

Milestones	Measurable Indicators	YEAR 1												YEAR 2											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
INSTITUTIONAL MECHANISM ESTABLISHED	1. Memo Circular and Special Order to all units	--																							
	2. Policy group established		--																						
	3. User group established		--																						
	4. Budgets prepared		----																						
	5. Budgets approved			--																					
	6. SIS * staff approved (PPSO, NAMRIA, REDs 2 & 11, PENRO 2)			--	--																				
	7. Inter-group working mechanism established		--																						
SYSTEM OPERATIONAL	1. Workspace acquired (PPSO, NAMRIA, REDs, PENRO2)				----																				
	2. Hardware and software selected				--																				
	3. Hardware and software acquired				--	--																			
	4. Hardware and software installed/configured					--																			

ANNEX F. MILESTONES AND ILLUSTRATIVE WORK PLAN FOR A REGION

Milestones	Measurable Indicators	YEAR 1												YEAR 2											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
STAFF TRAINED	1. User training																								
	- Policy Group (1day- 3mos.)			-			-			-			-			-			-			-			-
	- Central Office- User Group (2 days-3mos.)			-			-			-			-			-			-			-			-
	- Field User Group (2 days-3 mos.)			-			-			-			-			-			-			-			-
	2. Data Mgt. Staff																								
	- Skills assessment				--																				
	- Trained (PPSO, NAMRIA, RENRO2) (1 wk)					--																			
	- Untrained (PPSO, NAMRIA, RENRO2) (2 wks)				--	--	--	--																	
	- Manuals completed													--											
	3. Technicians (PPSO,NAMRIA, RENRO2, PENRO2) (x 2 wks course followed by 3 wks later)						--	-	--																
	4. Manuals completed										-														
	5. Training Review (x 6 mos. after conduct of training)																								

ANNEX F. MILESTONES AND ILLUSTRATIVE WORK PLAN FOR A REGION

Milestones	Measurable Indicators	YEAR 1												YEAR 2											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
DATA PRIORITIES IDENTIFIED	1. Date assessment				----																				
	2. Data priority list developed																								
	- Initial				----																				
	- Reassessment									----				----					----						
	3. Collection mechanism identified/established				-	----																			
OUTPUT PRIORITIES IDENTIFIED	1. Priority outputs established																								
	- Initial						----	----																	
	- Reassessment											----			----					----					
DATA COLLECTION IMPLEMENTED	1. Memo of Agreement with LGU						--																		
	2. Data collection training/a						-	----		----		----		---											
	3. Manuals completed																		-						
	4. Land cover/b																								
	- Satellite image process/c							----	----	-															
	- Upgrade existing								----	----	----														

a Groups will be trained in specific data collection tecniques as required throughout the project.

b This illustrative list is based on land cover recommendations (Please see Annex C).

c Dependent on time of the year. Good quality (cloud-free) imagery can be collected only at certain times of the year

ANNEX F. MILESTONES AND ILLUSTRATIVE WORK PLAN FOR A REGION

Milestones	Measurable Indicators	YEAR 1												YEAR 2											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	5. Topography																								
	- Compile existing								--																
	- Upgrade									--	----	--													
	8. Climate (Existing)								--																
	9. Land-use																								
	- Existing								--																
	- Update									--	----	--	---												
	10. Infrastructure (Existing)								--																
	11. Administrative boundaries (Existing)																								
									--																
	12. Demography (Existing)								--																
	13. Social and economic (represesantative sample areas)						----	----		----		----			----										

ANNEX F. MILESTONES AND ILLUSTRATIVE WORK PLAN FOR A REGION

Milestones	Measurable Indicators	YEAR 1												YEAR 2											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	14. Residual forest inventories (represesantative sample areas)d						----	----	----																
DATABASE DEVELOPMENT	1. Data preparation						----	----	----	----	----	----	----	----	----										
	2. Data entry								--	----	----	----	----	----	----	----	----	----							
ANALYTICAL AGENDA: PRIORITY OUTPUTS PRODUCED5	1. Databases developed/e																								
	- Land use layers											----					----	----							
	-Other geographic layers (topography, soils, etc.)											----					----	----							
	- Attribute layers											--	----	--			----	----							

d This refers to NRMP additional sample areas.

e This illustrative list is based on recommended initial outputs. (Please see Annex C).

ANNEX F. MILESTONES AND ILLUSTRATIVE WORK PLAN FOR A REGION

Milestones	Measurable Indicators	YEAR 1												YEAR 2											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	2. Analyses (e.g. land use, timber cutting legal restrictions, forest, reforestation, tree suitability quantity/ quality, silvicultural methods assessment, change analysis, land management and community resource assessments, wildlife habitat assessments, flora/fauna income source assessments, infrastucture siting)																								

ANNEX G. INDICATIVE COSTS FOR HARDWARE, SOFTWARE, TRAINING AND TECHNICAL ASSISTANCE

I. HARDWARE

A. DENR Central Planning Office Spatial Information Unit

Item	Number	Unit Cost	Total
486-66 MHZ PC, with parallel ports, 330 MB hard drive, 5.25" & 3.5" disk drives, 2 serial ports, 16 MB RAM, Super VGA 1 MB video card, 80387-66 co-processor, color SVGA monitor	1	$6,000	$6,000
486-50 MHZ PC, with parallel ports, 300 MB hard drive, 5.25" & 3.5" disk drives, 8 MB RAM, SVGA 1 MB video card, 19" SVGA color monitor, 80387-50 co-processor	1	3,500	3,500
386-25 MHZ PC, 100 MB hard drive, 5.25" & 3.5" disk drives, 3 MB RAM	1	3,000	3,000
External Tape Device	1	1,500	1,500
Digitizing Tablet AO size, Cordless button cursor, electric pedestal	1	3,500	3,500
Digitizing Tablet (12"x18") Table Top model	1	800	800
Laser Printer	1	3,000	3,000
Plotter, AO size, 8 pen, 8 MB buffer, 256 Color Palette	1	15,000	15,000

Laser Printer, 5 MB RAM	1	3,500	3,500
Uninterruptable Power Supply, 2 kva	3	600	1,800
Generator, 5 kva	1	11,000	11,000
Photocopier	1	3,000	3,000
Misc. Drafting Equipment			5,000
	Total DENR Central SIU		60,600

B. Regional Planning Office SIU[20]

486-66 MHZ PC, with parallel ports, 330 MB hard drive, 5.25" & 3.5" disk drives, 2 serial ports, 16 MB RAM, Super VGA 1 MB video card, 80387-66 co-processor, color SVGA monitor	1	$6,000	$6,000
486-50 MHZ PC, with parallel ports, 300 MB hard drive, 5.25" & 3.5" disk drives, 8 MB RAM, SVGA 1 MB video card, 19" SVGA color monitor, 80387-50 co-processor	1	3,500	3,500
386-25 MHZ PC, 100 MB hard drive, 5.25" & 3.5" disk drives, 3 MB RAM	1	3,000	3,000
External Tape Device	1	1,500	1,500

[20]The planning office in Region 2 already has equipment provided under NRMDP. We recommend that this unit acquire one additional 486-66 MHZ PC. The other costs are intended to be indicative for expansion of the system.

Digitizing Tablet (36"x48") Cordless button cursor, electric pedestal	1	3,500	3,500
Plotter, 8 pen, 8 MB buffer, 256 Color Palette	1	15,000	15,000
Laser Printer, 5 MB RAM	1	3,500	3,500
Uninterruptable Power Supply, 2 kva	3	600	1,800
Generator, 5 kva	1	11,000	11,000
Global Positioning Systems Magellan Nav Pro 5,000	3	3,500	10,500
Misc. Drafting Equipment			5,000
Misc. Survey Equipment			5,000
	Total Regional SIU		69,300

C. Provincial Planning Office SIU

486-66 MHZ PC, with parallel ports, 330 MB hard drive, 5.25" & 3.5" disk drives, 2 serial ports, 16 MB RAM, Super VGA 1 MB video card, 80387-66 co-processor, color SVGA monitor	1	$6,000	$6,000
386-25 MHZ PC, 100 MB hard drive, 5.25" & 3.5" disk drives, 3 MB RAM	1	3,000	3,000
External Tape Device	1	1,500	1,500
Digitizing Tablet (36"x48") Cordless button cursor, electric pedestal	1	3,500	3,500

Plotter, 8 pen, 8 MB buffer, 256 Color Palette	1	15,000	15,000
Laser Printer, 5 MB RAM	1	3,500	3,500
Uninterruptable Power Supply, 2 kva	3	600	1,800
Generator, 5 kva	1	11,000	11,000
Global Positioning Systems Magellan Nav Pro 5,000	6	3,500	21,000
Misc. Drafting Equipment			3,000
Misc. Field Survey Equipment			5,000
	Total Provincial SIU		74,300
	Total Hardware		204,200

II. SOFTWARE

A number of GIS (vector) software packages currently are in use in the Philippines. ESRI's Arc/Info is the system installed at the DENR central and Region 2 Planning Office. No one software package, however, will perform all of the operations required for a fully-developed spatial information system. The system defined in this report, however, will develop specific routines for resource management. Consequently, we recommend that the existing Arc/Info system be complemented by ATLAS GIS to develop the system because:

- It is comparatively easy to learn;
- A local company is available to provide support;
- It can be networked;
- It has utility programs to convert to and from most other GIS software systems (including pc Arc/Info and MapInfo).

A. DENR Central Planning Office SIU

ATLAS GIS	1	$3,500	$3,500
ATLAS Mapmaker	1	600	600
QuattroPro	1	500	500
Word Perfect 5.1	1	500	500
SPSS-X	1	600	600
SuperCalc	1	500	500
	Total DENR Central		6,200

B. Regional Planning Office SIU

ATLAS GIS	1	$3,500	$3,500
ATLAS Mapmaker	1	600	600
QuattroPro	1	500	500
Word Perfect 5.1	1	500	500
	Total Regional SIU		5,100

C. Provincial Planning Office SIU

ATLAS GIS	1	$3,500	$3,500
ATLAS Mapmaker	1	600	600
QuattroPro	1	500	500
Word Perfect 5.1	1	500	500
	Total Provincial SIU		5,100
	Total Software		16,400

III. ENVIRONMENT

Spatial information software is expensive and fragile. The loss of data due to dust, high temperatures and humidity, or vandalism can be devastating. The SIUs should be housed in separate, well-monitored facilities. Equipment should be dedicated to spatial information work. Adequate locks, sealed windows, and an air conditioning system will be required for all facilities.

Air Conditioner	2	$1,500	$3,000
Maintenance Contracts for Hardware/Software		4,000 p/yr	4,000
Double Window Glass	All windows	2,000	2,000
Dead Bolts	All doors	500	500
	Total for Initial Year (x3 offices)		28,500

IV. TECHNICAL ASSISTANCE

A. Spatial Information Consultants

User Development Spec. (78 days @300/day)	$23,400
Applications Development Spec. (104 days @300/day)	31,200
Per diem (182 days x $132)	24,024
International Transportation 4 round trips: USA-Manila-USA @5,000 per trip	20,000
Total Consultants	98,624

B. Indicative GIS Software Training (Local)

ATLAS GIS	2 week course	$600
Arc/Info	1 week course	600
	Total GIS Training	1,200

C. Automated Database for Quirino Management Plan

ATLAS GIS	2	$3,500	$7,000
ATLAS Database Development		4,000	4,000
	Total for Quirino		11,000
	Total Technical Assistance		110,824

V. EXPANDED RESIDUAL FOREST INVENTORY COST ESTIMATES

A. Indicative Budget for NRMP Additional Forest Inventories

Costs are based on four additional inventory efforts.

FSO Contracts (250,000 ha @ $30.77/ha)	$7,692,500
Training (4 FSOs @ 4 weeks)	123,077
Field Equipment	
Haga Altimeter (4)	1,230
Suunto Compass (4)	923
Steel Diameter Tape (4)	923
50 m Tape (4)	1,230
Miscellaneous Forestry Equipment	962
Travel	
DENR/NRMP (8 people)	30,769
Check Crews (20 people)	38,462
Total Forest Inventory	7,890,076
GRAND TOTAL	8,250,000

ANNEX H. LIST OF PERSONS CONTACTED

Mr. Romeo T. Acosta
Director, Planning and Policy Studies Office
DENR

Mr. Virgilia Basa
Director, Remote Sensing and Resource Data
Data Analysis Department
NAMRIA

Mr. Jose Cabanayan
Chief, Land Resources Division
NAMRIA

Mr. Remedios Cabauatan
Chief, Human Resource Development Service
DENR, Region 2

Pedro Calixto
Regional Technical Director
DENR, Region 11

Mr. Rafael Camat
Director, Project Management Service
FASPO, DENR

Mr. Thawewat Chatchalermwit
Louis Berger International, Inc.
Mindanao Growth Plan

Ms Francisca Dayrit
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GEODATA SYSTEMS Technologies, Inc.

Mr. Des Dent
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Mr. Richard Edwards
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Mr. Robert Ellis
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Mr. Francisco Goncalves
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McElhanney Geosurveys, Inc.

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Benjamin Tumaliuan
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Mr. Romulo Valerio
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DENR, Region 11

Ms Victoria Vidad
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DENR, Region 2

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