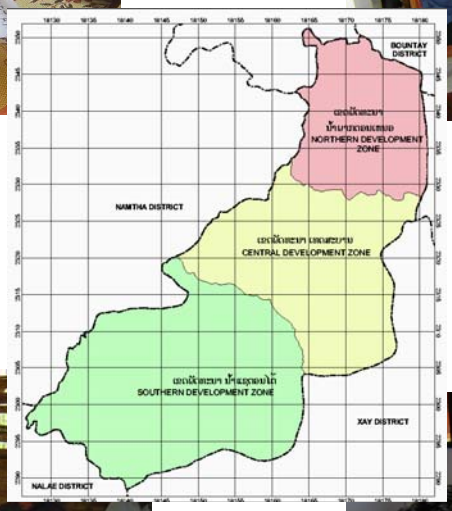
Ministry of Agriculture and Forestry

National Agriculture and Forestry Research Institute

Manual (Draft 2)

Agro-ecosystems Analysis and Agro-ecological Zoning



Land Management Component - Soils Survey and Land Classification Centre

Lao-Swedish Upland Agriculture and Forestry Research Program
January 2005

Ministry of Agriculture and Forestry

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* This first draft manual was produced in July 2004

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Part 1

Introduction to Agro-ecological Analysis

1. **Introduction**
2. **Definition of Agro-ecosystem Analysis**
3. **Purpose and Objectives of AEA**
4. **Key Outputs from AEA**
5. **Reasons for Conducting AEA in the Lao PDR**
6. **Key Terms and Definitions**

Part 1: Introduction

This manual (draft) has been prepared to assist field staff with undertaking agro-eco-system analysis (AEA) and agro-ecological zoning (AEZ) with a focus on upland areas in northern Lao PDR. It is based on field experiences from pilot AEAs conducted by the Lao Swedish Agriculture and Forestry Research Program in 2004 in Phonesay District in Luang Prabang Province and Na Mo District in Oudomxay Province.

Definition of Agro-ecosystem Analysis (AEA)

AEA is a methodology for zoning and analyzing agricultural systems in order to plan and prioritize agro-forestry research, development, and extension activities. It uses a holistic or systems approach to gather bio-physical and socio-economic information and to identify key issues or problems within the eco-system that will be useful for research, development, and extension programs.

It can be conducted at any level; province, district or zone depending on the particular needs of the AEA. In the Lao PDR the preference is the District or Development Area levels because these are the key levels for rural development planning. AEA is undertaken by multi-disciplinary teams of people who possess a range of different skills, for example in the Lao PDR, district administration, district planning, land use planning, farming systems, forestry research, socio-economics, geographic information systems, and extension.

The analysis relies heavily on secondary data, both bio-physical and socio-economic information. Examples of bio-physical data are topography, climate, water resources, geology, soils, communications, infrastructure, land use etc. Examples of socio-economic data are agriculture systems, agro-forestry systems, ethnicity, markets, poverty status, opium addiction etc. Information is gathered by work groups during workshops and in the area of study using various tools such as rapid rural appraisal (RRA), participatory rural appraisal (PRA), village problem census meetings, market surveys, and village transect walks.

Purpose and objectives of AEA

AEA can be used for a variety of purposes which commonly include:

Objective 1: To identify, delineate and characterise different agro-ecological zones within a given land area.
Objective 2: To obtain an improved understanding of agricultural systems in these zones and their key characteristics.
Objective 3: To identifying key issues related to the performance of the entire system and it's agro-ecological zones
Objective 4: To identify agricultural research and extension priorities for the system
Objective 5: To help plan programs, projects and development activities for the system.

Key outputs from AEA

The most important and useful outputs that AEA provides are:

- The delineation and description (bio-physical and socio-economic) of distinct agro-ecological zones.
- An improved, holistic understanding of the major livelihood systems of each zone.
- A prioritized list of important problems and opportunities for each zone.
- A prioritized set of research and development proposals to solve the problems.
- Enhanced interdisciplinary cooperation and improved research and extension linkages.

Reasons for conducting AEA in Lao PDR

The main reasons for conducting AEA in the Lao PDR are to:

- Describe upland land use systems of selected study areas
- Identify, demarcate and map agro-ecological zones of selected study areas
- Describe the physical and socio-economic characteristics and conditions of agro-ecological or forestry zones identified
- Identify agricultural, forestry and socio-economic issues and problems existing in the zones so that they can be addressed by research, development or extension research programs
- Provide District Authorities with information that can be used to plan development activities to address poverty
- Strengthen district skills and capacities in agro-ecological zoning and rural development planning
- Match available agricultural and forestry technology options with identified agricultural sub-systems or recommendation domains within the AEA study areas
- Promote co-operation and linkages between research, development and extension agencies
- To complement and support the agro-ecological zoning initiatives currently being undertaken by the National Agriculture and Forestry Research Institute (NAFRI)
- To document the procedures and methods used in piloting AEA and AEZ activities so that they are available to NAFRI and MAF and other organisations interested in AEA

Key AEA terms

The following key terms are commonly used in AEA and AEZ

English	Lao
System	ລະບົບ
Hierarchy	ການຈັດລະດັບຂອງລະບົບ
Agro-ecosystems	ລະບົບນິເວດກະສິກຳ
System properties	ຄຸນລັກສະນະຂອງລະບົບ
Productivity	ຜະລິດຕະພາບ
Stability	ສະເຖັຽລະພາບ
Sustainability	ຄວາມຍືນນານ
Equitability	ຄວາມສະເໝີພາບ
Agro-ecosystem evolution	ວິວັດທະນາການຂອງລະບົບນິເວດກະສິກຳ
Agro-ecosystem analysis	ການວິໄຈ ລະບົບນິເວດກະສິກຳ
Agro-ecological zone	ເຂດນິເວດກະສິກຳ
System definition	ການກຳນົດລະບົບ
System analysis	ການວິໄຈລະບົບ
Space analysis	ການວິໄຈດ້ານພື້ນທີ່
Time analysis	ການວິໄຈດ້ານເວລາ
Flow analysis	ການວິໄຈດ້ານການເຄື່ອນໄຫວ
Decision making analysis	ການວິໄຈດ້ານການຕັດສິນໃຈ
Key questions	ປະເດັນສຳຄັນ
Hypotheses	ສົມມຸດຕິຖານ
Rapid rural appraisal	RRA
Participatory rural appraisal	PRA
Multi-disciplinary	ຫລາກຫລາຍສາຂາວິຊາ
Ecology	Neeweit vitaya

Definitions of AEA Key Terms

Definitions and explanations of important AEA terms are presented below.

Term	Explanation/Definition
System	A system is an assemblage (or grouping) of elements contained within a boundary where the elements contained within the boundary have strong functional relationships with each other but have limited, weak or non-existent relationships with elements in other assemblages (or groupings)
Agro-ecosystems	As a consequence of agricultural development ecosystems are transformed into agro-ecosystems. The biological and physical boundaries of the system become more clearly defined. Linkages with other systems become limited. It is simplified by the elimination of natural fauna and flora and many natural bio-physical processes. But at the same time the system is made more complex through the introduction of human management and activity.
Systems hierarchies	In the process of agricultural development eco-systems are modified for the purpose of food or fibre production, so creating agro-ecosystems, which can be arranged in a hierarchic scheme. A heirachy is the range of agro-ecosystems above and below the system that is studied.
Agro-ecosystem properties	Four system properties describe the behaviour of agro-ecosystems; productivity, stability, sustainability and equitability. They describe the status of the agro-ecosystem, and are fairly easy to define, but difficult to measure.
Agro-ecosystems evolution	The four system properties of productivity, stability, sustainability and equitability. can be used to trace the historical evolution of an agro-ecosystem and to evaluate it's potential based on different forms of land use or the introduction of new technologies. New forms of land use or the introduction of new technologies may have the immediate effect of increasing productivity, BUT this results in lowered values of the other properties, ie, stability, sustainability or equitability.
Systems analysis	Analysis of the entire system rather than its individual components
System Productivity	The level of production of the system. This may be defined as output, yield, profit, etc. of the system
System stability	The degree of variability in production of the system from year to year or place to place
System Equitability	The distribution of the benefits of the system among the local population living within the system boundaries
System Sustainability	The ability of the system to maintain or increase its productivity over the longer term or in the face of changing conditions.
Key questions	Important issues regarding the performance of the system, which can be further analysed to establish research, development or extension priorities
Hypotheses	Suppositions about the system that can be tested by further survey, experiment or research
Multidisciplinary	Involves people from all relevant disciplines with an interest in the analysis, ie, district administration authorities, district planners, land use planners, and staff representing farming systems, forestry research, socio-economics, geographic information systems, and extension.

Part 2

Procedures and Methodology

1. Agro-ecosystem Analysis Procedures

2. Agro-ecosystem Analysis Implementation Stages

Part 2: AEA Procedures and Methodology

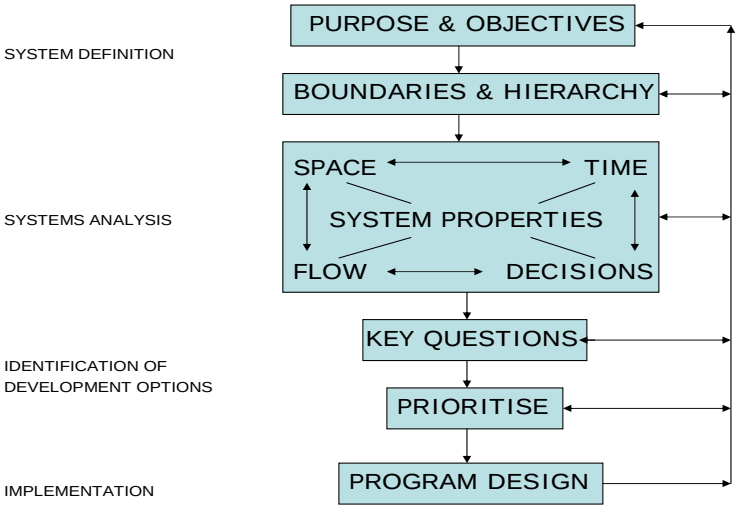
AEA is a methodology for zoning and analyzing agricultural systems in order to plan and prioritize agricultural and natural resources research, development and extension activities.

Agro-ecosystem analysis procedures

As shown in Figure 1 and Table 1, AEA follows a step-by-step procedure to decide on the purpose of the analysis, to define precisely the system(s) of study, identify its boundaries, its position in the hierarchy of other systems and its major components and their key interactions.

As an understanding of the system is developed, a limited number of key issues begin to emerge which are then used to guide later analysis and to plan further field, follow-up studies. As these issues are clarified and understood, key questions and hypotheses are proposed, elaborated and used to identify research and extension priorities.

Figure 1. Procedure for Agro-Ecosystems Analysis



The procedures are further explained in Table 1.

Table 1: Brief Explanation of AEA Procedures

Stage	Description
Systems Definition	Agree on the purpose and objectives of the analysis. Precisely define the system(s) to be studied Clearly identify and delineate the system's boundaries (physical, social, administrative, etc.). Describe its position in the hierarchy of other systems.
System Analysis	Identify and describe the major agro-ecological zones (agro-ecosystems) within the system and the important interactions among them. Analyse each zone in regard to: 1. Space – spatial diversity, sub-systems and key relationships 2. Time – long-term (trends) and short-term (cyclical) changes in the system over time. 3. Flow – the movement of materials, money, information, etc. both within, into and out of the system. 4. Decisions – the decision making process and choices/options for key decision makers (farmers, government, projects, etc.) Identify the key attributes of the system that contribute either positively and negatively to the productivity, stability, equitability and sustainability of each agro-ecosystem. Identify the key processes determining the overall performance of each agro-ecosystem.
Identification of development options	As an understanding of the system is developed, a number of key issues, problems and development opportunities begin to emerge. These are further developed and elaborated into hypotheses or 'key questions' for further analysis. System properties analysis is used to identify those attributes of each agro-ecosystem that impact positively and negatively on productivity, stability, equitability and sustainability. The results of this are used to further develop the key questions. The key questions are interfaced with available technologies to identify appropriate solutions or development options for each question.
Research Design and Implementation	Proposed development options are assessed using innovation assessment techniques. This provides a rating for each which are then used to set development priorities. High priority development options will include proposals for research, extension and management (district planning) interventions. These are used by the appropriate agency (NAFRI, NAFES or District Authority) to develop appropriate implementation plans. Once these activities have been implemented, their results should be re-assessed in the context of AEA and any new lessons used to modify plans.

Agro-ecosystem analysis implementation stages

The procedures have been modified by the Lao Swedish Agriculture and Forestry Upland Research Program, (LSUAFRP), wherein the preparatory stages as described in the table below, are undertaken at central level, while the other stages in the AEA process are all conducted "end to end" in the area of study, ie, in the District or Development Area. The stages are explained below.

Table 2: Explanation of AEA Implementation Stages

Stage	Main Activities	Location	Approximate Duration
Stage 1: Planning and Preparation	• AEA team formation and organisation • Inform and brief partner institutions (district authorities, development area leaders, research institutions, etc.) • Arrange logistics for meeting rooms, materials, supplies, transport, etc. • Prepare spatial data at central level: digital maps on topography, elevation, slope, geology, soils, climate, land use, watersheds, rivers, administration boundaries, village locations, roads, etc. • Explain secondary data collection needs and request district staff to prepare preliminary numeric data	Vientiane (NAFRI GIS Unit)	Intermittently over three (3) weeks by core AEA staff
Stage 2: Staff Orientation and Agro-ecosystem Definition	• Staff orientation on AEA; procedures, methods and expected outputs • System definition; defining AEA study area and boundaries • Explanation of agro-ecosystem hierarchies • Definition of AEA purpose and objectives • Forming work groups and designating responsibilities for data collection	District or Development Area	1-2 days
Stage 3: Secondary Data Collection and Organisation.	• Explanation of secondary data needs; (using prepared data list) • Collating initial secondary data including, socio-economic and biophysical information for the study area • Preparation of secondary data spread sheets using Excel program	District or Development Area	2-3 days
Stage 4: Agro-ecologicial Zoning	• Explanation of digital maps used in agro-ecological zoning • Explanation of zoning methods and tools • Identify initial boundaries of the agro-ecosystem zones	District or Development Area	2-3 days
Stage 5: Preliminary System Analysis	• Identify key issues/problems regarding land use and livelihoods for each zone. • Identify important missing information and data for each zone. • Assign responsibilities and prepare for follow-up field work.	District or Development Area	1 day
Stage 6. Fieldwork in the Area of Study	• Organise sub-group responsibilities for each agro-ecosystem zone • Prepare tools for field activities; ie, historical	District or Development Area	1-2 days

Stage	Main Activities	Location	Approximate Duration
	profiles, agro-ecosystem base maps, transects, seasonal calendars, flow diagrams, venn diagrams, etc • Gather additional data to complete zone descriptions • Verify and explore key issues with farmers and local stakeholders • Identify key problems and opportunities with farmers and local stakeholders using problem census meetings		
Stage 7. Completion of Systems Analysis	• Explain tools for describing agro ecological zones • Prepare a general description of district agro-ecosystems using a transect table • Prepare the information on time, flow, space and decision-making for each agro-ecological zone • Prepare detailed description of each agro-ecological zone • Present and analyse the information in plenary sessions • Analyse the system properties for each zone (system properties table) • Key issues and problem formulation and recording • Key issue and problem solution analysis • Key issue prioritisation and problem solution ranking (innovation assessment)	District or Development Area	2-3 days
Stage 8. Reporting and Write-up	• Draft report for presentation to key stakeholders • Presentation of findings to key stakeholders • Incorporation of feedback from presentation into an AEA report • Finalise and translate report	Vientiane	3-4 weeks
Stage 9. Use of the Outputs	• District implement priority programs with help from LSUAFRP • Use of adapted AEA methodology elsewhere in Lao PDR (AEA user manual) • Hold dissemination workshop on AEA methodology for potential users • Plan replication of AEA methodology for other areas	Vientiane	On-going

Part 3

Field Staff Orientation

and

Agro-ecosystem System Definition

1. **Field Staff Orientation**
2. **Required Outputs from System Definition**
3. **Purpose and Objective Definition**
4. **Defining the Boundaries of the System**
5. **General Study Area Description**
6. **Study Area Context**
7. **Systems Hierarchy**

Part 3: Field Staff Orientation and System Definition

Field Staff Orientation on AEA

Field staff orientation is undertaken as an on-the job activity at the commencement of an AEA exercise. It takes place at the District Headquarters of the area of study. It is conducted by senior and experienced staff who have the ability to explain properly the concepts, process, procedures and methods of AEA and AEZ as explained of this manual, particularly Part 1; Introduction to Agro-ecosystem Analysis, and Part 2; Procedures and Methodology.

Orientation materials are prepared during the planning and preparation stage of AEA by core staff responsible for the AEA exercise, in the case of the LSUAFRP, the Land Use Planning Component. The AEA Manual is the primary document used in staff orientation, and multiple copies are prepared and distributed to the AEA participants. In addition to the Manual, hand-out documents on specific topics are prepared in both English and Lao languages for distribution to participants. The hand-out documents are also reproduced as overhead transparencies and/or as power point presentations, because in most districts an electrical power source is available.

While initial orientation is conducted on the first day of the AEA, a process of on-going orientation and on-the-job training continues through the AEA exercise, which provides for reiteration and revision as each stage in the AEA and AEZ is conducted. The multi-disciplinary representatives, operate in work groups based on geographical areas and/or agro-ecological zones defined in the area of study, and are responsible for the collation of secondary data and the presentation of results at each stage in the process. Thus there is a continuous learning process commencing from AEA orientation on Day 1 until the AEA field exercise is completed.

The contents of this manual are restricted to explanations and examples of AEA outputs in order to reduce the volume of the document. An accompanying document titled, “AEA and AEZ Training Material”, has been prepared in which the hand-out documents and various forms and tables are presented. The following is a list of AEA orientation and training materials contained in the document.

- What is AEA?
- AEA Procedures Diagram
- List of Key Terms (Lao and English)
- Summary of Agro-ecosystems Analysis
- Example of AEA Purpose and Objectives
- Ecological and Administrative Hierarchies
- Transect Example – (Lao)
- Transect Example Tapo Village – Phonesay District
- Innovation Assessment Form
- Pairwise Ranking – Example
- System Property Table – Example
- Analysis Tools etc etc

Agro-ecosystem Definition

Agro-eco-systems definition means agreeing on, delineating, and describing the system to be studied in relation to the systems above and below it.

Systems definition involves;

- The identification of the system/s to be studied
- The delineation of the boundaries of the system/s
- The identification of systems heirarchies.

The definition of the system to be studied is made depending on the purpose and objectives of the AEA. If the main purpose of the AEA is to facilitate district planning and poverty alleviation, the AEA will be conducted for the system where the planning is undertaken. In Phonesay District, for example, two systems were identified for analysis, one being the Phonesay District Administrative area, and the other the Long Nam Pa Development Area (boriwen), because planning and poverty alleviation are focused at these two levels.

Required outputs from system definition

The outputs required from system definition are as follows:

- Developing a purpose statement and agreeing on AEA objectives
- Defining the boundaries of the system to be analysed
- Description of the system hierachies

These outputs are achieved using plenary discussions and brain-storming sessions among workshops participants

Purpose and objectives definition

An example of the purpose, objectives and outputs for the AEA activity conducted in Phonesay District is presented below.

Purpose	• To use AEA and AEZ methodologies to contribute to policy development, planning and implementation related to improved land management practices, and poverty alleviation in upland areas of Lao PDR.
Objectives	• To develop a procedure that will collate and consolidate various LSUAFRP information to assist the agro-ecosystem analysis activity • To use AEA to identify and characterise the current agro-ecosystems in Long Nam Pa Development Area (boriwen) and Phonesay District of Luang Prabang Province. • To undertake agro-ecological zoning (AEZ) in Nam Pa Development Area (boriwen) of Phonesay District • To create a procedure that will be compatible with district level and development

	area (boriwen) planning systems, and that will assist District Authorities with more objective planning of rural development programs focusing on poverty alleviation • To identify key research questions and to develop hypotheses and guidelines for future research and extension • To encourage and create research and extension co-operation at district, province and national levels.
Outputs	• Demonstration of the value of a multi-disciplinary group of specialists working together to undertake AEA • An improved understanding of the major farming systems of each agro-ecological zone • A prioritised list of important agricultural problems and opportunities for each zone that could be addressed by research and extension programs • A prioritised set of development and research interventions to solve problems identified • Guidelines for matching technologies already developed by the research program with specific agro-ecological zones. • Land suitability assessments, potential cropping areas, and population support capacity assessments, for each of the agro-ecological zones • The enhancement of co-operation and effectiveness of various district working groups responsible for rural development planning and implementation. • An AEA methodology developed and adapted to the needs of the Lao PDR • Improved research and extension linkages and co-operation

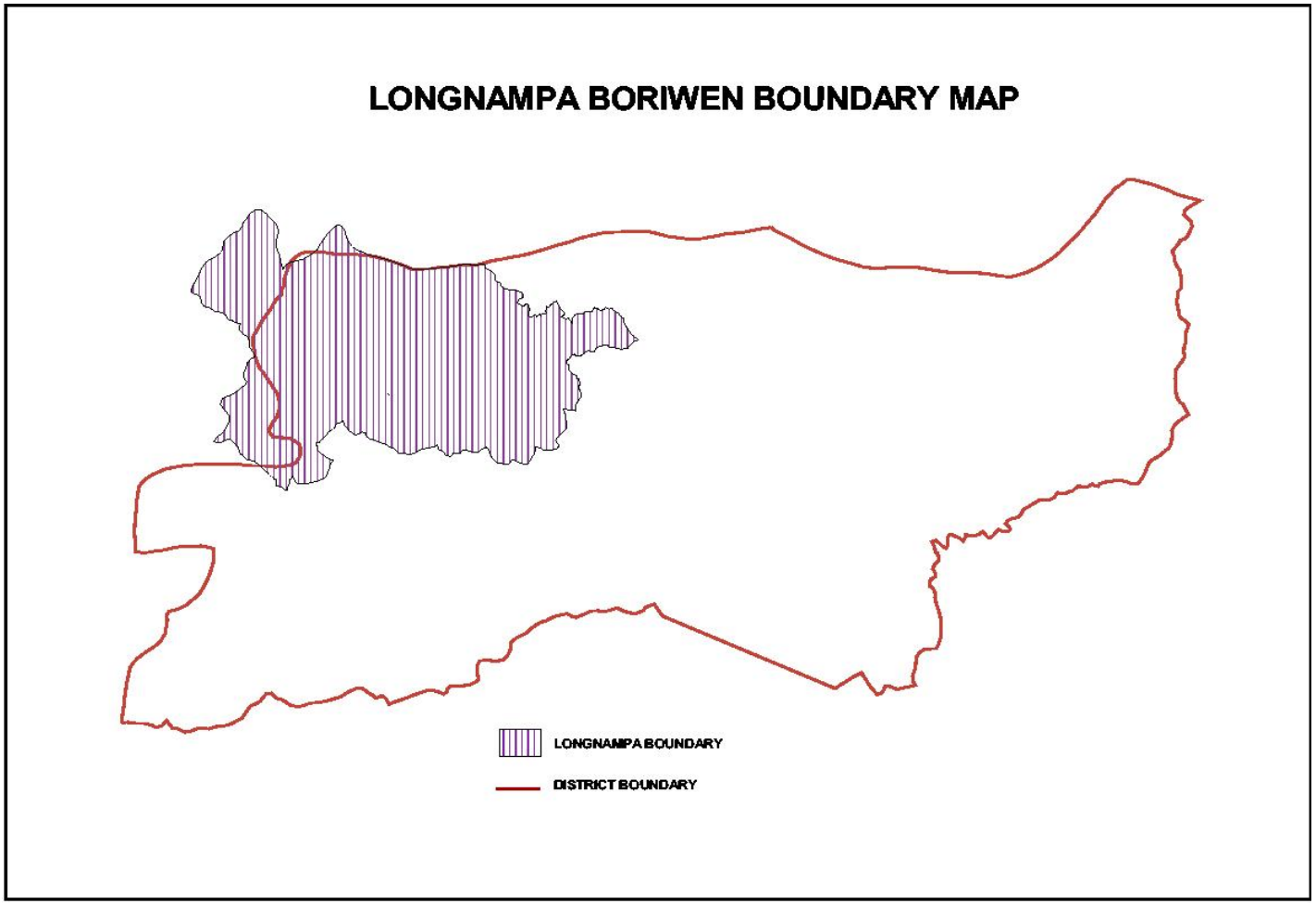
Defining the boundaries of the system

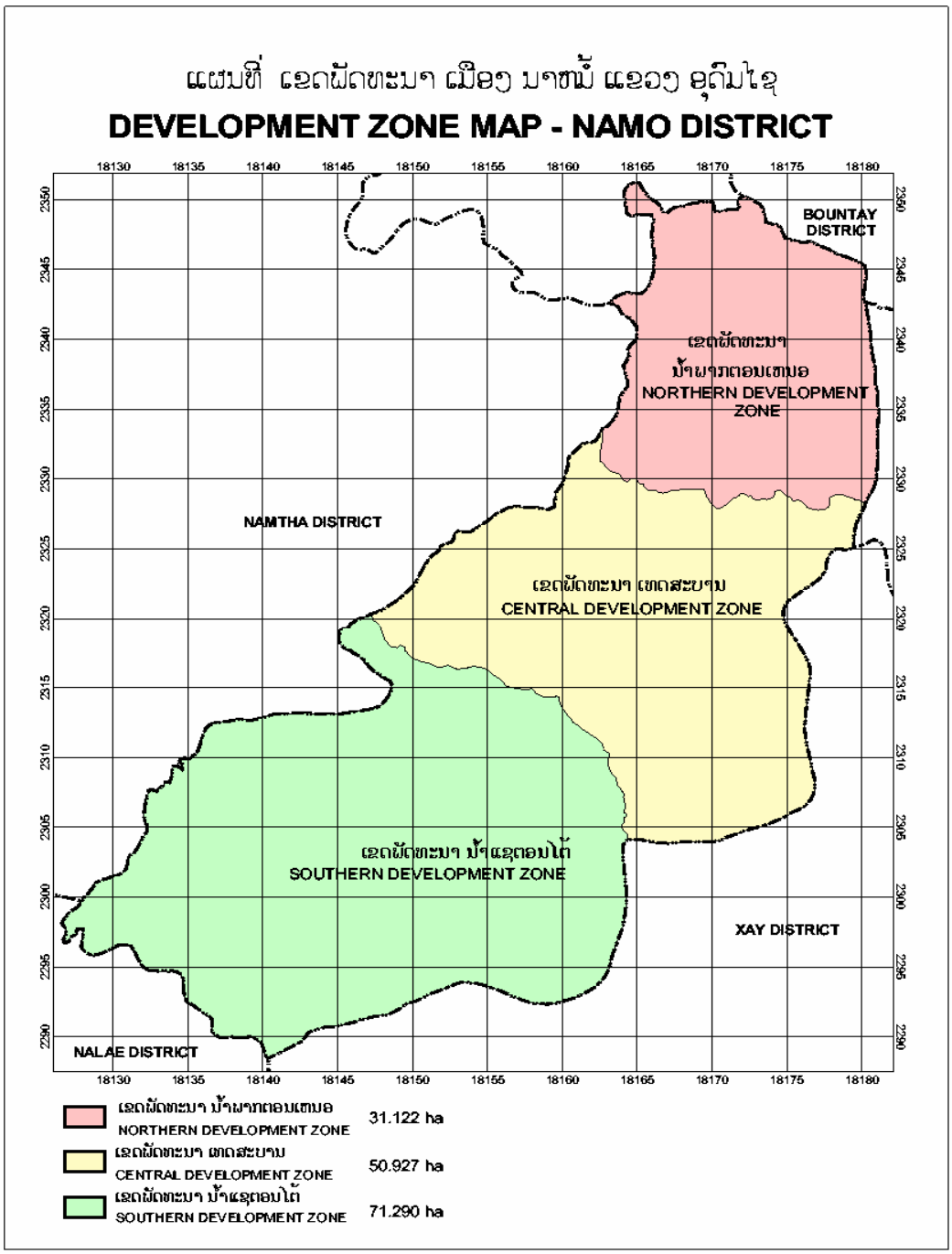
The boundaries of the system to be studied are determined when the purpose and objectives of the AEA activity are prepared. In this case, therefore, the boundaries of the systems chosen were the boundary of Phonesay District and the boundary of Nam Pa Development Area (boriwen) as indicated on the map below.

District boundary data sets are available from the GIS and therefore can be reproduced quickly and simply. However if analyses are undertaken for a lower level ecosystem, ie, a Development Area within the district, the development area boundary must be defined. This requires considerable work, and involves the delineation of the boundaries of all villages located in the Development Area. The boundaries of the outer-most villages in the development Area form the boundary of the Development Area. This is an important consideration when determining the area of study. If an AEA of a system lower than a district is required, the persons responsible must be prepared to define the boundary of that system accurately, by defining the boundaries of the villages within that ecosystem.

Examples: Systems Boundary Definition Maps

1. **Phonesay District System and Long Nam Pa Development Area System**
2. **Na Mo District Development Zones**


LONGNAMPA BORIWEN BOUNDARY MAP
LONGNAMPA BOUNDARY
DISTRICT BOUNDARY


ແຜນທີ່ ເຂດພັດທະນາ ເມືອງ ນາໜ້ ແຂວງ ອຸດົມໄຊ
DEVELOPMENT ZONE MAP - NAMO DISTRICT
BOUNTAY DISTRICT
ເຂດພັດທະນາ
ນ້ຳຜາກຕອນເໜືອ
NORTHERN DEVELOPMENT ZONE
NAMTHA DISTRICT
ເຂດພັດທະນາ ເຫດສະບານ
CENTRAL DEVELOPMENT ZONE
ເຂດພັດທະນາ ນ້ຳແຊຕອນໄຕ້
SOUTHERN DEVELOPMENT ZONE
XAY DISTRICT
NALAE DISTRICT
ເຂດພັດທະນາ ນ້ຳຜາກຕອນເໜືອ
NORTHERN DEVELOPMENT ZONE
31.122 ha
ເຂດພັດທະນາ ເຫດສະບານ
CENTRAL DEVELOPMENT ZONE
50.927 ha
ເຂດພັດທະນາ ນ້ຳແຊຕອນໄຕ້
SOUTHERN DEVELOPMENT ZONE
71.290 ha

Study area description

The next step is to describe the study area which includes an overview of the topography, ecology and demography of the area. This provides a basic "picture" of the area and an insight into the likely agro-ecological zones that exist in the area.

Box 1: Example of the Study Area Description of Phonesay District

Phonesay District is located in the northern region of Lao PDR and is characterised by rugged terrain interspersed with narrow valleys along rivers and streams. It is estimated that about 90+ % of District area is mountainous which limits the area of land available for paddy land development, and dictates that upland rain fed farming systems dominates the landscape. The total area of paddy land is approximately 190 hectares. At higher altitudes there are isolated pockets of elevated rolling plateaus which support both natural forest and grasslands, and are used by highland villagers to raise cattle.

The District has rather limited areas of natural forest remaining, the most important and least disturbed being the south-western extremity of the Nam Et- Phou Loi National Biodiversity Conservation Area (NBCA) and two adjacent areas, bordered by the Nam Khan River. These areas still have fairly rich forest stands and support a range of protected wildlife species. They are also important non-timber forest production areas and livelihood contributors for villagers. Other areas in the District were declared as Provincial Conservation and Provincial Protection Forests in 1996, however the status of these requires a review because they have been degraded by upland cultivation.

The District is populated by the three main ethnic groupings, ethnic Lao (13 %), Khamu (62.50 %), and Hmong (24.50%). Generally the Lao occupy the river-side valleys, the Khamu the valleys and the hill slopes, and the Hmong the higher elevated country. These distinctions are however quite rapidly changing due to both voluntary migration and planned re-location from the more mountainous and isolated areas to the lower-lying areas. There are presently many villages of mixed ethnicity.

Phonesay is one of the poorest 10 districts in the country, the district administration having determined that of the 56 registered villages today, only five villagers are in the low poverty bracket, and 10 are less poor (medium poverty). 41 villages or 73% are classed in the severe poverty bracket. Opium addiction is common, there being 876 addicts in 53 of the 56 villages. Of the total, 674 are ethnic Khamu and 198 are ethnic Hmong. Seventeen villages have permanent clean water, there are 31lower level schools, often inadequately staffed by teachers, one hospital at Phonesay, and eight permanent health centres.

Study area context

A "context" description of the study area is undertaken to place the study area in context relative to the areas immediate adjacent to the study area. For example, Phonesay District is bounded by districts in three Provinces, Luang Prabang, Houa Phanh and Xieng Khouang. The study area context also describes the main topographic features such as rivers and road systems that enter, pass through, and pass out of the study area. This provides the AEA team with an understanding of the natural and man-made features that have an impact or influence on the area.

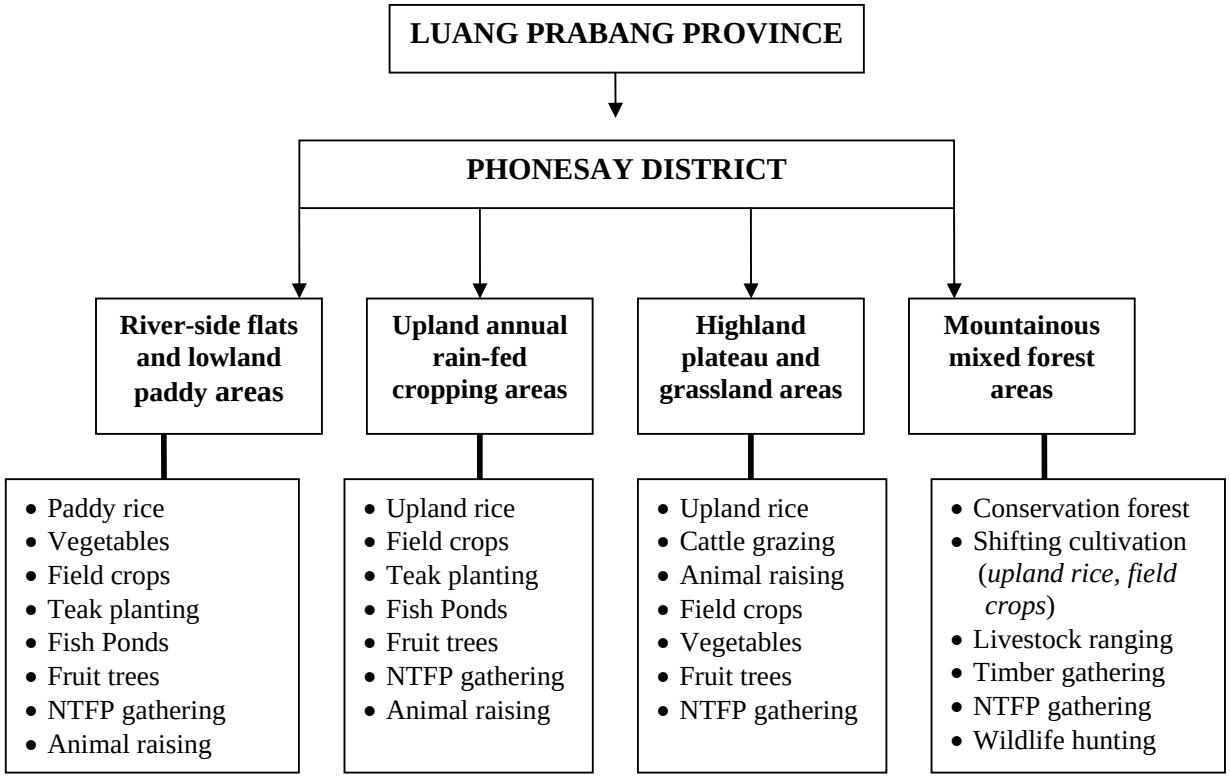
Box 2: Example of the Study Area Context Description of Phonesay District

The District has a total area of 246,104 hectares and is bounded by Luang Prabang District to the West, Pak Xeng (LPB) and Viengkham District (Houa Phanh Province) to the North, Phoukood District (Xieng Khuang Province) to the East, and Phoukhoun District (Xieng Khouang Province), and Xieng Ngeun District (LPB Province) to the South. There are four main river systems in the District, the Nam Pa, flowing west, the Nam Ter, flowing north east, the Nam Bak in the south, and the Nam Khan which bounds the District to the east. The Nam Khan is an important communication and transport system that links to Xieng Ngeun and Luang Prabang.

The District is served by a good standard gravel all-weather road reaching the District Headquarters, (46 Km from the main Luang Prabang road) and continuing further west to the area near Sop Chia village. There is a tentative plan to extend this road through to the eastern end of the District to link with neighbouring Houa Phanh Province. The access track network is being expanded, and presently 16 villages have a road or access track.

Systems Hierarchy

A heirachy is the range of agro-ecosystems above and below the system that will be studied. In the example below the agro-ecosystem that will be studied is Phonesay District. The system above the Phonesay District agro-ecosystem is the Luang Prabang agro-ecosystem, while the river-side flats, upland rain-fed areas, highland plateau areas, and mountainous mixed forest areas are the agro-ecosystems within the Phonesay system.



Part 4

Secondary Data Needs and Gathering

1. **Preparing Data Before the AEA Exercise**
2. **Assessing and Improving the Data Sets**
3. **Collation of the Data for Agro-ecological Zoning and System Analysis**

Part 4: Secondary Data Needs and Gathering

Secondary data is gathered to use in the processes of:

- Agro-ecological zoning
- Agro-ecosystem analysis

In the Lao PDR substantial secondary data is available at provincial, district, and village levels, including bio-physical, socio-economic, digital spatial data and numeric data. This data can be accessed and collated for agro-ecosystem analyses at any level chosen for study, for example provincial, district or development area. The examples presented below are for District and Development Area level analysis. Data needs identification, gathering, preparation and analysis are undertaken both at central level and in the field.

There are three basic steps:

- Preparing data before AEA field work
- Assessing and improving the secondary data during district workshop sessions
- Organising data for use in agro-ecological zoning and system analyses

Step 1: Preparing Data Before AEA Field Work

It is **essential to consider and identify** the types and sources of data that will be needed prior to conducting the AEA at district level. Spatial data (various digital maps) is prepared by AEA team members based at the NAFRI GIS Unit in Vientiane, while numeric data can be prepared at the district level by district staff who will participate in the AEA exercise.

1. Bio-physical Data

This information is presented in map form from data sets available from the GIS in Vientiane. The map sets cover the area or areas of study.

Example: Map Sets Produced for the Phonesay District and Long Nam Pa Development Area AEA.

District Bio-physical Maps	• Context map (showing surrounding Districts); Boundary; Village point (before 1999), Village point (2004); • Rivers and streams; • Roads and tracks; • Mean annual rainfall; Mean annual temperature; • Watershed classification; Slope categories; Elevation categories; • Soils; Geology; • Irrigation areas; Land use and Forest Management; Land use planning (forest & agriculture); Past land use (1992); Present land use (2000); Land suitability; Optimum land use;

Boriwen Nam Pa Bio-physical Maps	• Boriwen Nam Pa boundary; • Boriwen Nam Pa village boundaries; • Boriwen Nam Pa village point (2004)
Socio-economic Maps	• District poverty status (2004)

2. District Data

It is expensive and time-consuming attempting to summarise data from central sources such as the National Statistics Centre, and therefore it is recommended that all relevant data be gathered in the field because the District Authorities have available the most up-to-date and accurate secondary information concerning district and development area systems. The facilitators of the AEA should provide the District with a list of secondary data needs so that District staff can start to gather information before the multi-disciplinary AEA team arrives.

Example: List of Data Needs Provided to Na Mo District Authorities Prior to the AEA

Thematic map sets	Administrative boundaries, village water supplies, schools, health posts, main roads,access roads, irrigation sites and areas
Numeric Data	Population, opium addiction status, poverty status, ethnic composition for every village
Provincial Forest Categories	Provincial forestry categories (and/or development zones) District forestry categories (and/or development zones)
NTFPs	NTFP marketing information; NTFP market locations
Crop Production Data	DAFO reports (5 year reports): Annuals: paddy rice, upland rice, other important annual crops Perennials: Commercial trees; present rubber plantings and plans for rubber in the future, fruit trees, others
Projects Working in District	Project activities and target villages
Businesses or Companies Working in District	Companies and businesses activities and target villages
Re-location programs	History of village re-location and village merging in the District; data on merged villages and new locations

Step 2: Assessing and Improving the Data Sets

A secondary data check list is prepared by the AEA co-ordinators using the following format:

Type of Information	**Information Source**	**Have Data? (Yes – No)**	**Format in which Data Available**	**Data Format Required**

An example of a data check list prepared for the Na Mo District AEA is presented in Table 3

Table 3: List of Secondary Data Sources, Data Required and Format for AEA – Na Mo District - October, 2004

Type of Information	Information Source	Have Data ?(Yes - No)	Format in which Data is Available	Data Format Required & Responsibility
Socio-economic				
Socio-economic reports	S-E Unit - LSUAFRP	Yes	Reports	Rubber - Sugar; • Simple gross margins • Market information
Indigenous soils categories	S-E Unit, LSUAFRP	Yes (Phonesay)	Word report	Report: 4 LSUAFRP villages; 3 ethnic groups
Commodity marketing	S-E Unit - LSUAFRP	Yes	Word report	• LSUAFRP villages Na Mo District
Poverty				
Poverty status and distribution	District	No	Hand written Table	1. Table (by village) 2. Poverty status map (by village)
Digital Maps				
Context map Na Mo	IMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Boundary map Na Mo	IMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Kaet map, Na Mo	IMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Roads and tracks Na Mo	IMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Rivers & streams Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Village point map 1999	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Village point map 2004	District	No	Hard copy	Hard copy
Watershed Class map Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Elevation Class map Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Temperature Range map Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Rainfall Range map Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Geology map Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Soils map Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Slope Class map Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Forest Management map Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Forest Cover 1997 Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Land Use and Forest Type 2000	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Land Suitability Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Optimum Land Use Na Mo	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Land Use Planning & Forest Zoning Map	I&DBMD; NAFRI	Yes	Digital format	Hard copy A3 & A4 ; Transparency A4
Target Boriwen or Kaet map with village boundaries	District	No	Draft Boundary map	Delineate village boundaries while in Na Mo

Type of Information	Information Source	Have Data ?(Yes - No)	Format in which Data is Available	Data Format Required & Responsibility
Province Land suitability maps (for main commercial crops produced for MAF)	SSLCC	Yes	Digital format	Hard copy
Thematic Maps				
Village water supplies	District	No	Draft Thematic maps	Hard copy for digitising
Health posts	District	No	Draft Thematic maps	Hard copy for digitising
New main roads and access roads 2004	District	No	Draft Thematic maps	Hard copy for digitising
Irrigation sites and areas	District	No	Draft Thematic maps	Hard copy for digitising
Population				
Village population data	District	No	Hand written tables	Table; by village, by ethnic group
Relocation-Merging of villages	District	No	Hand written tables and summaries	District re-location Plan - Summary table Village point map of merged villages 2004
Opium addiction	District	No	Hand written tables	Table; by village, by ethnic group
Agro-forestry Systems and NTFPs				
NTFP Production Systems Data				
Commercial NTFPs NTFP markets and production data Commercial and industrial trees	District District District	LSUAFRP area only No No	Excel tables by Land Management District records District records	Summary tables Summary tables Summary tables
Farming Systems				
Crop Production Systems Data				
Annuals: paddy rice, upland rice, other important annual crops	District	No	Annual Reports 5 Year Report	Summary tables
Perennials: Commercial trees; present rubber plantings and plans for rubber in the future, fruit trees, others	District	No	Annual Reports 5 Year Report	Summary tables
Other District Stakeholders				
Projects: General activities	District	Yes	Reports	Summary tables
Businesses: General activities (including Chinese)	District	No	District files	Summary tables

Multi-disciplinary work groups are formed based on geographic areas and the data check list is explained to participants, after which responsibilities for acquiring any additional data required is allocated to the multi-disciplinary groups. Senior and supervisory staff members provide advice and assistance to the groups when data is being collated and recorded.

The work groups are broadly comprised of persons responsible for the following five areas of responsibility:

- Technology development (researchers - agriculture and agro-forestry)
- Technology transfer (extension workers, trainers, information dessimination)
- Study area characterisation (land use planners)
- Service provision (GIS technicians)
- Programming and planning (program management, district authorities)

Example: Work Groups Formed to Gather and Collate Data in Na Mo District

Group 1 – Southern Development Zone	Group 2 – Central Development Zone	Group 3 – Northern Development Zone
Mr Thongsoy	Mr Ten	Mr Khamxay
Mr Khambai	Ms Khamnang	Mr Khamsao (DAFO)
Mr Phouwa	Ms Bouaphone	Mr Khampieu
Mr Sokdala (DAFO	Mr Oun	Mr Oudong (Farming Systems)
Ms Bouamon (DAFO	Mr Khamsak	Mr Khamphou (S-E Unit)
Mr Khamphone (Forestry Research)	Mr Khamsao	Mr Daniel Talje (S-E Component)
Mr Hongthong (Land Management)	Mr Suwan (DAFO)	Mr Somsak (Land Management)
Mr Anolath (Land Management)	Mr Chankham LSUAFRP Co-ord.)	Mr Vayaphath (Info Services,VTN)
	Mr Phaythoun (NAFRI GIS Unit)	
	Mr Khamxay (District Trade)	

The preliminary secondary data gathered by district staff is reviewed and compared with the requirements on the secondary data check list to ascertain which data is available and which data still remains to be gathered and collated.

Example: Results of Secondary Gathering and Collation – Na Mo District

The work group activity in Na Mo District resulted in the documentation of the following data:

- Accurate boundary locations of the seven District Administrative Zones
- Accurate boundary locations of the three Development Areas (khet patana)
- Village poverty status and distribution
- Location of village water supplies, health posts, and schools (to enable the preparation of a digital infrastructure and services map)
- Extensions to the road and access track system (to update the digital road map)
- Updated village merging and re-location data (to identify the actual number of registered villages in the District)
- Village population data based on the current number of registered villages
- Location of merged and re-located villages (to facilitate the preparation of a current digital village point map)

- Status of opium addiction in the District
- Identification and mapping of 36 village boundaries within the District (using LUP and LA maps provided by the DAFO)
- Agro-forestry and NTFP production data and markets
- Crop Production Data:
    - Annuals: paddy rice, upland rice, other important annual crops
    - Perennials: Commercial trees; present rubber plantings and plans for rubber in the future, fruit trees, others
- Irrigation sites; 27 villages have small scale irrigation systems.
- Projects: summary of activities in which engaged
- Businesses: summary of activities in which engaged (eg, Chinese businesses)

Step 3: Collating Data for AE Zoning and System Analysis

1. Bio-physical Data

This information is presented in map form from data sets available from the GIS. The map sets cover the area or areas of study.

Example: Map Sets Produced for the Phonesay District and Long Nam Pa Development Area AEA.

District Bio-physical Maps	• Context map (showing surrounding Districts); Boundary; Village point (before 1999), Village point (2004); • Rivers and streams; • Roads and tracks; • Mean annual rainfall; Mean annual temperature; • Watershed classification; Slope categories; Elevation categories; • Soils; Geology; • Irrigation areas; Land use and Forest Management; Land use planning (forest & agriculture); Past land use (1992); Present land use (2000); Land suitability; Optimum land use;
Boriwen Nam Pa Bio-physical Maps	• Boriwen Nam Pa boundary; • Boriwen Nam Pa village boundaries; • Boriwen Nam Pa village point (2004)
Socio-economic Maps	• District poverty status (2004)

2. Socio-economic Data

Numeric data collated by the work groups is entered into Excel spread sheets with the assistance of the Socio-economic Unit so that the information regarding the various parameters, can be presented in tabular format for various geographic zones as required. For example in Na Mo District the data was organized for both Development Zones and Agro-ecological Zones.

The Excel tables include:

- Names and codes of registered villages
- Service centres (schools, village water, health posts)
- Poverty Status

- Infrastructure
- Small Village Commerce (village retail shops)
- Eco-tourism Destinations or Sites
- Ethnic Composition
- Population Composition
- Population Densities
- Areas of Main Agricultural Crops
- Production of Main Agricultural Crops
- Yield of Main Agricultural Crops
- Livestock Populations

The data contribute significantly to the description of the AEZs identified in the District. These data sets are also valuable assets for the District Planners when they are compiled for Agro-ecological Zones and the District Development Zones.

Examples: Excel Data Summaries:

1) **Poverty Status and Opium Addiction**
2) **Major agricultural Crop Areas**

Table 1: Poverty Status and Opium Addiction

Poverty Status	Agriculture Zone			Forest Zone			All
	CDZ	NDZ	SDZ	CDZ	NDZ	SDZ	
Less poor (no. of villages)	2	4	0	0	0	0	6
Opium addicts (No.of persons)	22	0	0	0	0	0	22
Female (No. of persons)	7	0	0	0	0	0	7
Poor (No. of villages)	11	1	2	5	2	0	21
Opium addicts (No.of persons)	60	0	2	0	97	0	159
Female (No. of persons)	15	0	0	0	33	0	48
Very poor (No. of villages)	10	1	9	6	12	13	51
Opium addicts (No.of persons)	87	11	8	41	64	30	241
Female (No. of persons)	32	0	0	10	6	1	49
Total number of villages	23	6	11	11	14	13	78
Opium addicts (No.of persons)	169	11	10	41	161	30	422
Female (No. of persons)	54	0	0	10	39	1	104

Table 8: Major Agricultural Crop Areas (ha)

	Agriculture Zone			Forest Zone			All
	CDZ	NDZ	SDZ	CDZ	NDZ	SDZ	
Paddy	486	638	329	194	286	514	2448
Upland Rice	621	134	487	245	161	107	1753
Maize	383	114	200	55	58	39	848
Job's Tear	101	23	5	32	15	22	198
Sesame	35	0	27	33	17	19	131
Sugar cane	0	35	0	0	0	0	35
All	1626	944	1049	559	536	700	5413

Part 5

Agro-ecological Zoning

1. **Required Outputs from Zoning**
2. **Zoning Tools - Map Overlay Techniques**
3. **Secondary Data Used**
4. **Zoning Procedures**
5. **Zones Delineated**

Part 5: Agro-Ecological Zoning

The purpose of defining agro-ecological zones is to define areas with fairly homogenous biophysical and socio-economic conditions or characteristics. A description and analysis of each zone can then be undertaken. The analysis reveals key agricultural, forestry and socio-economic issues and problems for each zone, for which solutions can be proposed, some of which may be addressed by research and others by extension and development.

The zoning procedure is applied for the system agreed and defined using the procedures explained in Part 3, and using the secondary data gathered and prepared, as explained in Part 4. In this case the zoning is described for Phonesay District.

Required Outputs from Zoning

Example: Outputs Required from Phonesay District Zoning

1	Draft zonation of the agro-ecosystems in Phonsay District
2	An initial description of agro-ecosystems in Phonsay District
3	An initial understanding of the major farming systems of each agro-ecological zone in Phonesay District
4	An initial list of key agricultural problems and development opportunities for each zone in the District

Zoning Tools - Map Overlay Techniques

Map overlay techniques, involve the sequential overlay of all available maps to identify distinct zones with fairly homogenous biophysical and socio-economic conditions. This is done using an overhead projector with maps of the same scale printed to fit on A4 transparencies. Starting with biophysical parameters, the maps are over-laid sequentially to elicit ideas and comments from participants about likely agro-ecological zones in the district eco-system. As possible zones are identified, they are drafted onto a transparency and over-laid once more with all the maps to check for accuracy and to refine the zone boundaries.

The following A4 sized maps are used for the map overlay technique:

Watershed classification	Land suitability
Elevation	Optimum land use
Slope	Rivers
Soils	Communications (roads and tracks)
Geology	Administrative boundaries
Climate (temperature and rainfall	Village locations
Current land use	Population density
Forest cover	Poverty

Some of these, for example, population and poverty, are thematic maps using village point locations, because village boundary data for all villages in the District is not available.

System 'context' maps showing areas outside but adjacent to the system of study are also produced for important parameters such as watershed classification, topography, forest cover and land use. These are used to explore issues about those agro-ecological zones that extended outside the boundary of the district.

Secondary Data Used

The secondary data used for zoning includes both spatial and numeric data sets.
The following map sets produced from digitized spatial databases held at NAFRI are used for agro-ecological zoning.

A3 Size Maps: Digitised maps of the District showing system boundaries, roads, rivers (watersheds), village points, village poverty (sketch maps), watershed classification, elevation, slope, soils, geology, land use planning and forest zoning, climate (temperature and rainfall), land use (2000), forest cover, and land suitability/optimum land use maps.

A3 System 'Context' Maps: Digitised maps including areas outside but adjacent to the district, including watershed classification, topography, forest cover and land use.

A4 Size Maps: Digitised maps of the District including; system boundaries, roads, rivers (watersheds), village points, village poverty (sketch maps), district "context" (district and surrounding areas), watershed classification, elevation, slope, soils, geology, land use planning and forest zoning, climate (temperature and rainfall), land use (2000), forest cover and land suitability/optimum land use maps.

Transparency Maps: A4 size overhead transparencies of all of the types of maps listed above for use on the overhead projector during brainstorming sessions

In addition to the spatial data, numeric attribute data sets on the socio-economic parameters of population, ethnicity, poverty, health, and education, (dis-aggregated to the village level) are used to produce thematic maps for these factors. Secondary data for this purpose can be sourced from the National Census (2000), the Agricultural Census (1998/99), and data sets usually held by the district planning authorities in hardcopy format.

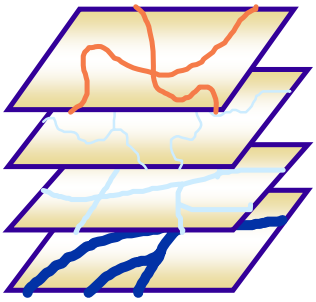
Zoning Procedures

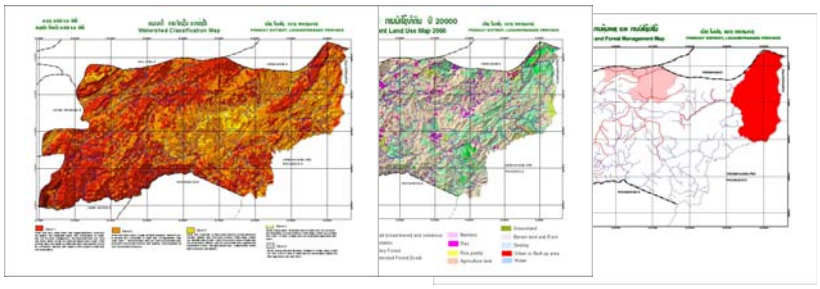
The zoning activity is facilitated by a "zoning facilitator" using the overhead maps.

The larger A3 size maps are posted on display boards for consultation and clarification in the brainstorming sessions. The A4 size overhead transparency maps are used on the overhead projector to project large images of the maps onto an overhead screen. This facilitates the active involvement of all participants in the zoning process.

A variety of maps of various biophysical and socio-economic parameters are displayed sequentially on an overhead projector. A transparent district boundary map is overlaid on each of the maps in turn from which impressions are formed by participants on possible agro-ecological zone boundaries.

Map Overlay Technique





These initial boundaries are further clarified using a number of iterations of map overlays and discussions until a concensus is reached, following which the zone boundaries are drawn onto the transparent district boundary map. The larger A3 size maps were consulted from time to time to verify bio-physical information and to help verify agro-ecological zone boundaries.

The verified zones are drawn onto the transparent district boundary map which is then used to digitize a final agro-ecological zone map.

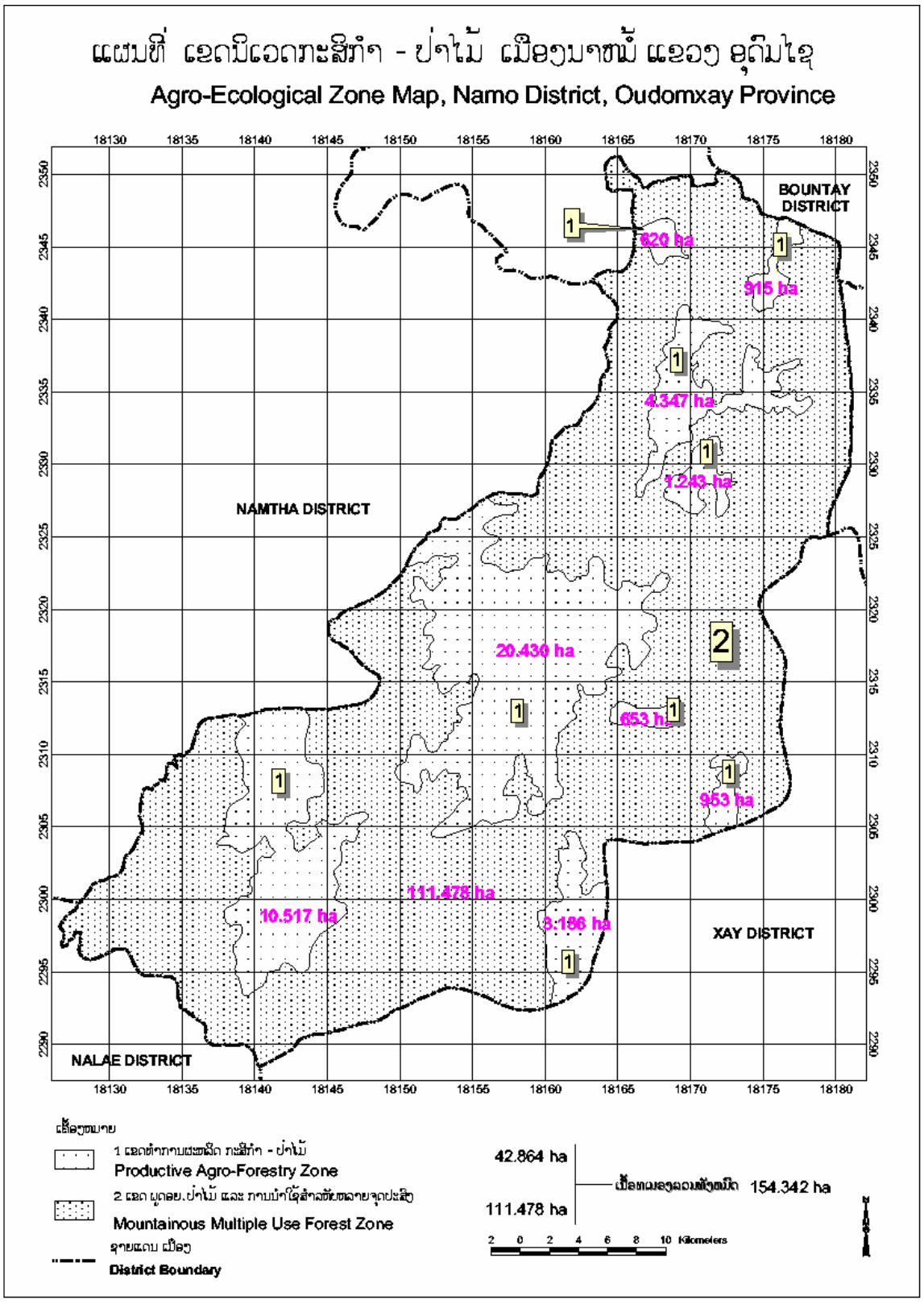
Zones Delineated

The example provided below is the Na Mo District agro-ecosystem showing the verified agro-ecological zones prepared using the procedure described above. In this case two zones were identified and given descriptive names based on their individual characteristics as follows:

Zone 1: **Productive Agro-forestry Zone**
Zone 2: **Mountainous Multiple Use Forest Zone**

These zones are depicted on Map 1: Na Mo District Agro-ecological Zones

Map 1: Na Mo District Agro-ecological Zones



Part 6

Preliminary Systems Analysis

1. **Key Issues Emerging from Zoning**

2. **Additional Information Needs**

Part 6: Preliminary Systems Analysis

Preliminary systems analysis is undertaken during and after agro-ecological zoning prior to work teams going to the field. The purpose of preliminary systems analysis is to discuss and record key issues and problems that arose as a consequence of the agro-ecological zoning activity, and to identify what additional information is required to complete detailed systems analysis.

Key Issues Emerging from Zoning

During the process of agro-ecosystem zoning key issues regarding the performance of the zones started to emerge. These issues are recorded and studied further during follow-up field work. Additional key issues and problems also emerge during field work and are consolidated for use during the final systems analysis in the latter stages of the AEA exercise.

Examples: Key Issues and Development Opportunities for Zones 1 and 2 of Phonesay District are illustrated in Table 4.

Table 4: Key Issues and Opportunities Identified from Initial Agro-ecosystem Zoning of the District Agro-ecosystem

Zone	Key Issues	Development Opportunities
Zone 1: Lower elevation, potentially productive upland agro-ecosystem	• Villagers still do substantial shifting cultivation while there is potential to improve farming systems • Areas with irrigation potential have not been developed and irrigation infrastructure needs expanding • Improvement of cattle breeds and control of cattle disease epidemics • Education levels in villages is low; only to level 5 • Access tracks to and between villages are inadequate • Seasonal epidemics, ie, malaria, dysentry	• Improve upland farming systems, incorporating conservation measures • Expansion of paddy areas • Construction of small weirs to increase irrigated production areas • Introduce vaccination programs
Zone 2: National biodiversity conservation area and buffer zone agroecosystem	• Are there needs for a buffer zone or protection zone in the forest areas west of the Nam Et - Phou Loi NBCA? • The proposed route of the road from the Nam Ter area passes through the NBCA, and although providing communication and transportation benefits, would result in various negative impacts on the NBCA resources. Is there an alternate route for the road? • Population growth in villages adjacent to NBCA (greater impact o resources) • The adjacent villages of Viengthong, Buakkham and perhaps Had Chong gather NTFPs and hunt wildlife in the NBCA	• Eco-tourism potential in the NBCA via the Nam Khan River • Investigation of need for buffer zone to the west of the NBCA to protect NBCA natural resources, involving villages that currently encroach on the NBCA • Development of comprehensive Natural Resources Management Agreements with adjacent villages

Additional Information Needs

Additional or missing data required to complete the detailed description of each zone are identified during the working group sessions when the secondary data list is examined by the multi-disciplinary groups, and during the preliminary agro-ecological zoning plenary session. Follow-up is undertaken during field work to acquire the missing data

Example: Missing Data Needs for Zones 1 and 2 of Phonesay District.

Table 5: Additional Information Needs Required from Field Work

Zone	Additional Data Required
Zone 1: Lower elevation, potentially productive upland agro-ecosystem	• The boundaries of this zone are still not properly defined; further consideration is needed when in the field • Diversity of NTFPs, location and NTFPs marketed, (in the areas adjacent to Sop Chia market) • Wildlife and fishing availability and exploitation
Zone 2: National biodiversity conservation area and buffer zone agroecosystem	• Which villagers (and populations) access the NBCA from Zone 1, and what impacts is this having, ie, on NTFPs, wildlife and fish. Are there logging impacts in the NBCA? • The areas of the NBCA that are being affected by shifting cultivators from Zone 1 • EStablish what are the plans are for the road that has been mooted to link Phonesay District with Houa Phanh. Is there an alternate route for the road? • Follow-up on information on forestry and agriculture relationships in the NBCA area; shifting cultivation etc. • Possible location of the proposed buffer or protection zone for the NBCA • Flow diagrams for NBCA impacts and management

Part 7

Fieldwork

1. **Required Outputs from Fieldwork**
2. **Logistics and Team Formation**
3. **Field Tools Used**
4. **Information Acquired from Fieldwork**
5. **Key Issues Emerging from Fieldwork**

Part 7: Fieldwork

Field work is carried out to acquire additional data that could not be acquired during the the earlier stages of AEA. It involves similar multi-disciplinary teams that participated in the previous workshops and it makes use of participatory methods with field staff and villagers.

Required outputs from fieldwork

The following table provides an indication of the outputs that are expected from field work.

1	Orientation and training on AEA procedures for District staff responsible for rural development activities at the agro-ecological zone level
2	The acquisition of additional and more concise secondary information to assist with the final analysis during detailed system analysis, including: • market information • agricultural and non timber forest production • villager perceptions of rural development problems and needs • up-to-date population data • village poverty status and poverty related problems • Provincial Protected Areas status within the District • Infrastructure and communications
3	A confirmation of the boundaries of the AEZs of the study area
4	A more detailed description of agro-ecosystems in the area of study
5	A more detailed understanding of the major farming systems of each agro-ecological zone in both study areas
6	A more complete list of key development and agricultural problems and development opportunities for each zone
7	Information on the agro-ecological sub-systems, that exist within the agro-ecological zones
8	Observations and information to assist system property analysis during the 3rd workshop

Logistics and team formation

Multi-disciplinary teams are formed comprised of centrally based staff and district staff members responsible for rural development programs within the district. The number of teams formed depends on the variety of filed tasks that have to be undertaken. In Phonesay District for example there were four teams, two teams responsible for transect walks, one team responsible for problem census meetings, and another team responsible for collecting additional NTFP marketing information.

Field tools used

During the field activity the teams make use of various AEA tools, such as:

- Focus groups (staff)
- Transect walks (staff and villagers)
- Key informants (staff and villagers)
- Problem census meetings (staff and villagers)
- Market studies (staff and villagers)

These tools are described below.

Focus Groups

Focus groups are comprised of staff who have taken part in previous AEA work sessions including district staff responsible for the rural development plans and activities within each agro-ecological zone. In the case of Phonesay District the focus groups were arranged as follows:

Group	District Agro-ecological Zones	Boriwen Agro-ecological Zones
1	**Zone 1:** Lower elevation, potentially productive upland agro-ecosystem	Not applicable
2	**Zone 2:** National biodiversity conservation area and buffer zone agro-ecosystem **Zone 3:** Forest protection and sustainable use agro-ecosystem	Not applicable Not applicable
3	**Zone 4:** Mountainous, recurring sub-watershed agro-ecosystem	**Zone 2:** Mountainous, recurring sub-watershed agro- ecosystem
4	**Zone 5:** High elevation plateau, rolling grassland and multiple use agro-ecosystem	**Zone 1:** High elevation plateau, rolling grassland and multiple use agro-ecosystem

Each group works with the aid of a complete set of A4 sized maps, the list of missing data, and the initial list of key questions for their particular zone to acquire additional information. The District staff played a key role in providing information based on their intimate knowledge of their areas.

Transect Walks

Representative transects walks are undertaken in selected villages in the agro-ecological zones The transect studies provide information on land uses and farming systems in various slope categories identified within the zones.

Key Informants

District staff and farmers must be involved in acquiring additional information needed. Both village men and women are consulted during the two transect walks, problem census meetings and discussions on production and marketing of agricultural and forestry commodities.

Problem Census

Problem census meetings are conducted to acquire a better understanding of villager perceptions on rural development constraints and problems. Groups of men and women contributed to the discussions which provide a list of priority problems as viewed by the communities. This information complements the information all ready acquired by the focus group discussions on key issues, problems and proposed solutions

Market Studies

Specific market enquiries are made with village representatives at known produce market locations to gather information on the marketing of agricultural and forest commodities. These enquiries should focus on NTFPs, annual cash crops, economic tree crops and fruit trees.

Information acquired from field work

An illustration of the types of information acquired during field work in Phonesay District is provided in the following table.

Table 6: Information Acquired During Fieldwork

Areas of Focus	Type of Information Acquired
District Agro-ecosystems: (Zones 1, 2, 3, 4 and 5)	• A more detailed and accurate description of agro-ecosystems in Phonsay District, including; agro-ecosystem context, land form, slope, soils, elevation, relative climatic conditions, land cover and trends, current land use, farming and livestock systems, fishing, wildlife and hunting, NTFPs, farming and forestry interactions, demography and ethnicity, infrastructure and communications, major livelihood problems, key poverty issues, and development opportunities. • Agricultural production information • Village poverty status and poverty related problems • Provincial Protected Areas status within the District • Up-to-date population data • Infrastructure and communications • A clearer definition of the boundaries of the AEZs for the District • A more detailed understanding of the major farming systems of each District agro-ecological zone. • A more complete list of key development and agricultural problems and development opportunities for each District zone • A clearer understanding of "system properties" and preparation of information to assist system property analysis
Specific Market Studies	• Cool season vegetable production and marketing: Yom Long Yai village Zone 1, Long Nam Pa Boriwen • NTFP collection, purchasing and marketing at Sop Chia village in the eastern sector of District Zone 4
Indicative villager perceptions of rural development problems and needs	• Gender dis-aggregated Problem Census Sop Chia village to define and prioritise problems in a representative village of District Zone 4 (also Boriwen Zone 2)
Indicative agro-ecological sub-systems, or recommendation domains in District Zone 4	• From a transect walk, description of the land uses and cropping systems in Tapo and Sop Chia villages, for five sub-zones: riverside paddy land, gentle lower slopes, moderate slopes, steep slopes and highland Sub-Zones

Key issues emerging from fieldwork

In addition to the key issues identified during the initial agro-ecological zoning activity, the multi-disciplinary focus groups enquire about additional key issues, problems and development opportunities from district rural development staff and villages during field work. A sample of these is presented in Table 6.

Table 6: Additional Key Issues, Problems and Development Opportunities Identified for the District Agro-ecosystem During Field Work

1. District Agro-ecosystem

Zone	Key Issues and Problems	Development Opportunities
Zone 1: Lower elevation, potentially productive upland agro-ecosystem	• Education levels in villages is low; only to level 5; lack teachers & school materials & equipment • Inadequate government services, ie education, health, electricity, communications ,agricultural extension and forestry • Some villagers from this zone still collect NTFPs from the NBCA (Zone 2) • Wet season poultry disease outbreaks • Lack agricultural and livestock techniques • Heavy rains (floods) cause stream pollution • Villagers lack finance for production and development: new paddy land , fish pond expansion, agricultural tools, & vaccines to protect livestock • A lot of opium addiction, 149 people: (women - 11, men 138) • Village merging (Ban Sop Kuan & Hat Saang) and land allocation for villagers has not been done • Some people still hunt prohibited wild animals	• There are potential production areas which could absorb people from other areas within the District • Improve government services including education, health, electricity, communications ,agricultural extension and forestry • Improve agricultural extension systems • Develop village level credit systems • Conduct opium consumption reduction programs and initiate a detoxification program • Consider the consequences of re-location and conduct land use planning studies before attempting re-location
Zone 2: National biodiversity conservation area and buffer zone agro-ecosystem	• Adjacent villagers in Zone 1 graze cattle in the NBCA	(See opportunities proposed in Section 4.3.5)

Part 8

Agro-ecosystem Analysis – Zone Descriptions

1. Required Outputs from System Analysis

2. Agro-ecosystem Analysis Tools

3. Overall District Agro-ecosystem Description

- **Transect table**

1. Detailed Agro-ecological Zone Descriptions

- **Spatial Analysis – Transect Table**
- **Time Analysis – Time Line –Historical profile**
- **Time Analysis – Seasonal Calendar**
- **Flow Analysis – Agriculture and Forest Products**
- **Decision Analysis – Administration Decision**
- **Making**
- **Systems Property Analysis**

Part 8: Systems Analysis - System Descriptions

Following field work and the acquisition of additional information, an analysis of each of the study area agro-ecosystems is undertaken during the third and final workshop.

Required outputs from systems analysis

The required outputs from systems analysis are as follows:

- An overall District Agro-ecosystem description
- Detailed descriptions of each agro-ecological zone of the study area
- A prioritised list of key issues and development opportunities identified for each of the zones in the study area
- An outline of proposed solutions to the key problems identified for each of the zones in the study area

Agro-ecosystems Analysis Tools

AEA uses a variety of tools to assist with the analysis of space, time, flow and decision-making. Many are similar to PRA tools and all emphasize simplicity, participation and objectivity.

The major analysis tools are explained below.

Analysis Tool	Explanation
Transect diagrams (space analysis tool)	Transect diagrams are used to describe and compare each agro-ecological zone according to a number of key agro-ecological and socio-economic parameters. Transects help to ensure that all relevant information is collected and clearly organized for each agro-ecological zone; they also assist in the analysis by facilitating comparisons and identifying important relationships among the zones.
Historical Profiles (time analysis tool)	Historical profiles or 'time lines' are used to identify key events and analyse changes and trends over the longer term. They review major occurrences over a number of decades and usually rely heavily on local knowledge. Their purpose is twofold. Firstly, to try to identify longer term trends, for example changes in forest cover, trends in rice yields, changes in livelihood systems, etc. Secondly, they are used to assess the robustness of the agro-ecosystem to major perturbations such as flood/drought, pest outbreaks, market-price fluctuations, etc.
Seasonal Calendars (time analysis tool)	Seasonal calendars are also used to analyse time related changes for each agro-ecosystem, but over the shorter-term (within-year). Climate, cropping patterns, major agricultural operations, labour use, price movements, social activities, etc. are presented by month so that comparisons can be made and key periods identified.
Flow diagrams (flow analysis tool)	Flow diagrams are used to analyse the flow of materials, money, information, labour, etc. both from outside and within the system. Flows occur both up and down the hierarchy, i.e. from village to district to province, etc. and from one agro-ecosystem zone to another, e.g. grazing-cattle migration from zone to zone in different seasons. Various schematic means of representing these flows exist and can be selected according to participants needs and capacities.
Venn diagrams (decision	Venn diagrams are used to analyse relationships among agro-ecosystem communities, and projects and agencies providing support to them. They are useful in identifying potential development partners or detecting where inter-agency

Analysis Tool	Explanation
analysis tool)	cooperation could be improved. In Venn diagrams, overlapping circles represent good cooperation, touching circles represent some cooperation and non-touching circles represent poor or no cooperation.
Problem-cause diagrams (decision analysis tool)	Problem-cause diagrams or 'problem-solution trees' are used to analyse the causes of problems, identify the linkages between them, understand the way farmers cope with the problem, and identify appropriate solutions. Problem diagrams begin with a broad statement of the overall problem which is then broken down into component problems and eventually the root causes; these are then examined to identify farmer responses to the problem, and finally, alternative solutions are proposed.
System properties tables (system properties analysis tool)	The 4 system properties of productivity, stability, sustainability and equitability are analysed for each agro-ecological zone using a system properties table. Analysis proceeds by listing those attributes of the agro-ecosystem which have positive and negative effects on the 4 system properties and explaining the way this occurs. This helps to identify the important elements of each system which affect its overall performance, and encourages a more balanced analysis than the traditional focus on productivity would provide.
Pairwise ranking (prioritization tool)	Pairwise ranking provides a means of objectively ranking or prioritizing issues, problems and solutions. Objectivity is improved if the ranking is conducted by multi-disciplinary groups, as it then incorporates a variety of different perspectives and points of view. Pairwise ranking proceeds by listing the problems to be compared, and then comparing each problem with every other problem, in turn. When all comparisons have been completed, the scores are totaled to provide a ranking of the relative importance of each. See pairwise ranking example below.
Impact assessments	Once proposed solutions to the key problems have been generated by AEA, a simple assessment technique can be used to assess the impact of each proposed solution on important cross-cutting issues such as gender, poverty and the environment. These assessments are used to modify each solution to enhance positive impacts and reduce potentially negative impacts in regard to these cross-cutting issues.
Innovation assessment (prioritization tool)	When designing development programs it is necessary to have some means of setting priorities for the set of proposed solutions to key problems generated by AEA. Innovation assessment is used to assist with this by allowing participants to set priorities in a rational and objective manner. Innovation assessment proceeds by scoring each of the proposed programs according to a sub-set of selected factors. The relevant factors are chosen according to the objectives of the study, but will commonly include the effect of the proposed program on system productivity, stability, sustainability and equitability; its cost and time taken to implement; its overall feasibility; and its impact on poverty, gender and the environment.

Overall System Description

The system is described using the district agro-ecosystems transect table an example of which is illustrated in **Figure 2: Transect Description of Phonsay District Agro-Ecosystems**

Figure 2 : Transect Description of Phonsay District Agro-Ecosystems

High elevation plateau, rolling-grassland and multiple use agroecosystem	**Mountainous, recurring sub-watershed agro-ecosystem**	**Lower elevation, potentially productive upland agro-ecosystem**	**National biodiversity conservation buffer zone agroecosystem**	**Forest protection and sustainable use agro-ecosystem**
				
1. Agro-ecosystem context				
An extension of a similar AE zone in neighbouring Luang Prabang District; the smallest of the five zones; ethnic Hmong population; accessible in dry season	Centred on the Nam Pa and Nam Bak river systems at the western end of the District; the mostly heavily populated area; has the best infrastructure & communications systems	Centred on the Nam Ter river system in the eastern end of the District; lower population than zone 4 & has potential to absorb more people; has paddy land development potential	Southern-most part of Nam Et - Phou Loei NBCA; adjacent to Houa Phan Province; some upland cultivation by villages from zone 1; potential for delineation of a "buffer zone"	A forested area adjacent to zone 2; bordered by the Nam Khan river; eco-tourism potential; NTFPs and wildlife resources being exploited by outsiders; very low population.
2. Landform, elevation, slope				
Mountainous & rolling plateau; high elevation (900 - 1700 masl); slopes between 2% to > 55%	Mountainous, mid elevation (500 - 900 masl); slopes between 15% to > 55%	Less mountainous; mid-elevation (500 - 1000 masl); slopes mostly between 8% & 20%, some areas steeper	Mountainous; higher elevation (500 - 1000 masl); slopes mostly between 30% and 55%; some areas steeper	Mountainous; higher elevation (mostly 500-1500 masl); slopes mostly between 30% and 55%, some areas less steep
3. Geology, Soil types				
Geology: Pcl -Calcaeous series; mainly massive limestone with conspicous relief, subordinate shale and sandstone Soil types: Plinthic Alisols and	Geology: Pca - Argillite series, shale, mudstone, siltstone and fine-grained sandstone Soil types: Ferric Luvisols, about 5% of the land area	Geology: Pca - Argillite series, shale, mudstone, siltstone and fine-grained sandstone Soils: Gleyic Cambisol (Cmg), Haplic Acrisol (Ach) Haplic	Geology: Pca - Argillite series, shale, mudstone, siltstone and fine-grained sandstone; a litle Pcl -calcaeous series Soils types: Mid-zone area:	Geology: Pca - Argillite Series; shale, mudstone, siltstone and fine grained sandstone ("hin garb leung" and "hin garb dum")

High elevation plateau, rolling-grassland and multiple use agroecosystem	**Mountainous, recurring sub-watershed agro-ecosystem**	**Lower elevation, potentially productive upland agro-ecosystem**	**National biodiversity conservation buffer zone agroecosystem**	**Forest protection and sustainable use agro-ecosystem**
Gleyic Acrisols	Harplic Lixisols about 95% of the land area	Luvisols (Lvh), Plinthic alvisols (Alp); good cropping land	Luvisols; Surrounding the NBCA Acrisols and Lixisols	Soils types: Gleyic and Ferric Acrisols.
4. Relative climatic conditions				
Area I: Mean average temperature in 14 to 22º C range Average annual rainfall range: 1,600 to 1,800 mm	Mean average temperature range: 14º C- 20º C Estimated annual rainfall range: 1,700 to 1,800 mm	Mean average temperature range : 20-24 C Average annual rainfall range: 1700 - 1800 mm	Mean average temperature range: 18º - 24º C; Average annual rainfall range: 1,600 - 1,800 mm	Mean average temperature range: 16º - 26º C; Average annual rainfall range: about 1,700 to 1950 mm
5. Forest cover and future trends				
Mostly "unstocked forest" and scrub; forest cover varies between about 10 % and 60%. Grassland in the less steeply sloping land. Cattle grazing potential	Mixed forest about 30 %; bamboo forest, upland cultivation & other forest types over the remainder. Forest area decreasing as population density increases (relocation)	Forest cover of various types is approx. 30-40%. Forest cover is decreasing where there has been village re-location and merging and populations have increased.	Forest cover is approximately 60%; de-forestation in some areas by upland cultivation. Wildlife and NTFPs are being exploited by outsiders.	About 60 % is undisturbed forest, 30 % degraded forest, and 10 %, secondary scrub. Potential to be classified as a "Provincial Protected and Sustainable Use Forest"
6. Current land use				
Upland swidden cultivation; Cattle grazing on natural grasslands; Small scale vegetable production	Provincial Protection Forest and Provincial Conservation Forest declared in the Nam Pa area; Upland cultivation, paddy rice production , & livestock production	Scattered natural forest; secondary forest in fallow agricultural systems; upland agriculture; irrigated rice	Part of Nam Et - Phou Loei National Biodiversity Conservation Area (NBCA); Shifting cultivation and uncontrolled cattle grazing	Natural forest, about 60% of land area; Agricultural cultivation and other uses, about 40% of the land area.
7. Farming systems major crop/livestock enterprises				
Upland rain-fed rice, maize and vegetables cultivation; Cattle, buffalo, pigs, goats, poultry (chickens ducks) raising;	Farming System: A rainfed upland rice farming system; other crops grown include maize and job's tear; and NTFPs Livestock System: Cattle, pigs and poultry	Upland rice and mixed crops using upland cultivation (rotational swidden)**;** wet season paddy rice production Extensive-natural cattle raising	Shifting cultivation (upland rice), uncontrolled cattle and buffalo grazing in NBCA *by adjacent villages in zone 1*	Upland rain fed rice based farming system. Other crops planted include, job's tear, sesame and some maize. Livestock: cattle and buffaloes, pigs and poultry
8. Fish and Fishing				
None; no natural streams and no ponded fish	Natural river fish conservation "ponds" are managed by	Natural stream fishing including pa far, tao (turtle), and others	Natural stream fishing including "pa jart" and others	Natural stream fishing including *Pa Jart and Pa Hian*

High elevation plateau, rolling-grassland and multiple use agroecosystem	Mountainous, recurring sub-watershed agro-ecosystem	Lower elevation, potentially productive upland agro-ecosystem	National biodiversity conservation buffer zone agroecosystem	Forest protection and sustainable use agro-ecosystem
	villagers in five villages. Varieties include: Fish ponds exist in several villages inc, Nam Bor & Thapo			
9. Wildlife				
Wildlife species have diminished because of deforestation and annual grassland burning; it is probable that no protected species survive in this zone	Wildlife resources include: Tiger, khwang, deer (farn), khating, mia, wild pig, kahor, kua (chicken), wild chicken, tua lin, lan (iguana) and snakes (ngou luang) Non-prohibited spp are hunted, consumed and /or sold in reasonable quantities	Hunting of khwang, farn, wild bear, ngeuang (like wildgoat), tiger, kathing, ngean (wild cat -civet), ga hoh (mouse, rat), wild chicken, (gai khua) and other birds species	Hunting of wildlife *by adjacent villages in zone 1*: Kathing, tiger, deer (khuang and farn), wild pigs and monkeys.	Wildlife resources include: kathing, tiger, deer (khuang and farn), wild pigs and monkeys.
10. NTFP's for subsistence and sale				
Villagers collect a wide range of about 50 NTFPs, including economic, medicinal, and housing products. Main ones are: Por sa, mushrooms, khaem, nor hok, dok euang, yao dong, & mai saang.	Commercial NTFPs: Por sa, puak muak, bamboo grubs (tua mae), mak tao, khaem, rattan, & yams. Two NTFP traders operate in the zone; markets available all year. Inadequate drying of products cause price reduction and market losses	NTFP collection in natural forests; mainly mai ketsana, mak neng, por sa, puak muak, and rattan. There is limited commercial trading because of roads reach only 5 of the 10 villages villages	Main NTFPs harvested in the NBCA for sale are: mai ketsana, por sa, doot tiang, khaem, puak muak; sold locally in the Phonthong market (Zone 1) and in Xieng Ngeun District using Nam Khan river transportation.	The main NTFPs marketed are por sa (paper mulberry), puak muak, toot tiang, khaem, and some mai ketsana. Substantial quantities are marketed in Xieng Ngeun District using Nam Khan river transportation
11. Farming – forestry interactions				
Part of this zone was declared a Provincial Conservation Forest in 1996, however large areas in this zone are natural grassland which villagers use for cattle grazing. The conservation forest classification therefore needs to be re-considered	Villagers are expanding the land area for agricultural production by bringing more forest areas under cultivation. This is partly caused by in-migration, some by District; some voluntary	Rotational swidden cultivation and cropping in forested areas; cattle grazing in forests; forest trees used for field fencing; NTFP collection supplements agricultural production	Shifting cultivation (upland rice) and uncontrolled cattle and buffalo grazing in NBCA by villages adjacent to the NBCA	Had Chong and Don Kham practice upland cultivation in the zone. The forest areas are also a source of NTFPs and wildlife. Some teak is planted
12. Demography and ethnicity				
Total of 5 villages in Zone	Within the Zone there are five	Total of 10 villages in the zone;	No resident population in the	Three "straddle villages" are

High elevation plateau, rolling-grassland and multiple use agroecosystem	**Mountainous, recurring sub-watershed agro-ecosystem**	**Lower elevation, potentially productive upland agro-ecosystem**	**National biodiversity conservation buffer zone agroecosystem**	**Forest protection and sustainable use agro-ecosystem**
Hmong 4 villages Khamu 1 village Total families: 369 Population 2,567; Hmong 2,290, Khamu 277	Village Development Groups, & 18 villages in which all three major ethnic groups reside. Lao Theung : 11 villages Mixed Ethnicity : 4 villages Hmong: 2 villages Lao: 1 village	Three ethnic groups, Lao; 70 families; Lao Theung 479 families and Lao Soong, 62 families Population is 3,722 people; 611 families	NBCA; adjacent impact villages: Mixed Lao Theung + Lao Lum: Had Jong; Lao Lum: Pak Vang Lao Theung: Vieng Chaleon & Buakkham;	adjacent to the NBCA: Lao Lum 125 families; Lao Theung 130 families, Total: 255 families. Total population: 1,446
13. Infrastructure and communications				
Walking tracks exist between all villages; a 4WD vehicular road reaches only 1 village (LomYom Yai) One school and health post	Villages along the Nam Pa river area as far as Sop Chia have quite good road access to the main road connecting to Luang Prabang. Other villages do not have access to roads. Other infrastructure is quite well developed, including health posts (7), basic schools (18), a post office at Phoneay & 12 permanent village water supplies	Schools: non-permanent - 8; permanent - 1; VWS: Every village has a VWS Health Post: 1 health post; 9 villages have "medicine boxes" Roads: Roads reach 5 villages Radio: Radio broadcasts from Province and Vientiane	An access road reaches Phonthong villages in the adjacent Nam Ter River area, from which there are walking tracks into the NBCA.	The Nam Khan River to the south is the main transportation system to Xieng Ngeun District and Luang Prabang. A road reaches the village of Sop Hout, west of the zone boundary. Only Don Kham village has a water supply and a level 3 school.
14. Major livelihood problems				
No clean domestic water; no reliable all weather vehicular road, low income, no toilets, limited access to schooling	Soils fertility levels are being depleted; available farming land is usually quite steep; little potential for more paddy land Health levels are low	Villagers still dependent on forests for survival Health levels are low Knowledge levels are low	None: No resident population in the zone	No road access Insufficient farming land with moderate slopes Education levels are low
15. Key issues in regard to poverty				
Severe poverty levels in all villages; shifting cultivation remains the main form of agriculture; lack of production investment funds; development opportunities are limited until reliable access roads reach the villages	Food production levels are low & consumption needs are high Improved crop production methods have not been adopted Production does not follow the market needs; villagers lack market information	No economic production system (still subsistence rice system) Lack funds to invest in agricultural production Road system still inadequate; some villages do not have road access	None: No resident population in the zone	Lack moderately sloping farming land; lack capital to invest in agricultural production; low knowledge on improved farming methods; no potential paddy land available; Opium addiction is quite severe

High elevation plateau, rolling-grassland and multiple use agroecosystem	Mountainous, recurring sub-watershed agro-ecosystem	Lower elevation, potentially productive upland agro-ecosystem	National biodiversity conservation buffer zone agroecosystem	Forest protection and sustainable use agro-ecosystem
16. Development opportunities				
If an access road reaches the villages the zone is very suitable for planting short season crops (organic vegetables) for sale in Luang Prabang. If domestic and livestock water facilities are improved, there is considerable potential for permanent settlement of villages, improved livestock production, fruit trees and vegetables	Potential to further develop livestock production systems Some areas used for cultivation - young fallow - could be regenerated to forest. Improve production by adopting new varieties and improved agricultural production methods Infrastructure could be improved through-out the zone Improving access to education	Irrigation weirs; expand paddy areas; approximate 100 ha; NTFP domestication; Fruit trees, commercial trees, and vegetables Animal raising: cattle,buffalo, goats and pigs Extension of the road to Houa Phanh Province Paper Mulberry growing for silk production Develop markets in Phonthong and Huay King Improve extension, management and use of NTFPs Formation of production groups Permanent primary & secondary schools & health posts Potential for eco-tourism Sustainable management of stream fish resources	Bio-diversity conservation (flora and fauna) and eco-tourism. Detailed NTFP, wildlife and fish surveys Land use planning in adjacent villages to rationalise and improve resource use in the NBCA Village Natural Resource Management Agreements to increase village co-operation in NBCA resource management. Potential to establish an NBCA buffer zone (or protection zone) along the boundaries of the NBCA and in the mountainous and forested area to the south west of the NBCA, adjacent to Phoukhoun and Phoukood Districts.	Markets for commercial crops exist in Xieng Ngeun and Luang Prabang A road connection between Sop Hout and Don Kham to provide road access to Phonsay and the market at Don Kham. Clean water supplies & latrines in Hat Jong and Hat Gap Opium detoxification centre to treat opium addicts Improved health facilities Permanents schools in Hat Jong and Hat Gap Eco-tourism activities using the Nam Khan river to provide access for tourists. (Buddist images are housed in caves in Don Kham)

Detailed Agro-ecological Zone Descriptions

The descriptions of each agro-ecological zone in the study area are derived from information prepared during workshop sessions and additional information gathered in the field. Agro-ecological zones are described using the following analysis tools:

Historical Profiles: Time analysis tool
Seasonal Calendars: Time analysis tool
Flow Diagrams: Flow analysis tool
Venn Diagrams: Decision analysis tool
System Properties Tables: System properties analysis tool
Key Issues Table: Issue documentation tool
Problem Census: Problem Identification tool

Examples from Phonesay and Na Mo Districts are presented below.

Spatial Analysis: Transect Table - Zone 1 - Phonesay

Descriptor	Information
Land Form	The land form is undulating; some areas are higher
Slope	In the ranges 8 - 16 % and 16-30%+
Elevation	In range 500 to 999 masl
Soils	Gleyic Cambisol (Cmg), Haplic Acrisol (Ach) Haplic Luvisols (Lvh), Plinthic alvisols (Alp) These soils are fertile and suitable for cropping and livestock production
Relative Climatic Conditions	Temperature Range : 20-24 C Average annual rainfall: In the range : 1700 - 1800 mm There is heavy cloud cover and cool misty conditions every year, some years more than others; very cold winters in 1992, and 2001
Forest Cover and Trends	Forest cover of various types is approx. 30 to 40%, but this is difficult to estimate from land use maps. Forest cover is decreasing in areas where village re-location has resulted in population increase. There are some opportunities to protect and regenerate forests at village level through village forest allocation programs
Present Land Use	Scattered natural forest; secondary forest in fallow agricultural systems; upland agriculture; bunded irrigated rice There are opportunities to undertake permanent field cropping in selected locations where slopes are moderate
Major Farming and Livestock Systems	Upland rice and mixed crops**;** wet season paddy rice Small scale pig and poultry raising; buffaloes for paddy cultivation and economic security; limited cattle raising
Livelihood Systems	Mostly natural (extensive) methods of upland cultivation (rotational swidden) Paddy cultivation where available NTFP collection in natural forests Extensive-natural cattle raising
NTFP Resources	Mai ketsana, mak neng, Por sa, Puak Muak, rattan and others
Wildlife and Fish Resources	Wildlife: Khwang, farn, wild bear, ngeuang (like wildgoat), tiger, kathing, ngean (wild cat -civet), ga hoh (mouse rat), wild chicken,(gai khua) and other birds species Fish; Pa far, tao (turtle), and others
Farming -Forestry Interactions	Rotational swidden cultivation and cropping Large animal raising: cattle, buffaloes and goats; open grazing in forests Wood cutting (trees) for domestic use, and NTFP collection
Population and Ethnicity	In 10 villages in the zone: Na Pieng, Sop Hout, Huay King, Kiew lay, Na Ngoui, Ban Phonthong, Na Ngiou, Ban Buakkham, Phou Samay and Vieng Chaleon.

Descriptor	Information
	The population is 611 families and 3,722 people, Females: 1,804; Males There are 3 ethnic groups; Lao; 70 families; Lao Theung 479 families and Lao Soong, 62 families
Infrastructure and Communications and Information	Schools: (Patom patarn) native/natural material - 8 locations; Permanent School: 1 location; There are 2 villages with schools that do not have teachers VWS: Every village has a semi-permanent or permanent VWS Health Post: There is 1 health post in the Zone; 9 villages have only "medicine boxes" Roads: Roads reach 5 villages Wireless: There is wireless-phone "phoney" in the Zone at Phonthong operated by the Army Radio: Can receive radio broadcasts from Province and Vientiane
Major Livelihood Problems *(adjacent villages only)*	Food: Villagers eat survive from the forest (natural) Health: Levels of health is low Knowledge levels are low
Poverty Related Problems	Villagers have limited opportunities to reduce poverty levels because they are restricted to shifting cultivation farming systems No economic production system - still subsistence rice system Lack funds (investment) for agricultural production No good road reaches all the villages
Development and Conservation Opportunities	Construction of irrigation weirs Expand paddy areas; approximate 100 ha ; a survey has been made of 30 hectares allready There are areas for cropping; (mai ketsana, fruit trees, industrial/commercial trees, and vegetables) Animal raising: cattle ,buffalo, goats and pigs Potential to extend the road network to reach adjacent Provinces (Xieng Khwang and Sam Neau) Mulberry growing for silk production Market places in Phonthong and Huay King Improve extension, management and use of NTFPs (mai ketsana, mak neng, Por sa, Puak Muak, rattan and others Build "development-economic- production - technique" groups" Build permanent Mattayom school - secondary schools Build permanent health posts Potential for developing a natural tourist industry (eco-tourism) Manage and use (sustainability) stream fish (agreements)

Time Analysis: Historical Profile - Zone 1 - Phonesay

Main Events	Period	Information
• There were 5 villages in this zone; Ban Na Mart, Na Ngoui, Ban Poung, Ban Hian, and Ban Mun. They were located along the Nam Ter River	**1960 - 1969**	• There is potentially new paddy but it has not been developed , • The main occupation is upland swidden
• At this time there were difficulties associated with the war	**1970 - 1979**	• The villagers fled to the forest during the war - 1970 to 1973 • Started a new village in 1974
• Villagers started to make paddy	**1980 - 1989**	• The paddy rice varieties came from Ban Nga, Phonesay • Equipment to do production came from Xieng Khwang
• There were some security concerns (Not quiet in the zone) • Disease epidemic "thong daeng" in the area in 1993-94	**1990 - 1999**	• There was a bush fire in Ban Phon Thong in 1992
• Sickness outbreak, 40 people died in 2000	**2000 - 2004**	• Started to merge villages in the area

Sickness, "mak daeng" and throat infections, outbreak 2004 - 73 people died.		• Villagers started to use new higher yielding rice varieties from Xieng Khwang; "khao kai noy", "khao arnong"

Time Analysis: Seasonal Calendar – Zone 1 – Na Mo

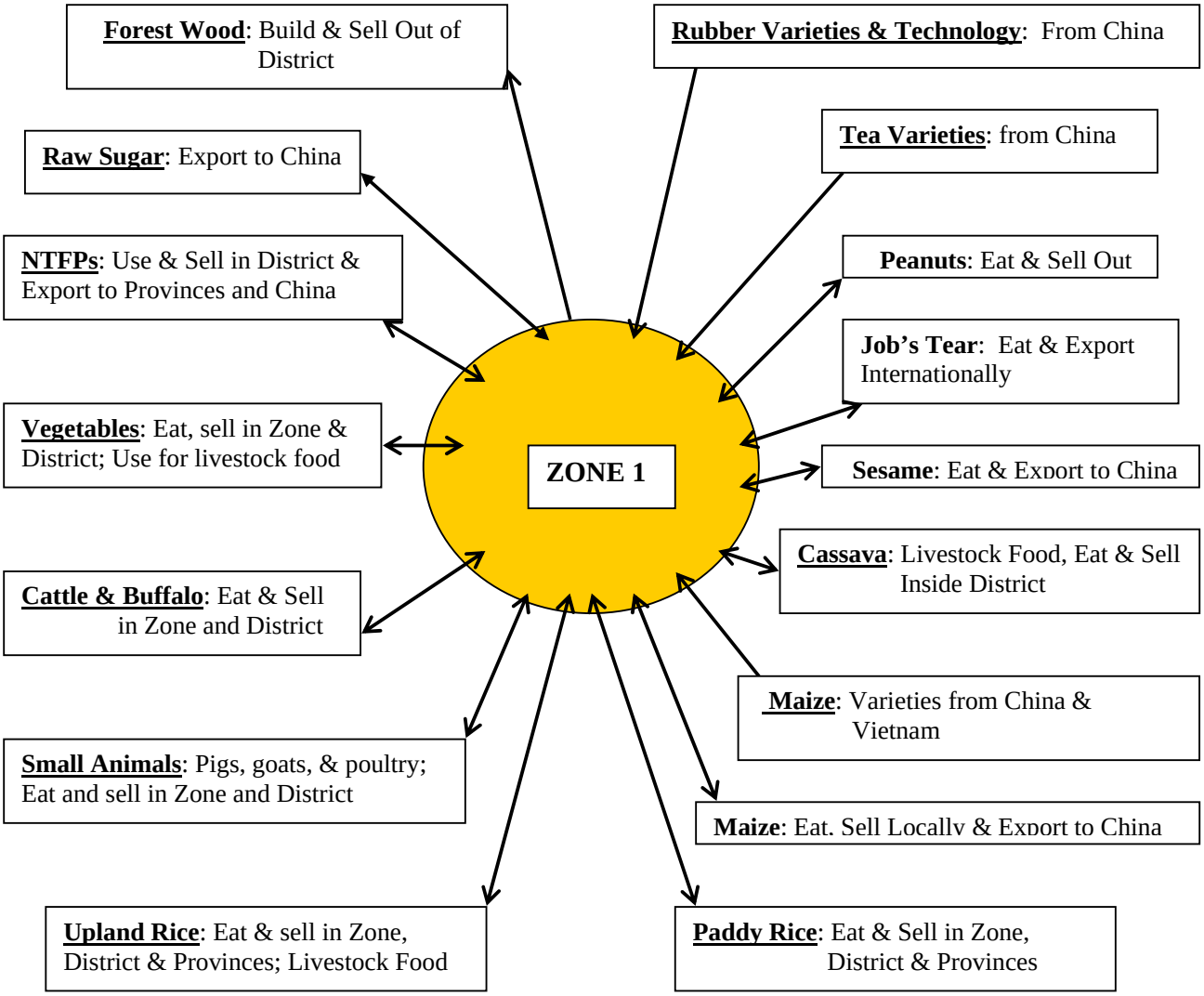
Non-timber Forest Products (NTFPs)

Activity\Month	1	2	3	4	5	6	7	8	9	10	11	12
Climate/weather												
Wet season												
Cool season												
Hot season												
NTFP Harvest												
Por sa												
Khaem												
Puak Muak												
Puak Bong												
Cardamom												
Ginger												
Yar Bai Lai												
Hua Idook												
Leuat Jan Dai												
Jan Daeng												
Mai Ketsana												
Rattan(Wai Fart)												
Mak Kaen												
Bamboo (various)												
Sakarn												
Pak Kar												
Kai Hin (Ferns)												
Pak Hak												

Agricultural Calendar

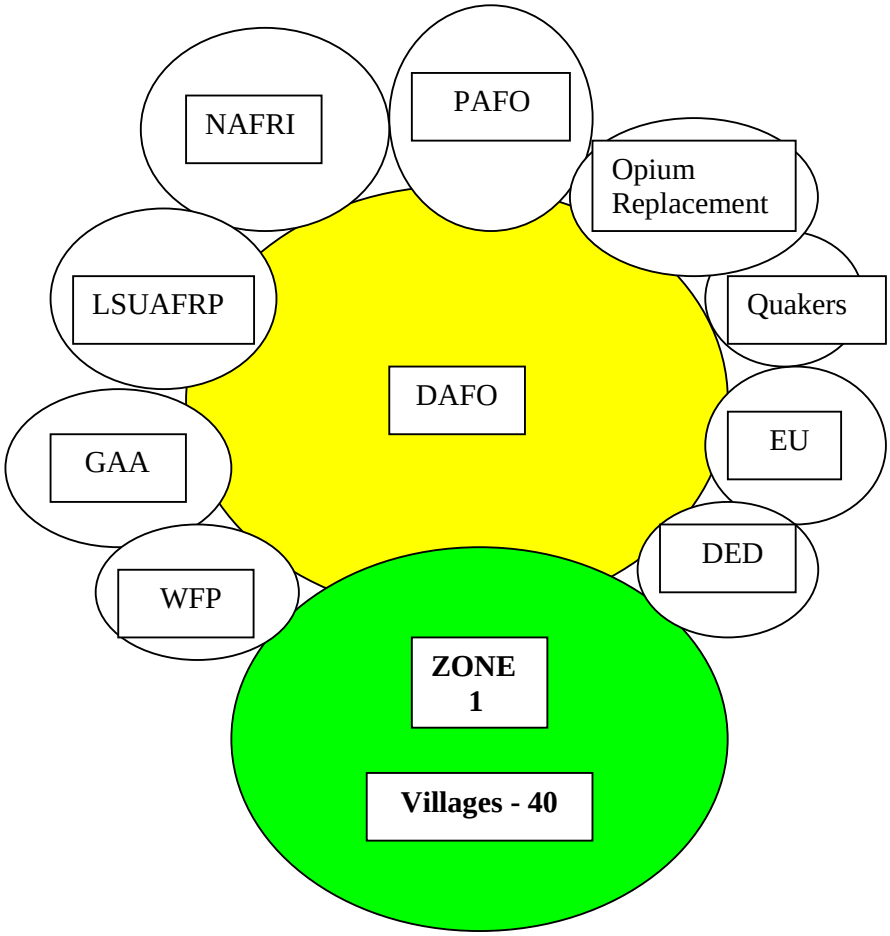
Activity\Month	1	2	3	4	5	6	7	8	9	10	11	12
Weather												
Wet season												
Cool season												
Hot season												
Annual Crops												
Paddy Rice				Plough	Nursery	Trans-plant	Plant	Weed	Harvest	Harvest	Harvest	
Hill Rice		Slash	Burn	Weed – Prepare	Plant	Plant	Weed	Weed	Harvest	Harvest	Harvest	
Job's Tear		Slash	Burn	Weed – Prepare	Prepare	Plant	Plant	Weed	Weed	Weed	Harvest	
Sesame		Slash	Burn	Weed – Prepare	Prepare	Plant	Plant	Weed	Weed	Harvest	Harvest	
Maize (w/s & d/s)	Harvest	Slash	Burn	Plant	Weed	Weed	Harvest	Harvest - Slash	Burn – Prepare	Plant	Weed	Weed
Vegetables	Harvest	Harvest	Plant	Plant	Harvest	Harvest			Plant	Plant	Harvest	Harvest

Flow Analysis: Agriculture &Forest Products - Zone 1- Na Mo



Decision Analysis: Venn Diagram - Zone 1 – Na Mo District

Zone 1: Venn Diagram - Administration and Project Co-ordination



DAFO:	District Agriculture and Forestry office
DED:	German Development Service
EU:	European Union
GAA:	German Agro Action
LSUAFRP:	Lao Swedish Upland Agriculture and Forestry Research Program
NAFRI:	National Agriculture and Forestry Research Institute
PAFO:	Provincial Agriculture and Forestry Office
WFP:	World Food Program

System Properties Analysis - Zone 1- Phonesay District

Positive Aspects (+)	Negative Aspects (-)
Productivity	
• Suitable climate for food production • High rice yield; rice sufficiency - medium to high • Soils are good and there are areas available for expanding production • There is potential for a variety of crops	• Market access lacking • Access roads lacking • Agricultural production techniques need improvement
Stability	
• Production levels each year are fairly level • The people/families that have rice shortage can find seasonal work in the zone or in adjacent zones •	• Produce prices are low; lack permanent and stable markets • Poor road access in wet season for marketing
Sustainability	
• Large areas available for agriculture and there is potential for irrigation development • New areas are being developed for cropping; a small weir is planned with a benefit area of 30 hectares • Moderately sloping land being cultivated therefore there is potentially less soil erosion. • Longer upland fallow cycles are being maintained	• The natural resources are not managed well • Land use planning has not been done yet (allocation of agricultural land) • Forest cover is reducing
Equitability	
• Most people have access to farming land • Most people have access to NTFP collection areas	• Population increase from re-location • Education and health levels are not good; they are lower than other zones • Some families do not own or have access to paddy land

Part 9

Systems Analysis – Key Questions and Important Problems

1. **Tools for problem Analysis**

   - **Problem Cause Diagram**
   - **Pair-wise Ranking (prioritization tool)**

2. **Key Issues and Problems**

3. **District Agro-ecological Zone Innovation Assessments (Problem Solution Ranking)**

Part 9: Systems Analysis – Key Questions & Analysis

To conclude the systems analysis, key issues and important problems are identified for each agro-ecological zone within the area of study, solutions are proposed and the solutions are assessed or ranked to determine priorities. These issues and problems are identified during the AEA process, starting from agro-ecological zoning, follow-up field work, and during the characterization and systems property analysis of the various zones.

This chapter provides examples of key issues, important problems, proposed solutions and problem solution ranking derived from the Phonesay and Na Mo District AEAs. The tools that may be used in these processes are also described.

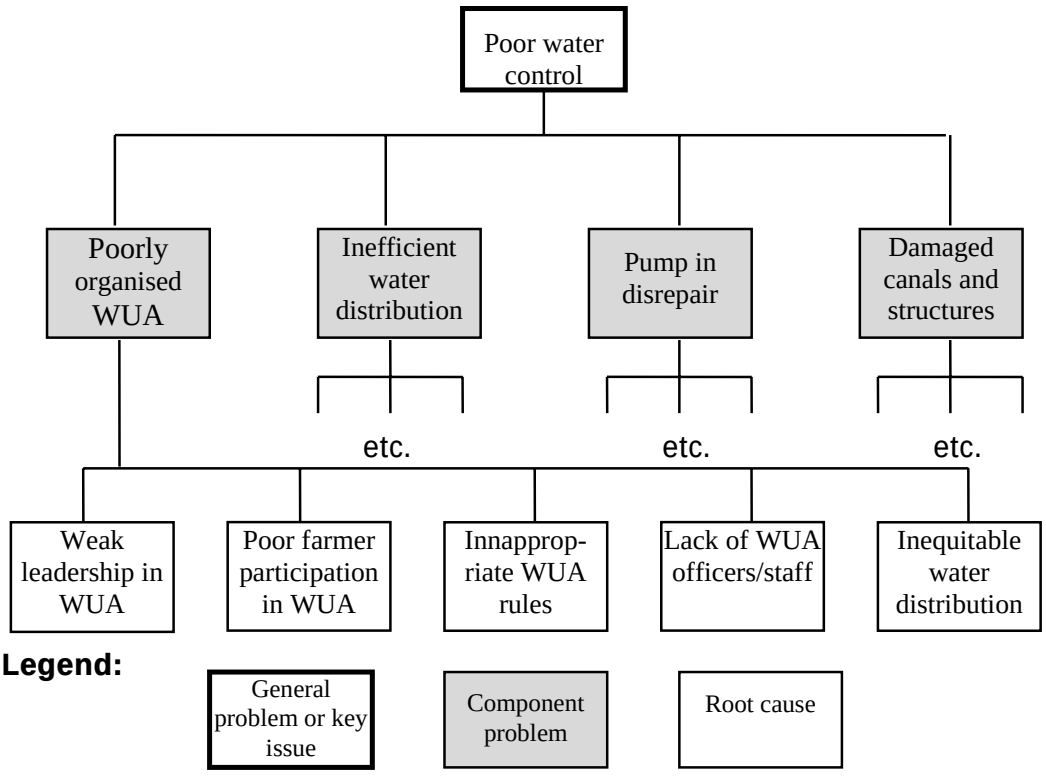
Tools for Problem Analysis

Problem-cause diagram (decision analysis tool)

Problem-cause diagrams or 'problem-solution trees' are used to analyse the causes of problems, identify the linkages between them, understand the way farmers cope with the problem, and identify appropriate solutions.

Problem/Solution Trees

Example of a problem tree for poor water distribution in an irrigation scheme



Pair-wise ranking (prioritization tool)

Pairwise ranking provides a means of objectively ranking or prioritizing issues, problems and solutions. Pairwise ranking proceeds by listing the problems to be compared, and then comparing each problem with every other problem, in turn. When all comparisons have been completed, the scores are totaled to provide a ranking of the relative importance of each. See pairwise ranking example below.

Ranking Matrix

Key questions or problems	1. Lack of water in dry season	2. Poor communications and difficult access	3. Low NTFP prices (district mkt. concessions)	4. Declining numbers of NTFPs	5. Designated as Provincial Conservation Area	6. Human disease outbreaks	7. Problems of relocation of villages
1. Lack of water in dry season							
2. Poor communications and difficult access	1						
3. Low NTFP prices (district mkt concessions)	1	2					
4. Declining numbers of NTFPs	1	2	4				
5. Designated as Provincial Conservation Area	1	2	3	4			
6. Human disease outbreaks	1	2	6	6	6		
7. Problems due to relocation of villages	1	2	7	7	7	6	

Scoring Chart

Key Question or problem	Response Frequency	Ranking
1. Lack of water in dry season	6	1 st
2. Poor communications and difficult access	5	2 nd
3. Low NTFP prices (district mkt concessions)	1	6 th
4. Declining numbers of NTFPs	2	5 th
5. Designated as Provincial Conservation Area	0	7 th
6. Human disease outbreaks	4	3 rd
7. Problems due to relocation of villages	3	4 th

Key Issues and Problems

Table 6 illustrates key issues and problems in two zones arising from agro-ecological zoning and system analysis in Na Mo District.

Table 6: Key Issues and Problems Arising from Agro-ecological Zoning and System Analysis

Productive Agro-forestry Ecosystem (Zone 1)		Forested Multiple Use Agro-ecosystem (Zone 2)	
Key Issue	**Proposed Solution**	**Key Issue**	**Proposed Solution**
1. Village boundaries not delineated clearly between some villages	1. DAFO: Stake out the boundaries and erect boundary sign boards to notify villages 2. Review & use Village Land Use Agreements 3. Establish inter-village networks & do networking	1. Village boundaries not delineated clearly between some villages	1. DAFO: Stake out the boundaries and erect boundary sign boards to notify villages 2. Review & use Village Land Use Agreements 3. Establish inter-village networks & do networking
2. Management of agricultural land and forests does not follow the District Regulations	1. DAFO: Inform and encourage better village management 2. Follow-up on existing Village Land use Agreements 3. Regular monitoring of village Land Use Agreements	2. Management of agricultural land and forests does not follow the District Regulations or existing village agreements	1. DAFO: Inform and encourage better village management 2. Follow-up on existing Village Land Use Agreements 3. Regular monitoring of village Land Use Agreements
3. Agricultural land is limited for livelihoods	1. DAFO: Promote permanent occupations to replace SC 2. Improve agricultural techniques 3. Introduce commercial tree crops, ie, rubber (use less land to replace rotational hill-rice)	3. Agricultural land is limited for livelihoods	1. DAFO: Assess the conditions of the area in more detail to determine the available areas 2. Promote permanent occupations to replace SC 3. Improve agricultural techniques and diversify farming methods 4. Introduce commercial tree crops (use less land to replace rotational hill rice) DAFO: 5. Review village merging plans and procedures
4. 75% of villages have road access. Access roads still needed in some villages. Wet season access is difficult in 50% of villages with roads	1. Liase with Communications Dept. to develop a plan 2. Access NPEP funds 3. Seek funds from other projects	4. There are few Land Use Agreements established in this zone, including for NTFPs	1. DAFO: Undertake LUP and LU zoning in villages after boundaries have been delineated 2. Prepare Village Land use Agreements after zoning completed 3. Follow-up on implementation of existing Village Land use Agreements and improve implementation 4. Regular monitoring of village Land

Productive Agro-forestry Ecosystem (Zone 1)		Forested Multiple Use Agro-ecosystem (Zone 2)	
Key Issue	**Proposed Solution**	**Key Issue**	**Proposed Solution**
			Use Agreements
5. Opportunities for schooling is low, because not enough teachers	1. Education Dept build sufficient schools and provide teachers 2. Train teachers who will live in the isolated villages 3. Improve access roads (convenient for teacher travel) 4. Consider teacher isolation incentives	5. The need for expanding access tracks is more important in this zone. Only 16 villages have access tracks or small roads; 22 villages have access by walking tracks	1. Dept of Communications: Expand access & permanent roads to villages 2. Access NPEP funds 3. Seek funds from other projects
6. Health levels are low: dysentery; malaria, and opium addiction; 3% of the population are opium addicts There are only 6 health centres in the zone. Only 18% of villages can access health centres	1. Have the Health Dept. establish medicine "cabinets"in each village (to complement the kaet health posts) 2. Train Village Health Workers 3. Encourage household toilet construction & use 4. Health and sanitation education	6.Large livestock and poultry (small livestock) disease epidemics cause major instability in villager incomes	1. introduce and/or improve livestock vaccination programs
7. 21 of 40 villages have small irrigation systems. Irrigation systems are not efficient, need improvement, and some villages need new systems	1. Expand small irrigation systems in villages where there are suitable sites 2.Improve (repair) existing systems 3. Improve management of systems 4. Protect system water sources 5. Liase with relevant sources for funds for new weirs	7.Education is a severe problem and teachers are insufficient	1. Education Dept: build sufficient schools and provide teachers 2. Train teachers who will live in the isolated villages 3. Improve access roads (convenient for teacher travel) 4. Consider teacher isolation incentives
8. Clean water supplies are inadequate. There are 13 clean water supplies in 40 villages	1. Build water supplies in villages where piped water is possible 2. Install deep bores in other villages where reticulating water is not possible	8. Health levels are low: dysentery; malaria, and opium addiction; There are only 3 health centres in 38 villages)	1. Have the Health Dept. establish medicine "cabinets"in each village (to complement the kaet health posts) 2. Train Village Health Workers 3. Encourage household toilet construction & use 4. Health and sanitation education
9. Indiscriminate harvesting of NTFPs	1. Village NTFPs management and use agreements 2. Enrichment-replacement planting 3. Educate villagers in appropriate NTFP harvesting practices	9. Very high need for clean village water supplies. There are only 7 VWS in the 38 villages	1. Build water supplies in villages where piped water is possible 2. Install deep bores in other villages where reticulating water is not possible
10 Some opium addiction. There are 190	1Build a detoxification centre	10. Only about 25% of the land in the	1. Introduce crops that are suitable to the

Productive Agro-forestry Ecosystem (Zone 1)		Forested Multiple Use Agro-ecosystem (Zone 2)	
Key Issue	**Proposed Solution**	**Key Issue**	**Proposed Solution**
opium addicts in the zone, some in each of the 40 villages	2 Train/educate addicts, (alternate occupations)	zone is either lowland or moderately sloping. Villagers lack sufficient moderately sloping land	sloping land conditions 2. Promote livestock as alternatives for cropping 3. Improve livestock fodder (ie, EU trial plots – Ban Vun)
11. Not possible to do DS paddy. Water for DS rice is insufficient in lowland areas	1. Study soil and climatic conditions and varieties for improving wet season rice yields 2. Plant other DS irrigated crops that use less water, eg, vegetables 3. Use non-photosensitive varieties that require water for a shorter period	11. Soil fertility decline is more pronounced in this zone because there is more dependency on upland cultivation	1. Improve the soil by using improved conservation farming methods 2. Use varieties adapted to soil types
12 . Soil is not fertile (soil is acidic); both paddy and upland.	1. Improve the soil by using improved conservation farming methods 2. Use varieties adapted to soil types	12. Opium addiction is fairly high. There are 232 opium addicts in the 38 villages	1. Health Dept: Build a Detoxification Centre 2. Opium addiction education 3. Alternate occupations
13. Only about 25% of the land in the zone is either lowland or gently sloping. Villagers lack sufficient moderately sloping land	1. Introduce crops that are suitable to the sloping land conditions 2. Promote livestock as alternatives for cropping 3. Improve livestock fodder (ie, EU trial plots – Ban Vun)	13. Village Land Use Agreements are not being implemented well	1. DAFO: Inform and encourage better village management 2. Follow-up on existing Village Land use Agreements 3. Regular monitoring of village Land Use Agreements
14 Population increase is more rapid than in zone 2 Population increase is rapid which causes a reduction in available agricultural land	1.Plan for family planning (birth spacing) with the Health Dept 2. Review the criteria for village merging & adopt appropriate procedures 3. Review village merging plans and procedures	14. Grazing areas for large livestock are limited. Animal fodder is unsuitable (not nutritious)	1. Undertake LUP to identify suitable grazing areas with the villagers 2. Improve livestock fodder (ie, EU trial plots – Ban Vun)

Problem census meetings are held in representative villages of each agro-ecological zone to acquire information on livelihood problems, as perceived by both men and women in the villages. The results from a problem census meeting in Na Mo District are illustrated in Table 7.

Table 7: Problem Census : Na Mo Neua Village: 25-10-04

Women's Group (5)	Men's Group (6)	Summary of Key Problems
1. Lack funds for agricultural production	1. Lack funds for agricultural production	1. Lack funds for agricultural production
2.Short of land for planting mulberry for silk production	2. Paddy rice land is insufficient and not suitable	2. Lack village services, ie, village water shortage, electricity, and village "medicine cabinet"
3. Insects attack silk worms and reduce production levels	3. Rice production is low; eg, wet seed bed rice, 2.7 t /ha and rain-fed seedbed, 2.0 t/ha	3. Commodity prices are inconsistent; sugar, maize, job's tear, and silk thread.
4. The sale price for silk thread is low, ie, K120,000 /KG.	4. Agricultural commodity prices are low: eg, Puak Muak: K4,000 to K4500 Job's Tear: K 2,000 Maize: K800 - K900	4. Short of cropping areas, ie, paddy areas, dry season irrigated areas for maize and vegetables, and mulberry plants for silk worm production.
5. Short of clean village water	5. Prices of sugar, maize,and job's tear are variable year to year	5. People do not have sufficient areas for grazing large livestock, ie borrow land in Pangthong and then animals damage Pangthong crops
6. Short of electricity for activities at night, ie, reading, weaving etc	6. Traders and middle men come from the village and the District and depress prices.	6. People do not have sure or major occupations; crop production is low
7. Traditional marriage ceremonies involve heavy drinking and loss of time for productive activities	7. There is only one main market, China, therefore dependent on Chinese traders and businesses	7. Short of knowledge on silk worm production and larvae are attacked by insects
8. Silk worm productivity is reduced because they can collect leaves only 2 times instead of 8 times per year as in the past	8. Not possible to irrigate sufficiently in the dry season and so can not plant enough maize	8. Dependency on Chinese markets
	9. There are too many holidays; New Year and weekends	9. Village boundary disputes have still not been clearly resolved, ie with Phousang, Kiew Larn and Pangthong villages
	10. No village "medicine box"	10. Rice pests ie, when weather is hot; grubs attack the rice plants.
	11. The village boundary and management area is not clearly defined	11. Productivity is reduced because there are too many public and official holidays to observe
	12. People have animals but lack areas to look after them.	
	13. Rice pests.	

District Agro-ecological Zone Innovation Assessments

Innovation assessments **(or problem solution ranking)** of the proposed solutions to key questions and problems of each agro-ecological zone are undertaken to assist planners with development priority setting. Key question or problem solutions are given a ranking based on an assessment of the relative benefit that would arise should the various proposed solutions be implemented, ie

+++ Expectation of high or positive benefit
++ Expectation of medium or neutral benefit
+ Expectation of low or negative benefit

An example of a problem solution ranking exercise for one agro-ecological zone in Na Mo District is presented in Table 8.

Table 7: District Agro-ecological Zone Innovation Assessments: (page 1 of 2)

+++ Expectation of high or positive benefit
++ Expectation of medium or neutral benefit
+ Expectation of low or negative benefit

Zone 1: Productive Agro-ecosystem

Proposed solutions	Productivity	Stability	Sustainability	Equitability	Cost	Time	Feasibility	Poverty impact	Score	Ranking
1. Village boundaries	+++	++	+++	+++	++	++	+++	+++	21	2
2. Land Use Agreements	+++	+++	+++	+++	+++	++	+++	+++	23	1
3. Land availability	+++	+++	+++	+++	+	+	++	+++	19	4
4. Access roads	+++	+++	+++	+++	+	+	++	+++	19	4
5. Schools -education	++	++	+++	+++	++	+	++	+++	18	5
6. Health – Health Centres	++	++	+++	+++	++	+	++	+++	18	5
7. Clean water supplies	++	+++	+++	+++	+ +	++	++	+++	20	3
8. Irrigation systems	+++	++	+++	++	+	+	++	++	16	7
9. Indiscriminate NTFP harvesting	+++	++	+++	+++	++	++	++	+++	20	3
10. Opium addiction	++	++	++	++	++	+	++	++	15	8
11. Dry season paddy water deficiency	++	++	++	++	+++	++	++	++	17	6
12. Soil improvement; paddy and upland	+++	++	+++	+++	++	+	++	+++	19	4
13. Inadequate suitable sloping land	++	++	++	++	+++	+	++	++	16	7
14. Population increase	++	+++	++	+++	+++	++	++	+++	20	3
15. Fish and wildlife depletion	+++	++	++	++	+++	+++	++	++	19	4
16. Land for large livestock	++	++	++	++	++	++	++	++	16	7
17. Livestock diseases	+++	+++	++	+++	+	+	+	+++	17	6
18. Paddy rice gall midge	+++	+++	+++	+++	++	++	+++	+++	20	3

Figure 1: Tapo Village Transect - District AE Zone 4, 19th May, 2004

Description	Riverside Paddy Land Sub-Zone	Gentle Lower Slope Sub-Zone	Moderate -Mid Slope Sub-Zone	Steep Upper Slope Sub-Zone	Highland Zone
	 				
Soils	Sandy loam ("say gam tom"); the most fertile	Silty clay loam; (din dak, din dum LL) (din ar doo (HM); quite fertile	Brown clay loam with some gravel; din daeng, din dak	Red clay loam; fertility good Brown clay loam; shale & gravel evident - not too fertile	Red clay loam; fertility good
Slope	0-2%	2 - 5 - 10 %	20 - 30 - 45 %	40 - 50 - 60 + %	30 - 40 %
Elevation	200 - 499 masl range	200 - 499 masl range	500 - 800 masl range	800 - 900 masl range	900 - 1,100 masl range
Vegetation	Some river side gallery forest, bladey grasses	Scattered secondary forest; some bamboo in swidden fallows	Secondary forest (pa lao on) Village Use Forest is in this zone. Eupatorium	Secondary forest (pa lao on); some Imperata; bamboo; wild bananas	Undisturbed forest (except small areas where annual cropping has started
Land Form	Paddy land and riverside flats adjacent to Nam Pa river	Gently sloping land adjacent to riverside flats	Moderately sloping land leading up the hills; (foot slopes)	Steeply sloping land between the foot slopes and limestone cliffs	Limestone cliffs and highland "plateau" areas
Farming system	a) Rain-fed paddy; permanent cropping b) Rain-fed step; permanent cropping system	Rain-fed upland; semi-permanent wet season cropping	Rain-fed upland; rotational farming practised; 2 year rotations mainly; some 3 years	Rain-fed upland; rotational farming practised; 3 year rotations mainly.	Normally not farmed since opium production stopped Now swidden cultivation starting
Annual Cropping Patterns	a) Paddy rice/maize; Yield: Rice; 5t to 7t / ha Maize; ??? b) WS: Maize ??? DS; water melons, cabbage, tomatoes	Single crop upland rice Single crop job's tear Single crop maize Single crop sesame Pineapples (No relay cropping)	Single crop upland rice Single crop job's tear Single crop sesame Some peanuts (No relay cropping)	<u>Fertile soils near limestone cliffs</u> Single crop maize; single crop sesame, vegetables; cucumber, gourds ("mak nam") <u>On less fertile soils</u> Sugar cane; mixed crops Single crop job's tear &	Single crop maize Vegetables; tomatoes and cabbage

Description	Riverside Paddy Land Sub-Zone	Gentle Lower Slope Sub-Zone	Moderate -Mid Slope Sub-Zone	Steep Upper Slope Sub-Zone	Highland Zone
				pumpkins (mak eu - mak fak)	
Notable husbandry Practices	Weedicides; pesticides; fungicides commonly used Hmong farmers buying land	Some weedicides used if Imperata grass present Hmong farmers buying land	Some insecticides used if Imperata grass present	Some farmers now sub-divide plots to retain rotations	
Economic Tree Crops	Small teak plantations	Small teak plantations	Small teak plantations	Teak (minor)	None
Fruit Trees & others	Lychee (LSAFRP); longan (LSUAFRP); Scattered mandarin & banana plantings	Lychees (LSUAFRP)	Lychees being trialed; (LSUAFRP); some scattered bananas.	None	None
Emerging Land Use Practices	• Dry season vegetables becoming important • Villagers claim they will revert to annual cash crops on riverside flats after teak is harvested	Teak planting increasing	• Teak planting starting • Farmers are encouraging paper mulberry regeneration in swidden fields	• Farmers are encouraging paper mulberry regeneration in swidden fields • Some teak starting	• Lao Lum farmers are starting to use the "plateau" land for annual cropping
NTFPs	Paper mulberry (por sa)	Secondary forest vegetables	Rattan; some paper mulberry (por sa)	Rattan; paper mulberry (por sa) quite abundant, broom grass, "ta hoy"	(See LM NTFP survey)
Fish	Fish trapping in Nam Pa River Fish ponds	Fish ponds	Fish ponds starting	None	None
Livestock	No large animals (to avoid crop damage); pigs; poultry	None	None	None	None
Wildlife	None	None	None	None	None
Land Values	High; K4-5 m per 2.5 rai				
Problems or Concerns	• Vigorous weed growth • Pests and diseases of annual crops • Use of chemicals • Some flooding	• Use of chemicals • Erosion • High land demand	• Considerable surface erosion • Some water course erosion • Land shortage • Shortened field rotations	• Considerable surface erosion • Some water course erosion • Land shortage • Shortened field rotations	• Swidden cultivation starting on "plateau" lands by Lao Lum probably caused by land shortage in lowlands • Some erosion