The Philippine Environmental Governance 2 Project
Mapping Guidebook for Forest Land Use Planning

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ACRONYMS

A&D  :  Alienable and Disposable
BLLM : Bureau of Lands Land Monument
BSWM : Bureau of Soils and Water Management
CA  : Co-production Agreement
CADC : Certificate of Ancestral Domain Claim
CADT : Certificate of Ancestral Domain Title
CENRO: Community Environment and Natural Resources Office
CIS  : Community Irrigation System
CLUP : Comprehensive Land Use Plan
CSC  : Certificate of Stewardship Contract
DA  : Department of Agriculture
DAR  : Department of Agrarian Reform
DENR : Department of Environment and Natural Resources
DOH  : Department of Health
EcoGov: Philippine Environmental Governance Project
EXP : Exploration Permit
FL  : Forest land
FLA : Foreshore Lease Agreement
FLGMA: Forest Land Grazing Management Agreement
FLMA : Forest Land Management Agreement
FLUP : Forest Land Use Plan
FTAA : Financial or Technical Assistance Agreement
GIS : Geographic Information System
GPS : Global Positioning System
IFMA : Industrial Forest Management Agreement
JAFTA: Japan Forest Technology Association
JVA : Joint Venture Agreement
LGU : Local Government Unit
MGB : Mines and Geosciences Bureau
MPSA: Mineral Production Sharing Agreement
NAMRIA: National Mapping and Resource Information Authority
NCIP : National Commission for Indigenous Peoples
NIS : National Irrigation System
NIA : National Irrigation Administration
NWRB : National Water Resource Board
PACBRMA: Protected Area Community-based Resource Management Agreement
PENRO : Provincial Environment and Natural Resources Office
RED : Regional Executive Director
SIFMA : Socialized Industrial Forest Management Agreement
SPDA : Southern Philippines Development Authority
SSC : Swedish Space Corporation
TLA : Timber License Agreement
TWG : Technical Working Group
UNEP : United Nations Environmental Program
This guidebook is a product of many years of working with the DENR and Ecogov LGU partners in the course of formulating Forest Land Use Plans (FLUPs). Feedbacks from DENR field staff and members of FLUP technical working groups of LGUs have enriched the guide and grounded it to different field realities.

During a review of FLUP related knowledge products of Ecogov, which included this guidebook, we were joined by the following persons who shared their comments and suggestions: Alfonso Calimag, Jr., the Chief of DENR Forest Resource Development Division Region 2; Richard Abella, the chief of Forest Resource Development Division of DENR Region 7; Ruel Divino, the CENRO of Kiamba-DENR Region 12, Ariel Barrientos of the Forest Management Services DENR Region 9; Ronald Go of DENR Region 11; Rolando Tuballes, the Municipal Environment and Natural Resources Officer of Maasin, Sarangani; Jilsan Siang, member Provincial FLUP TWG of Sarangani; Edgar Paalan, the City Environment Natural Resources Officer of Kidapawan City; and Bien Pogoy, member of TWG of Davao City.

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INTRODUCTION

Maps are an indispensable tool in any planning exercise. They provide another dimension to the biophysical and socioeconomic descriptions of places usually presented with numerical summaries or statistics by showing its location and spatial distribution. The drawn representations of the real world, showing the shape and location of perceived features using points, lines, polygons and attributes or descriptions of features, help us see patterns and relationship of the features and better understand the processes that operate within our planning environment.

The formulation of the forest land use plan (FLUP) of local governments requires many maps. However, this is a challenge for many cities and municipalities in the Philippines because there is often very minimal information about the forestlands portion of their jurisdictions. The Comprehensive Land Use Plan (CLUP) of local government units (LGUs) mostly focuses only on the alienable and disposable lands (A&D), and forestlands are noted plainly as forestlands in the plan. This is primarily because forestlands are under the DENR’s mandate and all activities and approval of tenure agreements within it do not go through the LGUs.

However, recent changes in policies have mandated LGUs to plan for the forestlands of their municipality.

This guidebook walks the LGU through the mapping and map analysis needed for FLUP formulation. It provides a guide in gathering spatial data, its translation to thematic maps, and to the analysis of map overlays. It provides simple, practical and participatory procedures that can be followed easily by LGUs. It also clarifies the spatial data needed to properly assess forestland conditions, issues and opportunities to be able to propose allocations for LGU’s forestlands. To avoid the gathering of unnecessary data, this guidebook also specifies the level of detail of data needed for the development of the FLUP. Current standards or conventions in map-making in the Philippines are also included in the guidebook to update the
mapping practices among draftsmen and cartographers at the LGU level. This guidebook is part of a series of resource materials produced by the Philippine Environmental Governance (EcoGov) project to guide LGUs in building local spatial data and translating these spatial data to maps that allow overlay analysis for its use in land use and resource planning activities.

Computerized cartography and Geographic Information System (GIS) are now accessible to LGUs. However, many still adopt manual methods in making maps and analyzing spatial data. The LGU’s varying levels of skills in map making and their utilization of maps for analysis were carefully considered during the conceptualization of this guidebook.

The discussions contained in the guidebook provide basic information needed to compile all thematic map data, and thus will be useful to LGUs who wish to prepare their FLUP maps either by manual methods or through the use of the GIS.

The guidebook is organized into 3 major chapters: the spatial data-gathering techniques, thematic map production, and map overlay analysis. The first chapter guides users in collating local spatial data using existing maps. The spatial data collected are enriched by the LGU’s and community’s own knowledge of the place through participatory mapping techniques. The second chapter provides a guide in collating data for each thematic map. The individual thematic map discussion describes the significance of a thematic map in the FLUP analysis, directs the reader to source maps for each thematic data, suggests standard symbols, and gives notations on how to derive the needed thematic data from existing maps. The third chapter discusses the different map combinations or overlays that will help answer specific questions in the situational analysis phase of the FLUP formulation.
CHAPTER 1
Gathering, Updating and Validating Existing Thematic Maps
In the Philippines, municipality data, especially those that focus on forestlands, are not readily available. Most of the existing data are biased or are focused on the alienable and disposable lands (A&D) of an LGU. These can be compensated however by integrating the knowledge of local people—community members, tenure holders, LGU or DENR staff, of their locality. Locals can expound about their places in great detail, replete with spatial data that is, however, not expressed as maps. The challenge lies in translating these words, text and collective perceptions of place into a form that can be processed and analyzed with other maps.

This chapter discusses methods on how to put together validated and updated spatial data sets. These methods have been developed and used in social science research and development work. They are not expensive to implement and can be done at the community level using very simple resources.

Community mapping is one of the methods most commonly used in participatory natural resource planning. This has been used extensively among upland communities that are usually marginalized in the production of knowledge and information. Before the actual discussion of these methods, it is important to explain some key concepts that will help users understand these methods and be able to defend the integrity of the data that will be derived from these tools.

A. Spatial Knowledge Concepts

Environmental geographers who study the relationship of people and places say that people form perceptions about their environment as they go about their ordinary daily activities. People become aware, create impressions, gather information, build images, and form beliefs about their surroundings. This develops into an individual’s reading of the character, function, dynamics, and interrelationships of the place which people also infuse with meanings and significance, in relation to their needs, attitudes and values (Moore and Golledge in Golledge and Stimson, 1997). As individuals go about their daily tasks in their places of dwelling and work, they develop their own personal knowledge and impressions which are mentally stored. The breadth and complexity of this spatial knowledge is influenced by the frequency of use and the level of importance of certain places to a person. This personal knowledge of places acquired through time is stored in each person’s mind and is called a mental map. Just like a regular map, it stores landmarks or personal places of importance, routes and characteristics that people ascribe to places. But more than a map, it stores meaning and feelings that a person associates with the places. It is mentally stored, updated, related and integrated through time. People access their mental maps as they help them interact with different places and perform their daily tasks, such as finding their way home, describing a place to another person or providing directions to a destination.

The data gathering methods enumerated below harness the different individuals own spatial knowledge and mental maps of places.

B. Spatial Data Gathering Methods

The key in putting together a thematic map data set that addresses the needs of planning at the city or municipal level is the ability to integrate spatial data from different data sources. Not all spatial data that we need are going to be derived from just one source, such as an existing map. Other data sources may be a report, a result of a key informant interview or a staff’s observations from a field visit. The key is to draw from different types of spatial data sources and using methods to extract and integrate them into a common format that allows map overlay analysis later on in the planning process.

1. Indicative mapping using textual data

Texts, in the form of area profiles and reports, are the most common information available describing a certain LGU. These texts usually provide data of counts and amounts of features in a certain barangay that can be translated into a spatial feature on a map. To translate text into map format, one needs existing maps such as a topographic map and a person who is familiar with the area of interest. A topographic map can be used in this exercise as it shows landmarks that are easily identifiable on the ground. It also illustrates the lay of the land, showing where creeks and rivers, gullies and ridges, plains and mountains are located. More often than not, the spatial information that we need in our analysis are, in one way or another, related or restricted by the
topography of a place. An example would be the location of service areas of existing irrigation systems. It is common in reports to enumerate only the number of hectares in certain barangays being serviced by the irrigation system. With the use of a topographic map and a land use map, and with the help of somebody familiar with the area, delineating the indicative extent and location of the service area can be done. This data will contribute to the infrastructure thematic map.

2. Walkthrough

A walkthrough is a preliminary ground survey to gain information of the area being mapped. It requires a field visit to go through the area of interest. Talking to the people helps familiarize oneself with the place names, local terms, and landmarks of the area. It will be handy to bring a topographic map in the actual visit. Walkthroughs help a person get oriented with the place by allowing one to relate what one sees on the map and what it looks like on the ground. Finding a vantage point where one see most of the forest land areas is helpful to further appreciate the planning area.

Make notes on the conditions of the place during the visit. For instance, noting that certain parts of a ridge are now covered with grass instead of being a brushland is a useful input in the process of validating the current land cover data. Developing the ability to visually assess measurements (e.g., how big an area or how far it is), comes in handy when translating observations during the walkthrough on the topographic map.

Aside from its practical purpose in the mapping process, walkthroughs are important to allow the team to have a “sense of (the) place”, a personal appreciation of the conditions, relationships and interactions of the different biophysical and socio-cultural features of the area as seen on the ground.

3. Community mapping

Community mapping is a method of externalizing or bringing out the mental map of a group of individuals. The method involves a group of chosen representatives of the community to draw the information of the occurrence, distribution of different biophysical, socio-economic and cultural features of their area. Community mapping is like a focus group
discussion (FGD), but with the participants responding both verbally and by graphically showing or sketching their answers. The community mapping process is divided into three main phases:

**Preparatory Activities**

Before the actual community mapping, it is important for the technical working group (TWG) to meet, review and assess the existing data and decide what particular spatial data need to be gathered, updated or validated. The real challenge in doing the community map for FLUP planning is to be able to organize a community mapping exercise that will make use of existing data and build on it.

Community mapping has the potential to elicit a very detailed description of the community’s area and its various activities, relations and resources. However, the TWG should be able to identify and delimit the scope and detail of the information that they will need to collect, validate and update to escape the common pitfall of gathering more data than what is needed.

The common thematic maps used in FLUP that need validation and updating are:

1. Vegetative cover map
2. Settlements map
3. Infrastructure map
4. Issues map
5. Hazards map

With the expansion of the participatory natural resource management in the Philippines during the late 1990s, many upland communities that were under development programs in forest management underwent community mapping activities. In the light of these previous efforts, it is useful to inquire from the community if such maps are available. These maps will be helpful as reference so that the community may just add other information needed on the existing community map during the community mapping.

Instead of having the community start with a blank sheet, the TWG may opt to do the actual community mapping ready with prepared maps showing streams, roads, peaks and other landmarks from the topographic map. If the team decides to do this, the lead facilitator of the mapping activity should be well versed with the place, and must be able to answer where certain landmarks are located so that the community could properly adjust their mental maps to these landmarks.

**Participants.** The team should be able to determine the stakeholders in the community that need to be represented in the mapping activity. They will have to identify the groups that need to be represented in mapping and request the community to identify the representative for their groups. During the actual community mapping, the other members of the community, other than the key informants, usually watch and comment on the map that is being drawn.

**Materials in Community Mapping.** The community maps are usually drawn on large sheets of plastic or manila paper using colored pens, pencils and crayons. For practical reasons, participants oftentimes use plastic sheets so they can easily erase some features drawn on the map by using isopropyl alcohol. It is also advisable to use plastic sheets if the team has to travel long distances or cross rivers to ensure that the maps will be preserved. If using manila paper, masking tape can be used to cover mistakes on the drawing.
Actual Community Mapping

The facilitator is the key person in the community mapping activity. He or she must be prepared and should be able to do the following:

- Initiate the mapping activity and asks the questions;
- Encourage the active involvement of all participants; and
- Ensure that there is no participant dominating the activity.

A documenter should also be assigned during the activity to take note of the comments of participants and additional data that may be difficult to be noted on the map. An assistant facilitator, on the other hand, should be assigned to facilitate small discussions during the mapping activity. Some participants would tend to deviate from the central discussion and focus on other sections of the map that they are familiar with.

The first step during the actual community mapping is to orient the participants on the purpose of the activity and how the results of the activity would be used. Start orienting participants by showing the location of the community mapping on the prepared map (if a prepared map is used). Validate major landmarks and features such as roads, rivers and different infrastructure which will be used as reference. A sample community mapping guide questions are provided in the next page.

While the participants are plotting and sketching features, observers can comment on what is drawn. These observers can guide participants in identifying other features that have not yet been indicated. To make the map more understandable, they can also suggest corrections to the proportion of distance from one landmark to another. This activity becomes part of the validation process of the features drawn on the map by members of the community who have vast knowledge of the area. Some stakeholders may be able to manifest certain portion of the forestlands in greater detail because they often conduct activities in the area. An indigenous person living within the forestland, for instance, may have a deeper knowledge of a certain place compared to somebody living outside the forestlands.

Integration of Community and Topographic Maps

After the actual community mapping, the generated data needs to be integrated into a technical map such as the topographic map. It is important to integrate the community maps into the topographic map because it allows data from the community to be related to other thematic maps (ESSC, 1997). Landmarks, which are seen in both maps, are key features in the map integration. The landmarks are used as reference points to properly transfer data from the community map to its proper location on the topographic map. Figure 3 illustrates how the integration will be undertaken. Observations and notes, specifically on location of land uses and previous projects made during the actual community mapping as well as those gathered during the walkthroughs, are also useful in the integration.

Figure 3. Finding common landmarks between the community map and technical map is a key task in the integration process.
SAMPLE COMMUNITY MAPPING GUIDE QUESTIONS FOR FLUP THEMATIC MAPS

1. Magpakilala at sabihin ang pakay ng community mapping -- ang pag-update ng datos tungkol sa kanilang barangay sa mapa para gamitin sa paggawa ng forest land use plan ng munisipyo o siudad.

2. Sabihin kung tungkol saan ang mga itatanong (ang mga iba’t-ibang mga bagay na inamapa sa barangay)

3. Hindi dapat hayaan ng facilitator na iisa lang ang magsasalita o mag-dodrowing sa mapa, hikayatin na lahat ay may kontribusyon sa pagkocommunity mapping.

Ang mga sumusunod ay ilan lamang sa mga paksa na kailangang bigyang pansin:

**Landmarks**
- Mas mainam na simulang pong pag-community mapping sa mga lugar na pamilyar sa mga tao at madali ring hanapin sa ibang mapa gaya ng topographic map.
  - Iguguhit natin ang inyong barangay. Simulan nating idrowing kung nasaan tayo.
  - Iguguhit rin natin ang mga tuktok ng mga bundok na kilala ninyo.
  - Ilagay naman natin ang lokasyon ng ibang mga lugar na importante sa komunidad gaya ng mga lugar na mahalaga sa kasaysayan ng komunidad.

**Infrastructure**
- Isunod natin sa mga sapa at ilog, ang mga kalsada na meron dito sa lugar ninyo.
- Ipwesto naman natin sa mapa ang mga infrastruktura gaya ng barangay hall, mga eskwelahan, health center, palaruan, mga poso o bukal na pinagmumulan ng inyong tubig inumin, tulay, at iba pa.

**Settlement**
- Saan makikita ang mga kabahayan sa mapa? Isulat rin ang mga pangalan ng mga sitio o purok na kinaroroonan ng mga kabahayang ito.
- Ilan ang mga kabahayan sa inyong barangay?

**Forest/Landcover**
- May mga kagubatan pa ba kayo na hindi pa nadadaanan ng logging? Saan po ito sa naiguhit na?
- Meron bang mga plantasyon ng puno at kung anu-ano ang mga halaman dito? Itantsa po natin ang lokasyon ng mga ito. Anu-anong uri ng puno ang itinanim sa plantasyon?
- Ano ang meron sa ibang parte ng barangay? May mga lugar ba na panay cogon ang tumutubo? Saan ang mga ito sa mapa?
- Meron bang nagkakaingin sa lugar ninyo? Iguguhit kung saan sa mapa ang mga lugar ng kaingin.
- Anu-anong gamit ang lupang purok dito sa barangay? Nagtatanim ba kayo ng mga puno bukod sa mga punong-kahoy na nakatanim na nasasakupan ng inyong lupang purok?

**Hazards**
- Mayroon bang lugar na may guho ng lupa? Ilagay sa mapa kung saan ang mga ito.
- Nagkakaroon ba ng pagguho ng lupa o pagbaha ng ilog kung may bagyo? Saan ito nararanasan?
- Nagkakasunog ba sa kabuhayan? Saan ito karanibang nangyayari?

**Tenure/Issues:**
- Mayroon ba kayong kilala ng nagbibigay ng karapatan/papeles gaya ng CSC para gumamit ng forestlands? May iba pa bang legal na instrumento para paunlarin at alagaan ang forestlands dito sa lugar ninyo? Kung oo, pakituro kung saan ang mga lugar na ito.
- Saan din ang mga lugar ng forestlands na may nakapwesto na? May claimant na? Saan ito sa mapa?
- Saan kayo kumukuha ng kahoy para sa pagawa ng bahay at panggatong?
- Mayroon bang nagpuputol ng kahoy sa lugar ninyo? Kung oo, gaano kadalas na magpuputol ang lugar ninyo?
- Mayroon ba kayong kilala ng nagpuputol ng kahoy sa lugar ninyo? Kung oo, gaano kadalas na magpuputol ng kahoy?
- Mayroon bang nag-uuling? Kung oo, gaano kadalas na nag-uiling sa lugar ninyo?
- Mayroon ba kayong kilala ng nagmimina at nagtre-treasure hunting sa lugar ninyo?

**Figure 4. Sample guide questions for the community mapping for FLUP maps**
A. Maps and Thematic Maps

The real world is complex and has many different layers of information that describe the conditions of a particular area. Understanding the features of the real world and its processes helps in making plans and decisions on how we want to manage it. Maps are “graphic representation of a portion of the earth's surface drawn to scale, as seen from above” (www.mapreading.com). It is a tool that helps us in representing the real world on paper and is realized by generalizing the real world features and utilizing symbols, lines, colors and labels to represent these features.

The real world extends beyond what our eyes can see and maps help put this world into view. It provides a perspective of the area as a whole to enable us to see its characteristics and how things are related to other features of the area. A map provides information on the topography, resources and conditions that exist in a particular area at a particular time. However, maps show more than location and extent, it also illustrates shape and graphically describe distribution or pattern of features. Maps allow us to make associations of different spatial attributes and see coincidence of certain conditions, and discern if there are interactions between and among different features and processes. It also allows us to track changes in a place through time such as how forest cover changed given two different periods (Slater, 1982).

Thematic mapping is a technique to organize, understand and analyze various characteristics of an area. A thematic map is a map that displays the spatial distribution of an attribute that relates to a single topic, theme, or subject. Displaying an attribute such as land classification, vegetation, drainage patterns, land use, or landownership individually allows one to examine each attribute more closely without the distraction of other features.

Organizing the attributes of a geographic area into different thematic maps makes map updating easier. Users can also make more extensive analysis through map overlaying, a technique where two or more maps are placed on top of each other to obtain a better characterization or analysis of an area. By using thematic maps, a planner can focus the analysis on particular feature/theme or on several interrelated features/themes without being burdened by other information that are not crucial to the analysis.
The first challenge in formulating a Forest Land Use Plan of a municipality or city lies in the depiction of the different thematic data layers of a local government unit. The next section specifies how to compile the maps needed to come up with an FLUP.

**B. General Guidelines in Preparing Thematic Maps**

A good thematic map is clear and easy to use. The following guidelines should be considered in preparing thematic maps:

1. **Map Sources**
   Use the best available map sources for base map features and all other thematic maps. For most areas in the Philippines, NAMRIA’s 1:50,000 topographic maps is the best base map that can be readily accessed. A base map is a map containing geographic features used as locational reference to which other map data are compiled.

   Exercise diligence in sourcing maps and check all possible sources of prescribed thematic maps. Make a thorough evaluation of the maps’ reliability and up-to-dateness before adopting them. If the maps are not available, utilize documents that provide the technical descriptions of points or polygons. Technical descriptions distinguish the location and shape of a feature by citing the coordinates of the cornerpoints, or the bearing and distance of arcs that make up the polygon.

   The examples of both types of technical descriptions are shown below:

   Point of origin is the Bureau of Lands Local Monument (BLLM) No. 263 with coordinates 124° 34’ 25”.

<table>
<thead>
<tr>
<th>Table 1. Examples of two types of technical descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Segment</strong></td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td><strong>Corner</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

2. **FLUP Base Map**
   Using the topographic map, create a base of the municipality or city that shows the boundaries of the area being mapped and other features (rivers or roads) traced from the topographic map. Each thematic map prepared should be traced from this base map. This will ensure that all thematic maps will have the same configuration and scale.

3. **Map Materials**
   Use materials that are transparent to allow the overlaying of one map to another which will be needed during the map analysis phase. Duplication is also cheaper through blue or white printing machines. Make sure that the material is durable and does not easily stretch to preserve the original scale and shape of the map. Tracing paper and transparent film (Mylar®) are often used, although film is better because it is more durable than tracing paper.

4. **Toponyms**
   NAMRIA maps sometimes have misplaced and misspelled location names that cause confusion. Validate and correct the names of rivers, mountains, sitios, barangays, and municipalities that appear on the topographic maps. Correcting errors will improve the quality of maps. The corrections may be officially submitted to NAMRIA so that they can be reflected in the next printing of maps.

5. **Documentation of Process**
   The compilation of data from different map sources and scales sometimes results into inconsistencies in the spatial information reported by different maps. Someone should keep a record of inconsistencies and the data sets that the team has decided to adopt in the thematic maps.

6. **Map Name or Title**
   Make sure that each map is properly titled. The map should reflect the theme and the location of the mapped area (municipality and province).
7. Map Symbols
Use distinguishable marks and symbols to describe the different features in the thematic map. For map overlay analysis, it is not advisable to use dark shading or colors on the thematic maps.

8. Summary Table
Provide a summary table of the relevant statistics that can be generated from the map. The figures percentage values should be rounded off to 2 decimal place and should be justified to the right so readers can easily compare the statistics.

Table 2. Sample summary table

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Area (ha)</th>
<th>% of Total Land Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>0-18% Slope</td>
<td>24,106</td>
<td>67.75</td>
</tr>
<tr>
<td>S2</td>
<td>18-30% Slope</td>
<td>7,513</td>
<td>21.11</td>
</tr>
<tr>
<td>S3</td>
<td>30-50% Slope</td>
<td>2,990</td>
<td>8.41</td>
</tr>
<tr>
<td>S4</td>
<td>50-100% Slope</td>
<td>966</td>
<td>2.72</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>35,575</td>
<td>100.00</td>
</tr>
</tbody>
</table>

9. Map Orientation
All maps must have its north arrow pointing to the upper part of the map. Make sure that the directional arrow is clearly shown on the map.

10. Map Scale
For most municipal scale planning, the 1:50,000 scale is adopted. However, for municipalities and cities with very small areas (below 10,000 hectares), they may opt to use a 1:25,000 scale to avoid the features looking too crowded. This may confuse users in the map overlay stage.

The scale should be properly reflected in the map as a representative fraction and as a graphical scale.

Example of how the scale is reflected in the map:

![Sample of map scale to be reflected on the map](image)

11. Map Projection
The type of projection used should be noted on the FLUP maps produced. Look for the information at the bottom of NAMRIA topographic maps. Since we use these as base maps, then it follows that the projection (Transverse Mercator Projection) used on the topographic map is also what is indicated on the thematic maps. Most of the spatial data produced by different government agencies (i.e. slope, land cover, administrative maps, etc) which we also access for the other thematic maps for FLUP also uses the same projection. This is because they also use NAMRIA topographic maps as their base maps.

Maps with the same projection allow us to readily copy spatial data from the sources with the same scale to our map. If the projection of the source map is not Transverse Mercator, some transformation may be needed, however, this is seldom the case.

![Sample of the projection information shown on the thematic maps](image)

12. Notes and References
Always show the references used in making the maps. The suggested format for the reference is: Name of Source. Year Published. Map Title. Map Scale. Place of Publication.

Any remarks, special notes or advisories regarding the quality of the map should also be indicated to guide users.
13. Preparer
It is also important to put the name of the person or group who prepared the map and the date the map was made.

Example:

![Preparer Example](image1)

14. Map Coordinates
All thematic maps should have its locational information indicated. This is usually done by drawing **tic points** on the map. Tic points are drawn as crosshairs on a map to mark specific locations usually distributed in the four corners of an area being worked on. The coordinates are written along the borders of the map or sometimes each tic point would be accompanied by coordinates—longitude and latitude. These points make it easy for anyone to relate features of a map to another because they serve as guides between the two maps. It also allows users to transfer not only the map features from a paper map but also its location.

Example:

![Map Coordinates Example](image2)

15. Signatories of Maps
Since thematic maps will be used later to propose priority areas for particular management strategies, there is a need for these maps to be checked by the planning office of the LGU as well as DENR to confirm the authenticity of the spatial data represented on these maps. The concerned people will be asked to affix their signatures on the map.

Example:

![Signatories Example](image3)

The proposed allocation map would require the signatures shown above as well as the following:

Example:

![Signatories on Allocation Map](image4)
Table 3. Summary of Spatial Data Sources

<table>
<thead>
<tr>
<th>DATA/MAP NAME</th>
<th>SOURCE</th>
<th>MAP SCALE</th>
<th>DATE</th>
<th>KEY MAP FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subwatershed &amp; Drainage Map</td>
<td>Topographic map</td>
<td>1:50,000</td>
<td>Reprints of 1950s aerial photographs with some of its features updated</td>
<td>Elevation, river, roads, political boundaries, location of towns, name of barangays</td>
</tr>
<tr>
<td></td>
<td>NAMRIA office in Fort Bonifacio and sales offices at selected DENR offices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Topographic map</td>
<td>1:250,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NAMRIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bigger Watershed Map</td>
<td>Topographic map</td>
<td>Various scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Proclamations or Republic Acts creating new municipalities or provinces</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Philippine Gazette</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Copies from Congress or Malacañang archives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provincial and regional maps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NAMRIA</td>
<td>Most printed in the 1990s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Classification Map</td>
<td>Land classification</td>
<td>Scale ranging from 1:20,000, 1:50,000 and 1:250,000</td>
<td>Depending on the date of groundsurvey</td>
<td>Extent of alienable and disposable (A&amp;D) and the forestlands (FL)</td>
</tr>
<tr>
<td></td>
<td>NAMRIA Land Classification Division</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Project control map of the Community Environment and Natural Resources Office (CENRO) and Provincial Environment and Natural Resources Office (PENRO) of respective areas</td>
<td>1:50,000, 1:100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATA/MAP NAME</td>
<td>SOURCE</td>
<td>MAP SCALE</td>
<td>DATE</td>
<td>KEY MAP FEATURES</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>--------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Land Cover</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Map from SPOT satellite images</td>
<td>NAMRIA</td>
<td>1:250,000</td>
<td>1988</td>
<td>• The two maps from the SSC and JAFTA show about 20 land cover categories; however, the two map data cannot be directly compared because they do not have similar categories</td>
</tr>
<tr>
<td>images classified by SSC (Swedish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space Corp.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Map from 1993 Landsat</td>
<td>NAMRIA (available only for Luzon and Visayas)</td>
<td>1:100,000</td>
<td>1993</td>
<td>• This map is a color composite of bands of Landsat images used for land cover assessment and are not presented as classified polygons</td>
</tr>
<tr>
<td>(produced by JAFTA (Japan Forest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology Association)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Vegetative cover map for</td>
<td>EcoGov2 Project Mindanao Maps (available also in digital form)</td>
<td>1:50,000, 1:100,000 and 1:250,000</td>
<td>2004</td>
<td>• Land cover categories used by EcoGov are largely based on the SSC map although some of the categories were aggregated</td>
</tr>
<tr>
<td>Mindanao</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATA/MAP NAME</td>
<td>SOURCE</td>
<td>MAP SCALE</td>
<td>DATE</td>
<td>KEY MAP FEATURES</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Land Allocation and Tenure</td>
<td>• Copies from Congress or Malacañang archives</td>
<td>Various scales</td>
<td></td>
<td>• The boundaries are indicated as technical description, sometimes accompanied by maps.</td>
</tr>
<tr>
<td></td>
<td>• Websites of law resources in the internet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Protected Area Wildlife Bureau (PAWB) office</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Philippine Gazette</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Certificates from Congress or Malacañang archives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Websites of law resources in the internet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Protected Area Wildlife Bureau (PAWB) office</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• CADC/CADT areas</td>
<td>• Certificate of Ancestral Domain Titles (CADTs) available at the National Commission for Indigenous Peoples (NCIP) central office or its provincial offices</td>
<td>Various scales</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Certificate of Ancestral Domain Claim (CADC) issued under DENR could be found also in the project control maps of CENROs and PENROs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Digital copy also available from the Philippine Association for Intercultural Development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Project control maps in the CENRO and PENRO offices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• DENR issued tenure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Updated by the CENRO and PENRO offices yearly or when new tenure is issued</td>
</tr>
<tr>
<td>DATA/MAP NAME</td>
<td>SOURCE</td>
<td>MAP SCALE</td>
<td>DATE</td>
<td>KEY MAP FEATURES</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>-------------------</td>
<td>------------</td>
<td>--------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Settlements</strong></td>
<td></td>
<td>1:50,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Topographic Map</td>
<td>NAMRIA</td>
<td></td>
<td>Reprints of 1950s interpretation of aerial photographs, some features are updated in the reprints</td>
<td>Individual houses are shown as small black box symbols</td>
</tr>
<tr>
<td>• Existing Community maps or spot maps</td>
<td>Community maps that are produced from other development projects in the area</td>
<td>Usually done per barangay</td>
<td>Community maps usually represent the settlement areas by individually drawing the houses</td>
<td></td>
</tr>
<tr>
<td>• Community Management and Development Plan (CMBP)</td>
<td>NAMRIA Community maps that are produced from other development projects in the area</td>
<td>Part of the requirements of the CMBP is to conduct community mapping</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LGU physical and socioeconomic profile in their CLUPs</td>
<td>Prepared in varied scales</td>
<td>Most of the national highways and provincial roads are indicated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NAMRIA list is updated by the National Water Resource Board (NWRB)</td>
<td></td>
<td>Coordinates of water permits locations is available from the list which includes name of permittee, permit type, charges etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NAMRIA data from the reports of National Irrigation Administration (NIA) and Department of Agriculture (DA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td></td>
<td></td>
<td>Reprints of 1950s interpretation of aerial photographs, some roads are updated in the reprints</td>
<td>Most of the national highways and provincial roads are indicated</td>
</tr>
<tr>
<td>• Roads</td>
<td>NAMRIA</td>
<td>1:50,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Municipal and barangay roads and other social infrastructure</td>
<td>LGU physical and socioeconomic profile in their CLUPs</td>
<td>Prepared in varied scales</td>
<td>Coordinates of water permits locations is available from the list which includes name of permittee, permit type, charges etc.</td>
<td></td>
</tr>
<tr>
<td>• Water Permits Issued</td>
<td>NAMRIA list is updated by the National Water Resource Board (NWRB)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Irrigation related infrastructure and irrigated areas</td>
<td>NAMRIA data from the reports of National Irrigation Administration (NIA) and Department of Agriculture (DA)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Elevation</strong></td>
<td></td>
<td></td>
<td>Reprints of 1950s aerial photographs with some of its feature updates</td>
<td>Elevation data are represented every 20 meter contour interval</td>
</tr>
<tr>
<td>• Topographic Map</td>
<td>NAMRIA</td>
<td>1:50,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**C. Core Thematic Maps Used in Municipal FLUP**

**1. Watershed and Drainage Map**

This map shows the streams draining through the planning area together with the watershed, catchments or sub-catchments covering it. A watershed is a unit of land that collects, concentrates, and conveys water. Its boundary is a line connecting topographic features such as ridges or high points and determines the direction of the water runoff flows (UCB, 2007). Watershed captures precipitation, filters and stores water and determines its release.” (UBC, 1998).

The stream data is readily available while the watershed or catchment boundary will have to be derived from the topographic map by identifying the ridge that encloses a certain river system.

**Content and Suggested Mapping Standard**

The objective in delineating watershed, catchments or sub-catchments is to highlight the upstream and downstream relationship present in any area that has a river system running through it. This is significant especially when the benefits of forest and forest land management to an LGU are discussed.

This map has both polygon and line features and will use the following legend:

- **Watershed divide or boundary**
- **Streams (Stream names should be indicated and should be italicized)**
- **Catchment polygons will have the watershed code inscribed in it**
Figure 14. Illustration of a watershed in the local context

Infiltration
Some of the water is absorbed by the ground

Rainfall

Part of an adjacent watershed

Watershed divide
Separates watershed

Political boundaries
Some watersheds are shared by two or more political units

Runoff water
Not absorbed by the ground runs over surface

River system
Summary Table
Table 4. Sample summary table for Watershed Map

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Watershed Area</th>
<th>% of Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>Kalawaig</td>
<td>2,065</td>
<td>17.85</td>
</tr>
<tr>
<td>W2</td>
<td>Gamot</td>
<td>3,778</td>
<td>32.66</td>
</tr>
<tr>
<td>W3</td>
<td>Kapigis</td>
<td>5,723</td>
<td>49.48</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>11,566</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Notes

a. Being able to read topographic maps and distinguish ridges and gullies are important requirements in identifying the catchment divide. Delineating the watershed divide or boundary can be confusing especially if the area being mapped has a complex terrain. The following steps may help in demarcating the catchment boundaries:

- Go over the topographic map and get a general idea of the drainage system of the municipality and how it links up with the surrounding area.
- Take note of the major river systems and mark a rough outline of its boundaries. These boundaries would follow ridgelines and would be near the headwaters or the tip of the tributaries of the river system. Spot elevations can also guide in identifying the ridgelines. It is represented by this symbol: 543

with a value indicating its elevation in meters above sea level (masl). Do the same thing for the secondary drainage systems.

- To make a precise boundary of the watershed, additional drainage lines are needed as guide, adding on to the permanent streams drawn on the topographic map as shown in Figure 15. These additional drainage lines need not be included in watershed thematic map; only the permanent streams will be reflected on the map.

Figure 15. Illustration of how to add drainage lines on the topographic map to guide delineation of catchments or watersheds
b. Watersheds, just like streams, follow a hierarchy. This means that a watershed area can span a large region with several tributaries, or will just be a small area with a single strand of permanent stream running through it. Smaller watersheds are nested within bigger ones.

The LGU area may be subdivided into catchments using the topographic map as guide. This exercise sometimes results in an LGU ending up with too many catchments and therefore too many management units. The decision of breaking down a watershed into manageable catchments or to have a cluster of small catchments, will be facilitated using the infrastructure map. This way, one will be able to track down how one or two catchments contribute to one irrigation line and therefore may be joined. There are no hard and fast rules in doing this since it is difficult to anticipate the different areas’ peculiarities. But it will be important to note how and why a watershed was segregated and what factors were considered. The discussions and agreed decisions should be documented and included as part of the FLUP discussing the subwatersheds within the LGU.
Figure 16. Sample Watershed and Drainage Map
2. Bigger Watershed and Drainage Map

This map is similar to the watershed and drainage map but its main function is to situate the subwatersheds found within an LGU to a bigger watershed context. This means the river drainage and watershed will be portrayed beyond the LGUs’ political boundaries. This intends to address the need for LGUs to view themselves as being a part of a larger biophysical system whereby their activities can impact neighboring LGUs as well as lowland and downstream coastal ecosystems.

Content and Suggested Mapping Standard

The symbols that are going to be used are the same with the watershed and drainage map but a few other features will be added.

- Watershed divide or boundary
- Streams (Stream names should be indicated and should be italicized or written using blue ink)
- Catchment polygons will have the watershed code inscribed in it
- LGU centers
- Name of bodies of water
- LGU Boundary
Figure 17. Sample Bigger Watershed Map
3. Administrative Map

The administrative map shows the boundaries of the political units (i.e., barangays and municipality) of the municipal LGU that is undertaking FLUP.

A description of the extent of a particular municipality is usually indicated in the documents of their establishment, usually a Republic Act or Presidential Decree. The map can be based on the administrative maps of NAMRIA and/or jurisdiction map of the LGU.

Content and Suggested Mapping Standards

Since the map covers political units at different levels, there is a need to differentiate the boundaries of these political units. The set of lines below are used to distinguish one type of political boundary from the other:

- **Regional**
- **Provincial**
- **Metropolitan**
- **City/Municipal Boundary**

In cases where two political units are sharing a segment of their boundary, that of the higher political unit will be used (i.e., if the boundary of the municipality is also the provincial boundary, use the provincial boundary line in the map). The names of the barangays should be indicated inside the polygons. Names of adjacent municipalities or province will be reflected as shown in the next example:

<table>
<thead>
<tr>
<th>Name of Barangay</th>
<th>Area (ha)</th>
<th>% of Total Land Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Kili-Kili</td>
<td>5,234</td>
<td>25.65</td>
</tr>
<tr>
<td>West Kili-Kili</td>
<td>6,617</td>
<td>32.43</td>
</tr>
<tr>
<td>Poblacion</td>
<td>8,552</td>
<td>41.91</td>
</tr>
<tr>
<td>Total</td>
<td>20,404</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Notes

a. Most LGUs have boundary conflicts with adjacent LGUs. FLUP is not designed to address these conflicts. It is, however, necessary to recognize these conflicts and, if possible, reflect them in the maps so that users will be informed of the existence and extent of the boundary conflict.
Here is an example of how the conflict area will be reflected on the map.

```
Sections 118 to 119 of the Local Government Code of 1991 provide for a process in the settlement of boundary disputes.

“SEC. 118. Jurisdictional Responsibility for Settlement of Boundary Dispute. Boundary disputes between and among local government units shall, as much as possible, be settled amicably. To this end:

a) Boundary disputes involving two (2) or more barangays in the same city or municipality shall be referred for settlement to the sangguniang panglungsod or sangguniang bayan concerned.

b) Boundary disputes involving two (2) or more municipalities within the same province shall be referred for settlement to the sangguniang panglalawigan concerned.

c) Boundary disputes involving municipalities or component cities of different provinces shall be jointly referred for settlement to the sanggunians of the provinces concerned.

d) Boundary disputes involving a component city or municipality on the one hand and a highly urbanized city on the other or two (2) or more highly urbanized cities, shall be jointly referred for settlement to the respective sanggunians of the parties.

e) In the event the sanggunian fails to effect an amicable settlement within sixty (60) days from the date the dispute was referred thereto, it shall issue a certification to that effect. Thereafter, the dispute shall be formally tried by the sanggunian concerned which shall decide the issue within sixty (60) days from the date of the certification referred to above.

SEC. 119. Appeal.—Within the time and manner prescribed by the Rules of Court, any party may elevate the decision of the sanggunian concerned to the proper Regional Trial Court having jurisdiction over the area in dispute. The Regional Trial Court shall decide the appeal within one (1) year from the filing thereof. Pending final resolution of the disputed area prior to the dispute shall be maintained and continued for all legal purposes.”

b. The published maps of NAMRIA, the topographic map, and the provincial maps, indicate political boundaries. Oftentimes, these maps are used by LGUs to establish their boundary claims over another LGU. These boundaries are only indicative and not authoritative. In fact, a disclaimer is written on NAMRIA maps:

“Political boundaries indicated on the map are not authoritative”

The best source for data on the official boundary of an LGU is its charter which is available from the Official Gazette of the Philippines. These charters usually provide the technical description of the delineation of an LGU’s boundaries. It is advisable that each LGU should have an actual copy of their charter.

c. The map should also reflect the location of the barangay centers. This can be denoted by a small hollow point."
Figure 20. Sample Administrative Map

Administrative Map
Municipality of Makilala
Province of North Cotabato

LEGEND
- Municipal boundary
- Barangay boundary

Prepared by:
MAKILALA MAPPING TEAM
March 2004

Reviewed by:
FULL NAME
Technical/Community Mapping Team Coordinator

Checked by:
FULL NAME
Municipal Planning and Development Coordinator

References:
4. Land Classification Map

This map presents the distribution of two general classifications of the Philippine lands: alienable and disposable (A&D) and forestlands.

Content and suggested mapping standard

This line type will be used to delineate the two categories and the result will be polygons marked respectively as:

- A & D: Alienable and Disposable
- FL: Forestland

Summary Table

Table 6. Sample summary table for Land Classification Map

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Area (ha)</th>
<th>% of Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL</td>
<td>Forestland</td>
<td>19,936</td>
<td>56.04</td>
</tr>
<tr>
<td>A&amp;D</td>
<td>Alienable and Disposable</td>
<td>15,639</td>
<td>43.96</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>35,575</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Notes

a. According to NAMRIA’s Land Classification Division, the maps they produce are the authority in terms of Land Classification. No other agency of the government is mandated to delineate on the ground the declared boundary between alienable and disposable lands.

b. If the mapping teams use data from the NAMRIA’s Land Classification Division, they should indicate the project number, land classification number, and date of the survey of the map references. This will facilitate the easy validation of the maps. If data were copied from the CENRO or PENRO, also indicate what particular maps were used.
Figure 21. Sample Land Classification Map
5. Elevation Map

This map shows the distribution of the area of the LGU according to these elevation (meters above sea level or masl) categories: 500, 500-1000 and 1000 and above. It can be derived from NAMRIA’s 1:50,000 topographic map, which shows contour lines at 20-meter interval.

Content and Suggested Mapping Standards

The 500 and 1000 meter contour lines in the 1:50,000 topographic map will be traced and the lines will serve as boundaries of the elevation polygons. Use thick lines as boundaries. The different elevation polygons will be symbolized as shown below:

- E1 Less than or equal to 500 masl
- E2 500 - 1,000 masl
- E3 Above 1000 masl

Summary Table

Table 7. Sample summary table for Elevation Map

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Area</th>
<th>% of Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Less than or equal to 500 masl</td>
<td>10,244</td>
<td>28.80</td>
</tr>
<tr>
<td>E2</td>
<td>500 meters to 1000 masl</td>
<td>10,662</td>
<td>29.97</td>
</tr>
<tr>
<td>E3</td>
<td>1000 masl and above</td>
<td>14,669</td>
<td>41.23</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>35,575</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Notes

The above elevation categories are considered useful for forest land use planning. The 1000-meter and above elevation category is useful in identifying protection forests. The other elevation categories specify general elevation ranges that are significant in locating certain crops for cultivation. If the LGU wishes to show other elevation lines for their special needs, additional elevation categories may be added. The 500 and 1000-meter contour lines however should be maintained.
Figure 22. Sample Elevation Map
6. Infrastructure Map

This map presents the location and distribution of a variety of infrastructure within the LGU, A & D areas and forestlands. The type of infrastructure that should be included in the map will depend on what is relevant to the planning activity being undertaken. For FLUP, the infrastructures that are considered important are those enumerated on the next page.

The map is designed to show the following:

a. Infrastructure support that has been provided in the uplands to support livelihood activities and the delivery of social services to upland communities;

b. Infrastructure that are dependent on water resources of the LGU, i.e., irrigation, domestic water supply and hydropower; and

c. Infrastructure investments in the lowlands, which may be adversely affected by flooding caused by the degradation of the uplands.

Content and Suggested Mapping Standards

**Transportation**

- ![Bridge](image)
- ![Port](image)
- ![Airport](image)
- ![National Road](image)
- ![Provincial Road](image)
- ![Barangay Road](image)
- ![Trail](image)
- ![Railroad](image)
- ![Power transmission line](image)

**Utilities/ Facilities**

- ![Elementary School](image)
- ![Secondary/Tertiary education establishment](image)
- ![Hospital](image)
- ![Barangay health center](image)
- ![Barangay hall](image)
- ![Municipal government center](image)
- ![Waste disposal site](image)
- ![Offtake point for domestic water supply](image)
- ![Offtake point for communal irrigation system](image)
- ![Offtake point for national irrigation system](image)
- ![Hydropower generation facility](image)
- ![Power generation facility](image)
- ![Irrigation service area](image)
Summary Table

Table 8. Sample summary table for Infrastructure Map

<table>
<thead>
<tr>
<th>Description</th>
<th>Number/Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge</td>
<td>No.</td>
</tr>
<tr>
<td>Port</td>
<td>No.</td>
</tr>
<tr>
<td>Airport</td>
<td>No.</td>
</tr>
<tr>
<td>National Road</td>
<td>Kilometer</td>
</tr>
<tr>
<td>Provincial Road</td>
<td>Kilometer</td>
</tr>
<tr>
<td>Municipal Road</td>
<td>Kilometer</td>
</tr>
<tr>
<td>Barangay Road</td>
<td>Kilometer</td>
</tr>
<tr>
<td>Trail</td>
<td>Kilometer</td>
</tr>
<tr>
<td>Railroad</td>
<td>Kilometer</td>
</tr>
<tr>
<td>Power Transmission Line</td>
<td>Kilometer</td>
</tr>
<tr>
<td>Flood Control Structures</td>
<td>No.</td>
</tr>
<tr>
<td>Elementary School</td>
<td>No.</td>
</tr>
<tr>
<td>Secondary/Tertiary Schools</td>
<td>No.</td>
</tr>
<tr>
<td>Hospital</td>
<td>No.</td>
</tr>
<tr>
<td>Barangay health center</td>
<td>No.</td>
</tr>
<tr>
<td>Barangay hall</td>
<td>No.</td>
</tr>
<tr>
<td>Municipal government center</td>
<td>No.</td>
</tr>
<tr>
<td>Waste disposal site</td>
<td>Has</td>
</tr>
<tr>
<td>Point sources of domestic water supply</td>
<td>No.</td>
</tr>
<tr>
<td>Offtake points for irrigation system</td>
<td>No.</td>
</tr>
<tr>
<td>Communal Irrigation Systems</td>
<td>No.</td>
</tr>
<tr>
<td>National Irrigation Systems</td>
<td>No.</td>
</tr>
<tr>
<td>Hydropower generation facility</td>
<td>No.</td>
</tr>
<tr>
<td>Power generation facility</td>
<td>No.</td>
</tr>
<tr>
<td>Extent of Irrigated Area (by CIS or NIS)</td>
<td>Has</td>
</tr>
</tbody>
</table>

Notes

a. Most of the map data on irrigation systems are limited only to location of the off-take points of the irrigation systems. The coverage areas of these irrigation systems are indicated only on documents mentioning the barangays or sitios that are served. We take this a step further by delineating these areas on the map to readily know which areas are served by certain catchments.

b. Data on water permits issued by the National Water Resources Board (NWWRB) can be accessed by LGUs. This is organized as a table but each permit has an accompanying coordinates of the location of each permittee which can easily be plotted. Other information included in the table are name of permittee, date of issuance, allowable volume for extraction, fees paid, etc.

c. The map may also show infrastructures that are included in the LGU’s current investment plan especially those that are related to water and that will be located within the forestlands.

d. The LGU may add other types of infrastructure but care must be taken so that the map is not cluttered by too many infrastructure types. Refer to the description of the map in determining what other infrastructure may be included.

e. If the infrastructure data are numerous and makes the map confusing, then the infrastructure map may be separated into two maps: the social infrastructure and the water-related infrastructure.

f. Carefully choose the size of the point symbols that it is neither too small that the symbols cannot be properly distinguished or too big that it blocks out other features of the map.
Figure 23. Sample Infrastructure Map
7. Settlement Map

This map shows the spatial distribution of the barangay centers and population clusters in a municipality, particularly in the forestlands. The population size is shown as a range of number of households. This kind of representation of the population is important to readily see where the concentration of population is in an area, in relation to other features such as watersheds, forest resources, and services.

Contents and Suggested Mapping Standards

This thematic map generalizes a cluster of houses as points in order to show the distribution of population clusters in an area. The legend below will be used to pinpoint the location of population clusters (sitiopurok centers or groups of not less than 5 households) and show the density of the population in each cluster. Each point symbol represents a range of number of households as shown below.

- 1-20 households
- 21-40 households
- 41-60 households
- 60 and above households

Summary Table

The summary table that will be indicated in the map will be no. of households per barangay.

Table 9. Sample summary table for Settlement Map

<table>
<thead>
<tr>
<th>Barangay Name</th>
<th>Population</th>
<th>No. of Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prutas</td>
<td>1,253</td>
<td>320</td>
</tr>
<tr>
<td>Kakahuyan</td>
<td>758</td>
<td>186</td>
</tr>
</tbody>
</table>

Notes

a. This data may not be readily available from a single source. Data may need to be integrated from different sources such as the topographic, LGU and community maps; and the mapping team’s knowledge of the area. The inputs of the community and the mapping team will be helpful in identifying the location of population clusters outside the sitio center.

b. Existing maps from other offices of the LGU such as spot or sketch maps from a Department of Health (DOH) household mapping project focused on the lowland areas will be very useful here.

Spot or community maps would usually illustrate the estimated locations of individual houses. For our purpose we need only to reflect the sitio/purok center and so we need to generalize the locations of individual houses. The location where there is greater concentration of houses can therefore be considered as the sitio/purok center. The sitio center will then be represented by the symbol that corresponds to the number of households present in the area. It should be noted that households that are isolated from the cluster but is still within the sitio’s jurisdiction will still be part of the household count of a particular sitio. The diagram below the number of household for Sitio Bayabas will be 9 and 7 for Sitio Santol.
Population within a particular watershed can readily be determined during the overlay analysis using this kind of representation.

c. Access to a GPS unit will be useful in taking the coordinates of the sitios on the ground. It is common that a cluster or group of houses have varying distances between each other. Somebody has to make an approximation of the center of the cluster and stand there to collect the coordinates using the GPS.
Figure 27. Sample Settlement Map

SETTLEMENT MAP
Municipality of Lebak
Province of Sultan Kudarat

LEGEND
- 1-20 households
- 21-40 households
- 41-60 households
- 60 & above households

BARANGAY POPULATION No.of HH
Basak 4,238 675
Bolebak 1,648 154
Bululawan 1,437 245
Capilan 2,414 321
Christianuevo 4,014 520
Kalampong 2,917 449
Keytodac 4,561 574
New Calinog 1,451 112
Nuling 2,426 415
Pansud 2,753 101
Poboy-poboy 4,662 447
Ragandang 1,983 228
Salaman 3,499 401
Salangang 4,508 324
Tran 2,243 50
Villamonte 3,762 606
TOTAL 48,516 5,622

Prepared by: Reviewed by: Checked by:
LEBAK MAPPING TEAM Technical/Community Mapping FULL NAME Municipal Planning and Team Coordinator Development Coordinator
March 2004

Mapping Guidebook for Forest Land Use Planning
8. Slope Map

The slope map shows the distribution of different degrees of steepness of a given area. Slope may be expressed in various ways, but all is dependent on the comparison of the vertical distance to the horizontal distance. We shall use the percentage slope as our unit of measurement for this map. Slope data is derived by relating the rise of land to run. Although angle measurement is easier to visualize, the slope percentage is used because the slope characteristics of certain area can be derived using the contour lines of a topographic map. Slope limits the kind of activities appropriate in a certain area. The categories under this map may vary according to the needs of the user but for FLUP the four slope categories below will be relevant.

Content and Suggested Mapping Standard

Four categories are suggested for use in forest land use planning. The polygon representing the area of one slope category will be presented in the map as follows:

- **S1**: 0-18 percentage slope (level to rolling)
- **S2**: 18-30 percentage slope (rolling to hilly)
- **S3**: 30-50 percentage slope (steep hills to mountainous)
- **S4**: 50 and above (cliff-like, stream side, mountainous)

Summary Table

Table 10. Sample summary table for Slope Map

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Area (ha)</th>
<th>% of Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>0-18 percentage slope</td>
<td>24,106</td>
<td>67.75</td>
</tr>
<tr>
<td>S2</td>
<td>18-30 percentage slope</td>
<td>7,513</td>
<td>21.11</td>
</tr>
<tr>
<td>S3</td>
<td>30-50 percentage slope</td>
<td>2,990</td>
<td>8.41</td>
</tr>
<tr>
<td>S4</td>
<td>50-100 percentage slope</td>
<td>966</td>
<td>2.72</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>35,575</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Notes

- a. The slope categories can help determine suitable land uses in the forestlands. For instance, agroforestry activities are generally suited to 30-50% slope and areas with slope of 50% and above should be protected as these areas are prone to erosion and landslides.
- b. The Bureau of Soils and Water Management (BSWM) have produced printed slope maps for the entire Philippines but are smaller in scale than the NAMRIA topographic map (usually in 1:250,000 scale). For the purpose of the FLUP, the BSWM maps will suffice. However, if the LGU needs a more detailed map which they will use for other purposes, they can derive it by using the instructions below.
- c. Topographic maps are the primary map data source in generating the slope map. The contour or elevation lines which we see as concentric lines on the map will enable us to determine the slope. In general, contour lines that lie close together indicate a steep surface. On the other hand, contour lines which are farther apart from each other indicate a surface that is slightly sloping to flat land. Since we need to be specific about the delineation of slope categories, we need to fine tune this process a little further. Percentage slope is computed using the formula below:

  \[
  \% \text{Slope} = \left( \frac{VD}{HD} \right) \times 100
  \]

  where:
  - \( VD \) is vertical distance
  - \( HD \) is horizontal distance

  We measure the values from the map, plug it into the formula then compute for the percentage slope. However, if we go through such process, it would take too much time. We can simplify and speed up the slope delineation by computing the range of horizontal distance (map distance) that will fall within each category. An area will be classified under a particular slope category if the measured distance of the two elevation lines fall within any of the distance ranges specified. A slope template is provided which will be useful if a slope map will be derived from the 1:50,000 topographic map. The equivalent of percentage slope in degrees is also provided.
<table>
<thead>
<tr>
<th>DEGREES</th>
<th>MAP/DISTANCE</th>
<th>SLOPE TEMPLATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>45°</td>
<td>Distance of 20-meter interval elevation lines on 1:50,000 topographic maps is less than 0.8 mm</td>
<td>100%</td>
</tr>
<tr>
<td>26.5°</td>
<td>Distance of 20-meter interval elevation lines on 1:50,000 topographic maps is less than 0.8 mm</td>
<td>50%</td>
</tr>
<tr>
<td>16.69°</td>
<td>Distance of 20-meter interval elevation lines on 1:50,000 topographic maps is 0.8 to 1.32 mm</td>
<td>30%</td>
</tr>
<tr>
<td>10.20°</td>
<td>Distance of 20-meter interval elevation lines on 1:50,000 topographic maps is 1.32 to 2.22 mm</td>
<td>18%</td>
</tr>
</tbody>
</table>

Distance of 20-meter interval elevation lines on 1:50,000 topographic maps is more than 2.22 mm

Figure 28. Visual chart of the slope data
Figure 29. Sample Slope Map
9. Existing Allocation and Tenure Map

This map shows the area of forestlands that have been allocated through the issuance of different kinds of tenurial and land allocation instruments. This map is useful to determine the “open access” areas or the extent of the forestlands that do not have any form of tenure or allocation arrangement.

Since the issuance of tenurial/allocation instruments over forestlands are done by different agencies (i.e., DENR, NCIP, Office of the President, Congress) the inputs to this map will come from various sources. Moreover, most of the available maps on allocated/tenured areas cover only the area that is placed under a specific tenure instrument or allocation arrangement.

Content and Suggested Mapping Standards

A number of tenure/allocation instruments may be present in an LGU so the legends suggested will be a combination of hatches and acronym written inside the polygon.

The tenure/allocation instruments can be divided into two groups according to the main purpose of issuance:

a) Forestland management, and

b) Other uses.

Forest Management Related

Involving communities:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBFMA</td>
<td>Community-based Forest Management Agreement</td>
</tr>
<tr>
<td>CADT</td>
<td>Certificate of Ancestral Domain/Land Title</td>
</tr>
<tr>
<td>CADC</td>
<td>Certificate of Ancestral Domain/Land Claim</td>
</tr>
<tr>
<td>FLMA</td>
<td>Forest Land Management Agreement</td>
</tr>
<tr>
<td>CSC</td>
<td>Certificate of Stewardship Contract</td>
</tr>
<tr>
<td>MSC</td>
<td>Mangrove Stewardship Contract or Community-based Mangrove Stewardship Contract</td>
</tr>
</tbody>
</table>

Involving private sector:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFMA</td>
<td>Integrated Forest Management Agreement</td>
</tr>
<tr>
<td>SIFMA</td>
<td>Socialized Integrated Forest Management Agreement</td>
</tr>
<tr>
<td>FLGMA</td>
<td>Forest Land Grazing Management Agreement</td>
</tr>
<tr>
<td>FLA</td>
<td>Foreshore Lease Agreement</td>
</tr>
<tr>
<td>TLA</td>
<td>Timber License Agreement</td>
</tr>
</tbody>
</table>

Involving local government units:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF</td>
<td>Communal forest</td>
</tr>
<tr>
<td>CWA</td>
<td>Community Watershed areas</td>
</tr>
<tr>
<td>CMA</td>
<td>Co-management Agreement</td>
</tr>
</tbody>
</table>

In protected areas:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA</td>
<td>NIPAS Proclaimed Protected Area</td>
</tr>
<tr>
<td>PACBRMA</td>
<td>Protected Area Community-based Resource Management Agreement</td>
</tr>
</tbody>
</table>

B. Special Land uses

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>Civil reservation</td>
</tr>
<tr>
<td>MR</td>
<td>Military reservation</td>
</tr>
<tr>
<td>LG</td>
<td>Land grant to universities and research institutions: regional bodies</td>
</tr>
<tr>
<td>SPLUMA</td>
<td>Special Permits issued by DENR (the initials will depend on what is awarded)</td>
</tr>
<tr>
<td></td>
<td>Other instruments (the initials will depend on what is awarded e.g. SPDA-Southern Philippines Development Authority</td>
</tr>
</tbody>
</table>
Forestland management includes forest management agreements and stewardship contracts issued by the DENR, ancestral domain certificates/titles issued by NCIP, issuances/agreements on the management of local watersheds, and presidential proclamations and laws declaring certain forestland areas as protected areas and forest reserves. The second category covers areas allocated/reserved for use such as settlement, mining, military purposes, and for special uses.

In many instances there would be several tenure holders for one kind of tenure with the LGU. For instance, there would be several CBFMA areas in a municipality. In such cases, label the polygons as CBFMA1, CBFMA2, etc., to distinguish one CBFMA from another. Gather also the area of each tenure which is indicated in the tenure holders’ papers. These are usually available at the CENRO and PENRO offices. Please be aware that the area in the papers does not necessarily indicate the area of a particular tenure within the municipality. It is common that the tenure would be located in portions of two or more LGUs. All these data should be summarized following the format of the two summary tables.

**Summary Table**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Area</th>
<th>% of Total Forestlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>CADC</td>
<td>1 CADT</td>
<td>8,750</td>
<td>25.95</td>
</tr>
<tr>
<td>TLA</td>
<td>1 TLA</td>
<td>10,500</td>
<td>31.14</td>
</tr>
<tr>
<td>CBFMA</td>
<td>3 CBFMA</td>
<td>6,900</td>
<td>20.46</td>
</tr>
<tr>
<td>CADC-CBFMA</td>
<td>CADC-CBFMA overlap</td>
<td>2,560</td>
<td>7.59</td>
</tr>
<tr>
<td>Total Tenure</td>
<td></td>
<td>28,710</td>
<td>85.14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Tenure Holder</th>
<th>Area Paper</th>
<th>Area within LGU</th>
</tr>
</thead>
<tbody>
<tr>
<td>CADC</td>
<td>Mangayunan</td>
<td>8,750</td>
<td>25.95</td>
</tr>
<tr>
<td>TLA</td>
<td>Tree Logging Corp.</td>
<td>10,500</td>
<td>31.14</td>
</tr>
<tr>
<td>CBFMA</td>
<td>DISKAI MPC</td>
<td>2,400</td>
<td>7.11</td>
</tr>
<tr>
<td>CBFMA</td>
<td>Buhay MPC</td>
<td>2,300</td>
<td>6.82</td>
</tr>
<tr>
<td>CBFMA</td>
<td>Matimbi MPC</td>
<td>2,200</td>
<td>6.52</td>
</tr>
<tr>
<td>CADC-CBFMA</td>
<td>Mangayunan-Buhay MPC</td>
<td>2,560</td>
<td>7.59</td>
</tr>
<tr>
<td>Total Tenure</td>
<td></td>
<td>28,710</td>
<td>85.14</td>
</tr>
</tbody>
</table>

**Notes**

a. Forest related tenure instruments are available at the DENR CENROs/PENROs. Ancestral domain maps are available at the NCIP central office in Manila. Maps of other allocation arrangements, covered by Presidential Decrees or Republic Acts can also be checked first with DENR before these are sourced from other agencies.

b. Since the instruments are awarded by different agencies, it is expected that there will be overlaps among them. These overlaps can be shown in the map by hatching or shading the overlapping area. These areas, however, should be accounted for in the summary table. A general entry on total overlaps can be included in the table and the figure can be deducted from the total tenured area.

Example:

Overlap of CADC/CADT and CBFMA

c. When the tenure/allocation instruments are too many, the FLUP Team may consider preparing two tenure maps: one on forest-related allocation/tenure and the other on non-forest related allocation/tenure.

d. The list provided in the legend may not be complete as some old tenurial instruments issued by DENR may still be in effect. Simply add these tenure instruments to the list.

e. There are cases when CLOAs are found to cover forestlands. Include these among the tenure/allocation instruments that are non-forest based.
Figure 30. Sample Tenure Map
10. Land Cover Map

This map shows the existing types of land cover in forestlands and their distribution. This map will determine the extent of (a) natural forests that still exist, (b) forests that have been converted to other uses, and (c) open areas that require rehabilitation.

The FLUP adopts the forest definition of the United Nations Environmental Program (UNEP). It describes forest as areas with greater than 10% canopy cover in every hectare of land. This definition is further classified into two types of forests with 10-40% canopy cover that are categorized as open or fragmented and areas with 40% or more is classified as a closed forest.

In the Philippines, vegetative covers are usually categorized into: old growth forest, residual forest, mangrove tree plantations, agroforestry (mix of forest trees and agricultural crops), grasslands/brushlands, agricultural crops, mangroves, built-up areas, and non-vegetated or open areas. In the absence of an existing land use map for forestlands, land cover maps provide indications on the current uses of forestlands since land cover is closely associated with land use. Very few LGUs would have updated vegetative cover data. The LGU can make use of published land cover maps and enhance it through community mapping and field validation.

Content and Suggested Mapping Standard

The map will cover only forestlands. The legend for the various types of vegetative cover in forestlands will look like this:

- NFC: Natural Forest - Closed
- NFF: Natural Forest - Fragmented
- M: Mangrove
- TP: Tree Plantation
- AF: Agro-forestry
- GB: Grassland/Brushland
- AC: Agricultural Crops/Kaingin
- N: Non-vegetated or open areas
- B: Built-up Areas
- O: Other

### Summary Table

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Area (Ha)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFC</td>
<td>Natural – Closed Forest</td>
<td>3,141</td>
<td>8.83</td>
</tr>
<tr>
<td>NFF</td>
<td>Natural – Fragmented Forest</td>
<td>9,259</td>
<td>26.04</td>
</tr>
<tr>
<td>M</td>
<td>Mangrove</td>
<td>128</td>
<td>0.38</td>
</tr>
<tr>
<td>TP</td>
<td>Tree Plantation</td>
<td>190</td>
<td>0.53</td>
</tr>
<tr>
<td>AF</td>
<td>Agroforestry</td>
<td>4,107</td>
<td>11.54</td>
</tr>
<tr>
<td>GB</td>
<td>Grassland/Brushland</td>
<td>1,495</td>
<td>4.20</td>
</tr>
<tr>
<td>CA</td>
<td>Agricultural Crops/Kaingin</td>
<td>16,427</td>
<td>46.18</td>
</tr>
<tr>
<td>N</td>
<td>Non-Vegetated Areas</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>B</td>
<td>Built-up Areas</td>
<td>828</td>
<td>2.30</td>
</tr>
<tr>
<td>O</td>
<td>Other land cover/uses</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>35,576</td>
<td>100.00</td>
</tr>
</tbody>
</table>

### Notes

a. If no old land use or vegetative cover map is available at the start of the FLUP process, the LGU can start with the 1988 land cover map which NAMRIA has published in their 1:250,000 SPOT Map Series. This can be the initial basis for field validation. The 1988 map can then be adjusted based on the results of community and on-site validation.

b. The 1988 map used over 20 categories, the descriptions of which do not fully correspond to the categories listed above. In converting the 1988 map to the standard FLUP vegetative cover map, the matching of the categories that is shown in the following page can be considered.

c. In forests and forestlands management, great importance are given to the natural forest cover mainly because of: a) relative diversity of its biological resources compared to the other vegetative covers and b) positive impact of its multi-storey canopy structure on the hydrological processes and soil and water conservation. Canopy structure of natural forests is composed of dominant, intermediate, and understorey canopy which help diminish the impact of water by redistributing the
rain to the leaves then trickles down the stems and trunks of trees before reaching the soil. This helps lessen the compacting effect of rain on soil thereby maintaining the water storage or absorption capacity of soils (FAO, 2007). The interception of rain by the forest canopy also “prolongs the time over which rain reaches the soil thus, lessening surface runoff and flash flood” (Mendoza-Diaz, 1999).

UNEP and the International Union of Forestry Research Organizations (IUFRO) drafted a working paper suggesting that the ratio of the natural forest areas to the total area be used as a measure of the environmental scarcity of forests. It proposes that a certain country would be an area with “low forest cover” when the ratio falls below the 10% threshold (UNEP and IUFRO, 2007). The same threshold could be applied at subnational level to guide policy and decisionmakers in taking action when a particular political unit is considered with low forest cover.

d. If small polygons (less than 50 hectares or smaller than a 1x2 centimeter polygon in 1:50,000 map) are found with a larger polygon with a different category, it is suggested that these be integrated into the larger polygon. If these polygons occur within forests an exception can be made because these polygons most likely represent kaingin areas and would be a useful input in terms of determining threats to the existing forest cover.

e. Data based on community maps and its area may not be precise but are approximation of the extent. It is advisable to make a note on the map how such map was derived.
### Table 14. Translating Past Land Cover Map categories to categories used for the FLUP

<table>
<thead>
<tr>
<th>OUR CATEGORIES</th>
<th>1988 LAND COVER MAP CATEGORIES AND DESCRIPTION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORESTS</td>
<td>CODE  NAME</td>
<td>DESCRIPTION</td>
</tr>
<tr>
<td>Natural Forest-Closed Canopy</td>
<td>Fp Pine forest</td>
<td></td>
</tr>
<tr>
<td>Fy Mossy forest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fd Dipterocarp and/or other broad-leaved forest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fdc Closed canopy</td>
<td></td>
<td>Mature trees covering &gt;50%</td>
</tr>
<tr>
<td>Natural Forest- Fragmented Canopy</td>
<td>Fdo Open canopy</td>
<td>Mature trees covering &lt;50%</td>
</tr>
<tr>
<td>Mangrove</td>
<td>Fm Mangrove vegetation</td>
<td></td>
</tr>
<tr>
<td>Agro-forestry</td>
<td>Im Mixed intensive cultivation</td>
<td>Crop land and plantations less than 100 has</td>
</tr>
<tr>
<td>Plantations</td>
<td>Ip Plantations larger than 100 has</td>
<td></td>
</tr>
<tr>
<td>lpo Other plantations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grassland/Brushland</td>
<td>Eg Grassland</td>
<td>Grass covering &gt;70%</td>
</tr>
<tr>
<td>Agricultural Crops/Kaingin</td>
<td>E Extensive land use</td>
<td>Populated areas in uplands and grasslands, &gt;10% cultivated and other open areas, &lt;70% cultivated area</td>
</tr>
<tr>
<td>Ec Cultivated and other open areas in forest</td>
<td></td>
<td>Each symbol representing 50 has</td>
</tr>
<tr>
<td>l Intensive land use</td>
<td></td>
<td>Croplands, plantations and fishponds, &gt;70% cultivated area</td>
</tr>
<tr>
<td>lco Arable land</td>
<td></td>
<td>Crops mainly cereals and sugar</td>
</tr>
<tr>
<td>lpc Coconut plantations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Vegetated Land</td>
<td>N Non-vegetated land</td>
<td></td>
</tr>
<tr>
<td>Ne Eroded area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E Symbol for minor eroded spot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nq Quarry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q Symbol for minor quarry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Other barren land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nr Riverbeds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Built-Up Area</td>
<td>B Built-up area</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>M Marshy area and swamp</td>
<td></td>
</tr>
<tr>
<td>L Lake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S Siltation pattern in lake or along the coast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If Fishponds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ifm Fishponds derived from mangrove</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ifo Other fishponds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 32. Sample Land Cover Map
11. Issues Map

This map depicts “deforestation hotspots” or areas where evident illegal cutting and forest conversion to other land uses have occurred in the last two years. The main sources of these data are the community. The areas shown should be perceived by the community as a prevalent site of deforestation activities. This theme can usually be generated using community mapping.

Content and Suggested Mapping Standards

The areas considered by the community as “deforestation hotspots” can be symbolized using the example below:

- Timber poaching
- Forest conversion site

Notes

a. Other issues such as areas with contested political and tenure boundaries that the LGU technical working group would consider important in the planning process may be included in the map.

b. Data from the CENRO may also help in generating this map.
Figure 34. Sample Issues Map
12. Geologic Hazards Map

This map intends to show geologic hazards and risks within the LGU’s area. Hazards are defined as “a potential threat to humans and their welfare” (OAD). Geologic hazard or geohazard is “any geological or geomorphological events which has an adverse impact on the human use system. These are naturally occurring phenomena and they only become hazardous when the presence of human beings, properties and infrastructures are at Risk” (MGB, 2007).
Geohazards can be classified into 2 kinds:

1. High magnitude, low frequency events or events that happen with significant amount of damage but do not occur frequently, such as earthquakes and volcanic eruptions.

2. Low magnitude, high frequency events or events that have lower degree of destruction but occur more frequently such as flooding, landslide and soil erosion/siltation.

Other examples of these adverse geologic conditions are the following:

- Fault rupture displacement of the terrain or ground along a geological fault
- Recent (active) fault exhibiting actual movement or seismic activity
- Mudflows or avalanche-like muddy flow of soft/wet soil and sediment materials, narrow landslide
- Rock falls or rocks tumbling down

Figure 36. Illustration of different geohazards produced by an erupting volcano
• Rock slides (rock avalanche) and debris flows
• Torrents or rapid floods or heavy current creeks with irregular course
• Volcanic eruptions, lahars and ash falls (Wikipedia, 2007)

It is important to note that the occurrence of any of the possible threats enumerated above do not make it a hazard since these are natural occurrences. It becomes a hazard when these threats would result in human injury, loss of life, disease and stress and its welfare such as property damage, economic loss, pollution and loss of amenity.

**Risks** are defined as the “possibility of suffering, harm, loss or danger” (UNESCO). Risk areas are usually the areas where settlements are located near the hazard areas or are in the path of moving materials from hazard areas (e.g., lava from mouth of volcano, rocks and soil from landslides brought down by rainwater). For the purpose of forest land use planning, hazards and areas of risks will be located through the following:

a. Identifying areas where historically hazardous events have occurred; and,

b. Deriving these hazard areas from slope and thematic maps.

**Content and Suggested Mapping Standards**

The general area of these hazard source and risk areas shall be shown on the maps as polygons.

- **HZL** Hazard Areas (identify what kind of hazard is present and make symbolize them as indicated - HZL - Landslide Hazard
- **RSK** Risk Area

**Notes**

a. Identification of location of historical geologic hazard events may be done through community mapping or through interviewing people and locating the places that were mentioned on the map. This is very important because hazard prone areas are mostly to recur and will be located in the same locale.

b. Risk areas can be identified by overlaying the generated identified hazards, watershed and settlement map. Overlaying the hazards and settlement can show the proximity of the potential geohazards to settlement areas. Overlaying the hazards, settlement and watershed map will help figure out if the landslide occurring far from a settlement may cause potential harm because of the presence of drainage system that can move the landslide materials like rocks and soil to the downstream area of a watershed, where the settlement areas are.

It can also be identified by mapping settlement areas which have suffered the negative impacts of geohazards in the past. Historical geohazard events provide a clue on the geologic activity in a particular area. Experience of earthquakes due to fault line movement in the past would mean that the area is geologically active and potential hazards could occur. These risks could be identified through community mapping and interviewing old people in the area.
Figure 38. Sample Geohazards Map
13. Mining Tenements Map

This map intends to show the location and extent of existing mining reservations, agreements and applications, and exploration permits within the LGU’s jurisdiction. The mining agreements can be classified into three classes based on the scale of area and operation under the agreement. These are the following:

a. Small-scale mining or the minahang bayan;

b. Medium-scale mineral agreements; and,

c. Large-scale Financial or Technical Assistance Agreement (FTAA)

The mineral agreements have 3 types also and these are the

a. Mineral Production-Sharing Agreement (MPSA)

b. Co-Production Agreement (CA), and the


The exploration permit (EXP), on the other hand, is a mining right that allows an individual or company to carry out the searching or prospecting for mineral resources that would entail drilling, tunneling, or any other means to determine the existence, extent, quantity and quality of mineral feasible for mining for profit (Congress, 1991). These data can be sourced from the DENR’s Mines and GeoScience Bureau (MGB) and in the CENRO and PENRO offices. The information on issued small-scale mining permits may be sourced from the provincial LGU.

### Content and Suggested Mapping Standards

- **SSM** Small Scale Mining
- **MPSA** Mineral Production Sharing Agreement
- **CA** Co-Production Agreement
- **JVA** Joint-Venture Agreement
- **FTAA** Financial or Technical Assistance Agreement
- **EXP** Exploration Permit
- **APSA** Application for Mineral Production Sharing Agreement
- **AFTA** Application for Financial or Technical Assistance Agreement
- **EPA** Exploration Permit Application
- **MR** Mining Reservation

### Summary Table

**Table 15. Sample summary table for Mineral Map**

<table>
<thead>
<tr>
<th>Type</th>
<th>Agreement Holder</th>
<th>Area</th>
<th>% of Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA</td>
<td>Coolabah Mining Corp.</td>
<td>7,850</td>
<td>19.60</td>
</tr>
<tr>
<td>FTAA</td>
<td>Arimco Mining Corp.</td>
<td>7,715</td>
<td>31.18</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>12,565</td>
<td>50.78</td>
</tr>
</tbody>
</table>
Figure 39. Sample Mining Tenements Map
### 14. Past Forest Cover Map

This map is an important input for the situational analysis as it is used in analyzing the forest cover change in a particular LGU. This map is also important in measuring how much forest cover was there in the previous period and how much forest cover was lost.

**Content and Suggested Mapping Standard**

- **NFC** Natural Forest - Closed
- **NFF** Natural Forest - Fragmented
- **M** Mangrove

**Summary Table**

Table 16. Sample summary table for Past Forest Cover Map

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Area (Ha)</th>
<th>% of Total FL Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFC</td>
<td>Natural - Closed Forest</td>
<td>3,141</td>
<td>8.83</td>
</tr>
<tr>
<td>NFF</td>
<td>Natural - Fragmented Forest</td>
<td>9,259</td>
<td>26.04</td>
</tr>
<tr>
<td>M</td>
<td>Mangrove</td>
<td>128</td>
<td>0.38</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>12,529</td>
<td>35.25</td>
</tr>
</tbody>
</table>
Figure 40. Sample Past Forest Cover Map
CHAPTER 3
Map Overlay Analysis
What is Map Overlay Analysis?

The maps discussed in the previous section organize the different factors that need to be considered in order to decide on how to best manage the forestlands. Thematic mapping lays the ground for doing analysis using maps and gaining understanding how the processes of the real world work. This section describes how to go about processing these maps to provide results that will form the basis for decisions on strategies in improving forest management appropriate to local realities.

All the secondary, field and spatial factors gathered and organized during the data gathering phase will be utilized during the situational analysis phase of the FLUP formulation process. Maps provide a crucial component in the analysis of biophysical and socioeconomic conditions of a local government’s forestlands that will lead to the proposition of strategies in its management. In spatial analysis we answer these questions not by reading a reference of a particular area’s conditions. We use the thematic maps we have earlier produced and do map overlays. Map overlay analysis requires us to literally lay one map over the other in order to see relationships of one spatial information to another. By doing this we are able to locate areas where certain spatial conditions occur based on the forest management criteria we set. By overlaying two or more maps we are able to generate a derived map that can show us graphically the intersection of the different features and what coincident attributes occur in these areas. Figure 42 illustrates the result of a map overlay analysis.

Figure 41. FLUP TWG members using the thematic maps for map overlay analysis
Figure 42. Diagram of the map overlay process

<table>
<thead>
<tr>
<th>Land Classification</th>
<th>Land Cover</th>
<th>Hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forestlands</td>
<td>Closed canopy forest</td>
<td>1,566</td>
</tr>
<tr>
<td>Forestlands</td>
<td>Open canopy forest</td>
<td>2,357</td>
</tr>
<tr>
<td>Forestlands</td>
<td>Plantation</td>
<td>592</td>
</tr>
<tr>
<td>Forestlands</td>
<td>Brushland</td>
<td>1,010</td>
</tr>
<tr>
<td>Alienable &amp; Disposable Lands</td>
<td>Cultivated</td>
<td>2,023</td>
</tr>
<tr>
<td>Alienable &amp; Disposable Lands</td>
<td>Brushland</td>
<td>376</td>
</tr>
<tr>
<td>Alienable &amp; Disposable Lands</td>
<td>Plantation</td>
<td>1,923</td>
</tr>
</tbody>
</table>

Table 17. Resulting attribute table of the sample overlay
Map Overlay for FLUP

The map overlay analysis will have to respond to two main facets of analysis and these are:

1. subwatershed prioritization—one that examines the entire LGU emphasizing the upstream and downstream link and the value of each subwatershed to the LGUs proper functioning, and
2. the closing of the “open access” forestlands which looks specifically at the forestlands and the characteristics of the allocated and unallocated public lands.

Much of the writeup for the situational analysis will be derived from the results of the map overlay analysis but supporting writeup can be drawn from the information gathered from the focus-group discussions, key informant interviews and the observations of the TWG during the field data gathering and community meetings.

In order to logically go through the process of overlaying, one needs to go back to the objective of the planning exercise and this is to set an environmentally and socio-economically sound framework of allocating, managing and mobilizing investments in the forest lands. The main thing to remember when doing overlay analysis is to translate the objectives into a series of questions which will be answered by using the thematic maps.

Before we make decisions on the allocation of the open access areas, we need to know the conditions of the area with respect to the watersheds and later on decide what kind of allocation is appropriate for a certain area given its conditions. The different thematic maps produced capture both biophysical and socio-economic status of the municipality. The number of map overlays that will be done differs from one LGU to another because of the varying conditions of the LGUs. The overlays presented are the basic overlays that need to be done.
OBJECTIVE 1: Determine the general trend in the natural forest assets of the LGU

Map Overlay 1: Natural Forest Cover Change

This overlay will use the current land cover and past land cover maps to be able to determine the changes in the forest cover given two periods. The figure below shows a sample of the comparison of forest cover change trend. This trend analysis will be enriched by the results of key informant and focus-group discussions regarding the history of forest management in the area.

**NATURAL FOREST COVER 1981**
Antipolo City

**NATURAL FOREST COVER Current**
Antipolo City

**LEGEND**

- Forest Cover
- Residual Forest
- Old Growth Forest

Figure 43. Comparison of the Past and Current Forest Cover of Antipolo City
**OBJECTIVE 2: Determine where and how much forestlands are allocated and unallocated or “open access” in an LGU**

**Map Overlay 2: Allocated and Unallocated Forestlands**

This overlay will locate forestlands that are allocated and those that are considered open access areas. The maps that will be used for this overlay are the land classification map and tenure map.

**Output**

The result will be an allocated and unallocated forestlands map. From this map, the extent of the allocated and unallocated areas can be generated by filling out the table below. This table helps identify the areas of the forestlands that need to be allocated.

<table>
<thead>
<tr>
<th>Category</th>
<th>Area (in hectares)</th>
<th>Percentage of Total FL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unallocated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 44. Sample overlay of the Land Classification and Tenure maps
OBJECTIVE 3: Examine the biophysical and socio-economic condition of the delineated watersheds

The next series of overlays are done to characterize biophysical and socio-economic conditions of each watershed or subwatershed system. The forest land use plan does not only focus itself in the allocation of the forestlands but also look at how these allocations and their implementation integrate concerns of productivity, equity and ecological balance in the use of the forestlands and upper watershed and stabilize the positive impact to the downstream areas.

Viewing the LGU within a watershed and using that context in planning is major advocacy of the forest land use planning process because forestlands as a land classification in the Philippines in many instances are the upland areas or the upper watersheds of a certain LGU area. Therefore this means that it impacts the alienable and disposable areas which are found mostly in the lowlands, coastal areas or settlement sites. Each subwatershed will be characterized using the following parameters:

- Biodiversity value
- Hydrologic services
- Economic value
- Potential to protect infrastructure
- Potential to protect lives and properties
- Ecotourism/Aesthetic value
- Extent of threat to forestlands and resources

These analyses inform local governments as to how biophysical systems existing in the area have a major effect in whatever investments they do in their LGU. This has a direct impact on the eventual implementation of management strategies especially when deciding how any forest management and protection is to be handled.

Map Overlay 3: Land classification per watershed

This overlay allows us to see the link of the forestlands to the alienable and disposable lands in a particular LGU. This overlay will use the watershed and land classification maps.

**Output**

The result of the overlay can be used as an indicator to interpret the following:

1. The relative significance of a particular sub-watershed with respect to the total area of the LGU, and
2. The extent of forestlands that directly support the alienable and disposable lands in each of the subwatershed within the LGU and those contributing to the adjacent LGUs.

The table provides a summary of the results of this overlay.

<table>
<thead>
<tr>
<th>Subwatershed</th>
<th>Area of SW (hectares)</th>
<th>% of Total Area of LGU</th>
<th>Alienable &amp; Disposable lands (hectares)</th>
<th>Forestlands (hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Map Overlay 4: Land cover per watershed

This overlay will use the watershed and land cover map to describe the kind and extent of land cover/land use in each watershed.

Output

The result of this overlay allows us to measure the various land cover/use per subwatershed as shown in the sample table on the other page. More significantly this table together with the result of this map overlay can be used as index in interpreting the biodiversity and economic value as well as the hydrologic services that a particular watershed provides.

1. Natural forest assets. The closed canopy and open canopy forest data taken together will provide us with natural forest assets and biodiversity-rich areas within a watershed. Natural forests are usually used as a proxy indicator of biodiversity rich areas.
2. Service areas. The extent of the cultivated and built-up areas illustrates the expanse of the downstream service area of a particular watershed. This can be used as a determinant of the amount of investments in social services.
3. Barelands for development. Brushlands and grasslands are areas that are candidate sites for development into more productive land uses.
4. Type of production area. Area of plantation and second growth areas are indication for type of production forests.
Table 20. Summary of various land cover/use per watershed

<table>
<thead>
<tr>
<th>Subwatershed</th>
<th>Natural Forest</th>
<th>Plantation</th>
<th>Barelands</th>
<th>Cultivated Area</th>
<th>Built-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Closed Canopy</td>
<td>Open Canopy</td>
<td>Brushlands</td>
<td>Grasslands</td>
<td></td>
</tr>
<tr>
<td>W1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>W3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Map Overlay 5: Slope distribution per watershed

This overlay will use the watershed and slope map to show the distribution of slope categories that may dictate the kind of activity and intervention within a particular watershed.

Output

The table will help in situating development activities that are allowable based on the kind of topography. Areas with 0-18 slope are suitable for agriculture and extensive agriculture while slope 18-30 may be suitable for sloping type of agriculture or agroforestry. Areas with the 50% slope are automatically protected, based on the law because of its high vulnerability to geohazards such as erosion and landslides.

Table 21. Summary of slope distribution per watershed

<table>
<thead>
<tr>
<th>Subwatershed</th>
<th>0-18%</th>
<th>18-30%</th>
<th>30-50%</th>
<th>Above 50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3</td>
<td></td>
<td></td>
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<tr>
<td>W4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 46. Sample overlay of the Slope and Watershed maps
Map Overlay 6: Elevation distribution per watershed

This overlay uses the watershed and elevation map to show the distribution and extent of areas within a certain elevation range.

Output

This table summarizes the distribution of elevation range in each of the watershed.

Table 22. Summary of elevation distribution per watershed

<table>
<thead>
<tr>
<th>Sub-watersheds</th>
<th>0-500</th>
<th>500-1000</th>
<th>1000 &amp; above</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>W5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 47. Sample overlay of the Elevation and Watershed maps
Map Overlay 7: Population distribution per watershed

This overlay will use the watershed and settlement map to be able to determine which subwatersheds have the highest concentration of population served both in the uplands and lowlands. This can easily be derived through map overlay analysis because the settlements are represented as dot density as opposed to population data aggregated for each barangay. There are many cases where extent of barangay straddles portions of two watersheds but only one watershed is actually inhabited.

Output

The overlay can be summarized using the table below. Apart from providing indicator of concentration of population the population figure per subwatershed can also be used as an indicator of the requirement for investments in social services in each watershed.

Table 23. Summary of population and household distribution per watershed

<table>
<thead>
<tr>
<th>Sub-watersheds</th>
<th>Population</th>
<th>No. of HH</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 48. Sample overlay of the Settlement and Watershed maps
Map Overlay 8: Type of infrastructure per watershed

This overlay will use the watershed and drainage and infrastructure map to summarize the social services and infrastructure found in each subwatershed.

Output

The table below summarizes the presence of different types of infrastructure per subwatershed. The infrastructure are grouped into roads, bridges, water infrastructure (i.e., dams, irrigation systems, deep wells) irrigated areas and social infrastructure which include schools, hospitals, airport, communication facilities, etc.

Table 24. Summary of different types of infrastructure per watershed

<table>
<thead>
<tr>
<th>Subwatershed</th>
<th>Road Density (km/ha)</th>
<th>No. Bridges</th>
<th>Water Infra (dams, irrigation systems, deep wells)</th>
<th>Irrigated Areas (hectares)</th>
<th>Social Infra (schools, hospitals, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>W3</td>
<td></td>
<td></td>
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<tr>
<td>W4</td>
<td></td>
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<tr>
<td>W5</td>
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<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Map Overlay 9: Barangays per watershed

This map overlay uses the watershed and administrative map to show which barangay units are within each subwatershed.

Output

The table below summarizes the result of the overlay. There could be several barangays within each of the subwatersheds so just indicate the barangay name and area. This may be used to signify the relationship of one barangay to another a watershed context. It can also be used to indicate which barangay would have the most accountability in a particular subwatershed by virtue of the extent of its area.

Table 25. Summary of barangays per watershed

<table>
<thead>
<tr>
<th>Subwatershed</th>
<th>Barangays</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td></td>
</tr>
<tr>
<td>W3</td>
<td></td>
</tr>
<tr>
<td>W4</td>
<td></td>
</tr>
<tr>
<td>W5</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
</tr>
</tbody>
</table>
Map Overlay 10: Status of forestland issues per watershed

This overlay will use the watershed and issues map to show the distribution of the issues that are experienced in each subwatershed. The distribution of issues should be shown so that users will see that there are variations in their intensity within each subwatershed. Issues may also need different solutions.

Output

This overlay does not need a separate resulting map. It is sufficient to overlay the watershed map and issues map to situate the discussion of issues per subwatershed. The table below is filled by descriptions of the issues that are experienced in each of the watershed. Additional columns may be added if the particular issues are not present in the example below.

Table 26. Summary of status of forestland issues per watershed

<table>
<thead>
<tr>
<th>Subwatershed</th>
<th>Illegal Logging</th>
<th>Conversion of Forestlands</th>
<th>Land Claim Conflicts</th>
<th>Resource Use Conflicts</th>
<th>Peace &amp; Order Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>W3</td>
<td></td>
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<tr>
<td>W4</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>W5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 49. Sample overlay of the Administrative and Watershed maps
Map Overlay 11: Protection and production forests per watershed

This overlay will use the land classification per watershed, slope, elevation and land cover maps to delineate the protection and production forests per watershed.

Output

The resulting table shows how much per watershed is the extent of two general forestland use categories, namely: Protection and Production forest. Criteria for delineating protection forests are the following:

- a. slope – areas with 50% and above slope
- b. elevation – areas above 1000 meter elevation, and
- c. land cover – areas with old growth forest

Table 27. Summary of the distribution of protection and production forests per watershed

<table>
<thead>
<tr>
<th>Subwatershed</th>
<th>Protection (Hectares)</th>
<th>Production (Hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This is useful in giving an idea of the general use of a specific subwatershed.

Figure 50. Sample overlay to derive forestland protection and production areas
OBJECTIVE 3: Describe the biophysical condition and status of the on-site management of forestlands by tenure holders and of the untenured area by claimants

Map Overlay 12: Land cover distribution per tenure

This overlay will use the allocated and unallocated map and land cover map to locate and measure the type of land cover within the different types of allocation of the forestlands.

Output

The table below specifies the kind of land cover present in each of the forestlands tenure holder area.

1. Natural forest area – This will be used as a measure for monitoring how tenure holder perform their responsibilities of helping reduce deforestation and reduce the conversion of forestlands.

2. Barelands for development. Brushlands and grasslands are areas that can be put to productive use. This can help LGUs and the DENR identify areas where improvements can be made as well as specify which tenure holders are in charge of managing the forestlands.

Table 28. Summary of land cover distribution per tenure

<table>
<thead>
<tr>
<th>Tenure</th>
<th>Natural Forest</th>
<th>Plantation</th>
<th>Barelands</th>
<th>Cultivated Area</th>
<th>Built-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Closed Canopy</td>
<td>Open Canopy</td>
<td>Brushlands</td>
<td>Grasslands</td>
<td></td>
</tr>
<tr>
<td>Tenure 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tenure 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tenure 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Access 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Access 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Map Overlay 13: Status of management of allocated and unallocated forestlands per watershed

This overlay will use the allocated and unallocated map and the watershed map. This overlay shows the distribution of allocated and unallocated forestlands per watershed.

Output

The table below provides a summary and status of allocated forest lands. Each tenure, as well as the area of its extent in each subwatershed, needs to be enumerated. Another column describing the status of management also needs to be filled out. The information for this column will be taken from the tenure assessment activity, interviews and field data gathering activity.

Table 29. Summary of status of management of allocated and unallocated per watershed

<table>
<thead>
<tr>
<th>Allocations</th>
<th>W1 (ha)</th>
<th>W2 (ha)</th>
<th>W3 (ha)</th>
<th>W4 (ha)</th>
<th>W5 (ha)</th>
<th>Status of Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBFMA – Tenure holder Name</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Describe the on-site management such as: • Area with tenure but not effectively managed – no significant planting or site development • Illegal extraction is occurring • No protection measures are in place • Land uses differ from what is indicated in the approved management plan Tenure holder uses destructive/non-sustainable harvesting methods</td>
</tr>
<tr>
<td>Open Access Area 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Indicate that there are claimants? What is the status of the area? How are resources being utilized on the area? Are the developments being done by the claimants? Who are the claimants?</td>
</tr>
</tbody>
</table>
Map Overlay 14: Extent of Protection and Production forestlands in open access areas per watershed

This overlay will use the protection and production forestlands per watershed and the allocated and unallocated forestlands map.

Output

This overlay shows how much of the protection and production forests are within the open access areas of each of the subwatersheds. This is one of the bases on deciding what kind of allocation will be proposed for the unallocated forestlands in each subwatershed.

Proposed Allocation Map

Integrating one of the major results of the map overlap analysis is the Proposed Allocation Map. This map visually shows the main decision points in formulating the FLUP which is deciding on what tenure arrangement will be applied to close the “open access” forestlands. After the map overlay and situational analysis the planning team proposes what type of allocation will best manage the open access areas in an LGU. The map resembles the tenure map however it presents current tenure and the proposed tenure for the open access areas. In some instances the planning team also proposes not only allocation of the “open access” public lands but also the proposed general land use as shown in the example below. In this case all the unallocated forestlands were proposed for Co-management agreement between Bayawan LGU and the local DENR.
Figure 51. Sample Proposed Allocation Map
SUMMING UP

Rationalizing natural resource management at the local government level is made possible with relevant plans that views LGUs jurisdiction holistically. Relevant plans also start with maps that provide sufficient and relevant detail which are the basis for analysis and subsequent decisions and strategies. This guidebook presents a process that has been used with LGU partners of the Philippine Environmental Governance Project in facilitating the forest land use plan. It shows that gathering accurate and detailed spatial data need not be complicated. Existing maps can be enhanced through the integration of the LGU staff’s spatial knowledge of their municipality, community’s knowledge of their area and the data from the different agencies and offices of the local government. In the process of producing the maps, the planning team was able to contribute to efforts in providing a complete, reliable and updated picture of their city or municipality. It also allowed the LGU to view its jurisdiction as a whole and relate it to its neighboring LGUs.

In recent years, the Internet has come up with web viewers called “earth viewers” (i.e., Google Earth, Microsoft Virtual Earth, etc.) which allows users to virtually go to any place in the world and visualize these places on the computer screen in 3D. This has become very popular not only because it provides a realistic rendering of different places in the world with the use of satellite images, but because it also allows users to add on their own data of their places and allow the public to see it.

These spatial visualization technologies which are accessible and easy to use have created a possible venue for LGUs to share and view maps. They can share maps internally among the different offices of the LGU, with their partner agencies and constituents. Availability of information in the Internet on the location of public investments and approved development projects and industries allow their constituents to visualize how development projects impact their safety and productivity. The possibilities of these technologies are limitless. In the future it may become a standard practice to promote transparency in the LGUs’ decisions and investments through the Internet.
GLOBAL GLOSSARY

Alienable and disposable (A and D) lands are public domain lands that have been limited, classified and declared as such and available for disposition under Commonwealth Act No. 141, otherwise known as the Public Land Act.

Agricultural lands (in forest lands) are areas that are extensively used for the production of cash crops, sustenance crops and fodder.

Agroforestry is a land use management system that combines the production of agricultural crops, forest trees and/or livestock simultaneously or sequentially on the same unit of land for the purpose of creating employment opportunities for upland farm labor, producing raw materials for agriculture or forest-based industries, providing food and other products for home consumption and improving ecological conditions in the watersheds.

Base map shows certain fundamental information such as rivers, roads and political boundaries on which additional, specialized data can be compiled. Base map provides the standard configuration of the planning unit and thus serves as the working map for the preparation of the thematic maps.

Brushlands refer to any tract of the production forest land covered dominantly with shrubby vegetation.

Civil reservations are forest lands that are proclaimed by the President for a specific purpose such as a town site or a resettlement area.

Thematic map is a map designed to show information on a single topic.

Community mapping is a process that aims to externalize or draw out the community’s interpretation of the landscape, its elements, and the activities within it; their socio-cultural relations with their environment; and their perceptions on how best to implement forest resource management.

Forest Lands are either public domain lands that are classified as such by the Public Lands Act or all unclassified lands of the public domain. For the purpose of this manual, forest lands will also include those areas legally classified as mineral lands and national parks.

Forest Land Use refers to the manner of utilization of forest lands, including their allocation, development and management. The primary land uses of forest lands are protection and production. Production forest lands are sub-classified, according to their use, into the following categories: timber production, agriculture, agroforestry, mineral production, grazing, residential, resettlement, and other uses (industrial, commercial, fish farm, fishponds).

Forest Reservation/Reserves refer to forest lands which have been reserved by the President of the Philippines for forest purposes.

Geologic hazard or geohazard is one of several types of adverse geologic conditions capable of causing damage or loss of property and life. Examples of these adverse geologic conditions include volcanoes, faultlines, landslips, unstable/landslides areas which pose risks to lives, crops, property and infrastructure.

Geographic Information System (GIS) is defined as an information system that is used to input, store, retrieve, manipulate, analyze and output geographically referenced data or geospatial data. Descriptive attributes in tabular form are associated with spatial features. Spatial data and associated attributes in the same coordinate system can be layered together for mapping and analysis. This tool is most helpful to support decision making for planning and management of land use, natural resources, environment, transportation, urban facilities, scientific investigations, etc.

Global Positioning System (GPS) is a radio navigation system that allows users on land, sea, and air to determine their exact location, velocity, and time 24 hours a day, in different weather conditions, any place in the world.
**Grasslands** refer to forest lands predominantly vegetated with grasses, devoid of trees or with very few isolated trees.

**Grazing Lands** are forest lands designated, in view of their terrain and vegetation, for the raising of livestock. They are likewise known as rangelands.

**Map overlay** is a method used for analyzing mapped data whereby two or more thematic maps are put on top of another to be able to delineate areas that meet a given set of criteria or conditions. Also known as overlay mapping technique.

**Military reservation** refers to forest lands which have been reserved by the President for military purposes.

**Mineral lands** are areas which are presently exploited for mineral production (including land rendered unproductive by deposits of extraction waste material) and those which are positive for ore reserves in sufficient quantities and grades to justify their extraction. These include proclaimed mineral reservation.

**National Integrated Protected Areas System (NIPAS)** is the classification and administration of all designated protected areas to maintain essential ecological processes and life support systems, to preserve genetic diversity, to ensure sustainable use of resources found therein, and to maintain their natural conditions to the greatest extent possible. The NIPAS was established by Republic Act 7586, known as the NIPAS Act.

**National parks** are forest reservations essentially of natural wilderness character which have been withdrawn from settlement, occupancy, or any form of exploitation except in conformity with an approved management plan and set aside as such exclusively to conserve the area or preserve the scenery, natural and historic objects, and wildlife, and to provide enjoyment of these features in these areas. In DAO 15 s. 1995, all NIPAS areas are to be categorized as national parks.

**Old growth forests** are natural forests which have not been subjected to timber harvesting or extraction; also known as virgin forest.

**Open access areas** are parts of forest lands which are not covered by an existing tenurial instrument.

**Open areas** are forest lands devoid of tree cover. These include grasslands, brushlands, denuded forests, croplands and grazing lands that have been abandoned.

**Percentage slope** is a measurement of the rate of change of elevation over a given horizontal distance, in which the rise is divided by the run and then multiplied by 100. A 45° slope is equivalent to 100% slope.

**Protected areas** are identified portions of land and water set aside by reason of their unique physical and biological significance, managed to enhance biological diversity, and protected against destructive human exploitation. The NIPAS Act has established the following categories of protected areas: strict nature reserve, natural parks, natural monument, wildlife sanctuary, protected landscape and seascapes, resource reserve, natural biotic areas, and other categories established by law, conventions or international agreements which the Philippine is a signatory.

**Residual or Second Growth Forest** refers to natural forest which has been subjected to timber harvesting or extraction.

**Spatial data** information pertaining to a place linked to coordinates or other positional information.

**Technical description** provides the data on the location of the points that make-up a polygon feature such as political boundary. It describes a point by citing the coordinates of the points; or the bearing and distance of succeeding point from a reference point to trace the shape of the polygon.
**Tenurial Instrument** is an agreement or contract between DENR and an individual, people’s organization or corporate entity which guarantee peaceful possession and use of specific forest land area and the resources found therein within a given time period. Such an agreement or contract cannot be altered or abrogated without due process.

**Thematic Map** is a map representing a particular theme or subject, such as vegetation, soils, slope or topography.

**Tic Points** are Geographic control points for a map representing known locations on the earth’s surface. Tics allow all map features to be recorded in a common co-ordinate system. Tics are used to register map sheets when they are mounted on a digitizer. They are also used to transform the coordinates of a coverage, for example, from digitizer units (inches) to the appropriate values for a particular coordinate system.

**Tree plantations** refer to man-made forests.

**Watershed** is an area or region bounded peripherally by mountain ridges and drained by a stream or fixed body of water and its tributaries having a common outlet for surface run-off. It is synonymous with a catchment area or drainage basin.

**Watershed reservation/forest reserve/watershed forest reserve** refers to a defined area in the forest lands that has been proclaimed by law as such, primarily to establish adequate vegetative cover that would prevent erosion, conserve water and nurture wildlife.
REFERENCES


“Two important characteristics of maps should be noticed. A map is not the territory it represents, but, if correct, it has a similar structure to the territory, which accounts for its usefulness.”

Alfred Korzybski