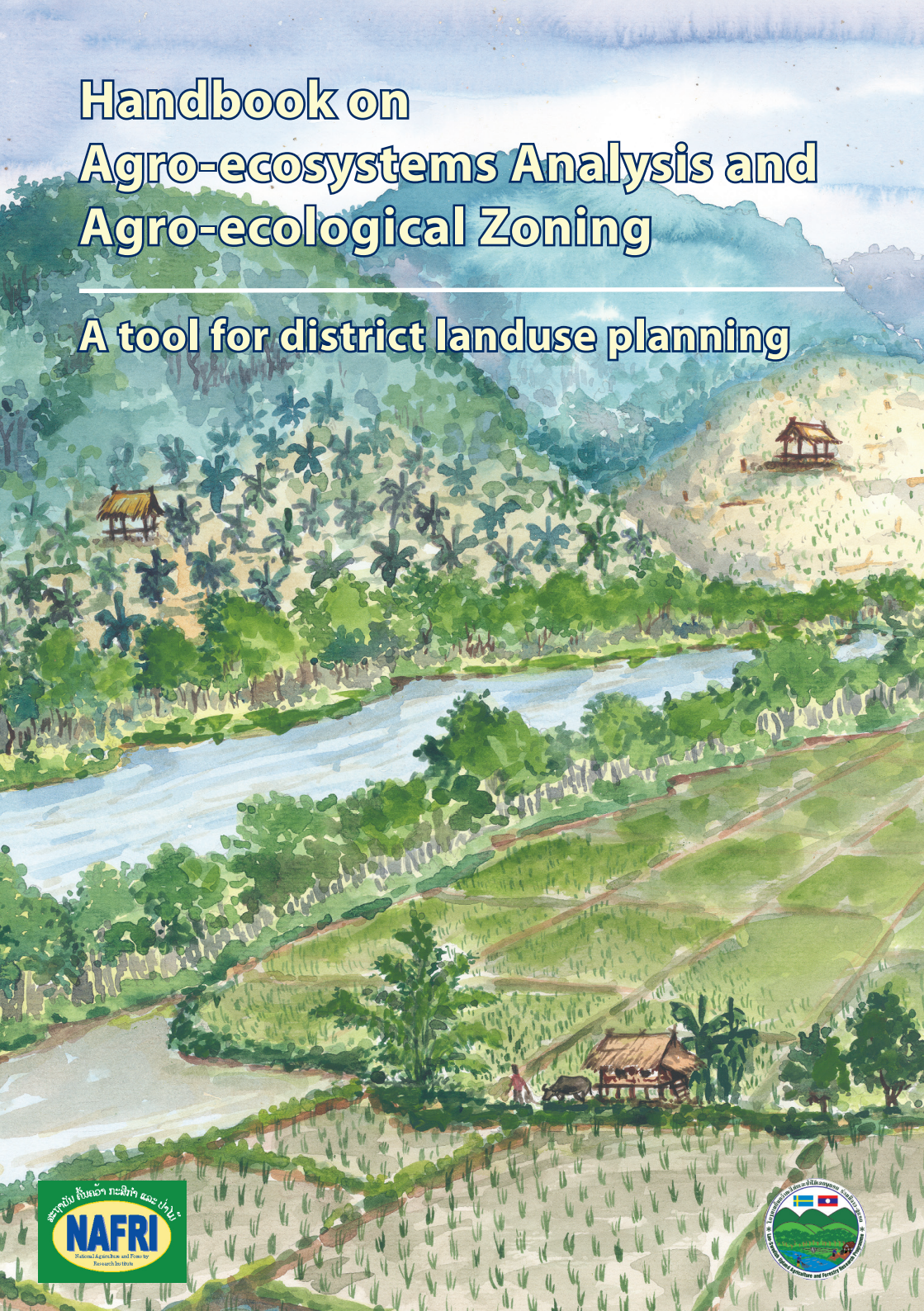
Handbook on Agro-ecosystems Analysis and Agro-ecological Zoning

A tool for district landuse planning



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NAFRI
National Agriculture and Forestry Research Institute

About NAFRI

The National Agriculture and Forestry Research Institute was established in 1999 in order to consolidate agriculture and forestry research activities within the country and develop a coordinated National Agriculture and Forestry Research System.

NAFRI aims to contribute to the goals of the Government of Laos by focusing on adaptive research to overcome specific problems limiting production and causing degradation of natural resources. NAFRI seeks to do this by carrying out demand-driven research that supports local peoples' active involvement in their own development.

NAFRI focuses primarily on adaptive research in order to provide technical options, recommendations and results to support agriculture, forestry, livestock, and fisheries development and strategic formulation of policies and programmes in accordance with the government policy.

NAFRI is comprised of seven discipline specific research centres and one regional research centre (in the north).

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Tel: (856-21) 770-084 Fax: (856-21) 770-047
Email: info@nafri.org.la website: www.nafri.org.la

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Handbook on Agro-ecosystems Analysis and Agro-ecological Zoning: A tool for district land use planning

By the
Land Management Component

National Agriculture and Forestry Research Institute
Lao-Swedish Upland Agriculture and Forestry Research Programme
August 2006

Contents

Foreword

The agriculture sector in Lao PDR is under going rapid transformation from subsistence to commercialization. This is in line with the 6th Five Year Plan of the Government of Lao PDR which emphasizes the commercialization of agriculture. In order to assist with this, planners at various levels will need better tools to recognize research and development issues and opportunities within different agro-ecosystems.

Agro-Ecosystems Analysis is an established methodology for the analysis of agricultural livelihood systems and for planning and prioritizing research and development activities. It can be used for planning purposes and for matching and expanding proven agricultural technologies. AEA/AEZ methods and tools have been used in Southeast Asia for many year. The work at NAFRI is aimed at developing an approach suited to Laos.

NAFRI has a mandate to undertake model development activities to complement its technology development. The AEA/AEZ process was tested to assist district level staff improve and prioritize development activities as well as provide them with improved methods to coordinate research and extension activities.

The AEA/AEZ procedure was piloted in 2004 and 2005 by the LSUAFRP Land Management Component in the target districts of Phonesay in Luang Prabang Province and Namor in Oudomxay Province.

While NAFRI has tested and developed this tool, ultimately, AEA and AEZ should be useful for the extension service. Dialogue has therefore been established with NAFES. Training of district extension staff in AEZ and AEA procedures and methods will continue during the method development phase with the aims of developing skills and mainstreaming AEZ and AEA in both the research and extension systems.

This handbook has been produced for extension, research and development staff working in district level agencies or projects, particularly district administrators, planners and agriculture extension staff.

We hope that you will find this handbook useful in your own work. It is for this reason that we are interested in hearing from you about your experiences in using this handbook or the AEA/AEZ methodology.

Dr. Bounthong Bouahom
Director General
NAFRI

Introduction

Various tools for land use planning and land zoning have been piloted and tested in Lao PDR, e.g., village land use planning and land allocation, watershed zoning, and crop suitability zoning. These tools have different objectives and can be applied at different levels. For example, village land use planning (LUP) is used to identify appropriate village forest and agricultural land use areas and to encourage sustainable management and use of natural resources by village communities. At the farm level land allocation (LA) is used to allocate parcels of agricultural land to families and individuals, with the aim of providing secure land tenure for families to facilitate livelihood improvement.

Agro-ecosystem analysis (AEA) is a multidisciplinary area analysis tool, used to facilitate area planning, to recognize research, extension and development issues and possible solutions, and to identify poverty alleviation opportunities. These analyses are normally undertaken at the district and the development zone levels using various physical and socio-economic parameters.

An important premise of AEA is that the identification of a limited number of key issues within an agro-ecosystem will have an significant impact on improving the performance of agriculture and forestry production systems. Thus, it is necessary to better understand zone characteristics and key issues from which solutions can be identified.

The following table explains AEA as one of a number of land use planning tools that have been developed in the Lao PDR. The zoning tools are arranged in hierarchical order to indicate at which level they are more appropriately used.

Level	Zoning Tool	Purpose
District	Agro-ecological zoning and agro-ecosystem analysis	• Identify research, extension & development issues • Define poverty alleviation opportunities. • Assist district development planning
Development Area	Agro-ecological zoning and agro-ecosystem analysis	• Identify research, extension & development issues • Define poverty alleviation opportunities. • Assist development area planning.
Village Clusters (Khum Ban)	Cluster land use planning and forest and agricultural land zoning (LUP)	• Create inter-village networking and improve forest and land management • Inter-village land and forest conflict resolution • Facilitate village livelihood improvement
Village	Village land use planning and forest and agricultural land zoning (LUP)	• Identify forest and agricultural land use areas • Village level land and forest conflict resolution • Encourage sustainable management and use of resources by village communities
Farm	Agricultural parcel (plot) allocation (LA)	• To provide secure tenure for rural households • To facilitate household livelihood improvement.

Overview of the AEA Handbook

The handbook is divided into three sections:

1. Understanding AEA
2. Examples of Steps in AEA
3. Follow-up Activities

The first section explains the uses, objectives, implementation steps, expected outputs and benefits of AEA . The second section provides explanations and examples of each of the steps while the third section deals with the use of AEA information. These examples are drawn from experiences of the LSUAFRP when implementing AEA in Phonesay and Namor Districts.

Users of the handbook should understand that it has limitations because it does not have detailed explanations of all procedures and methods used to implement AEA. It is a guide to explain the objectives, steps and outputs of AEA. Field staff gain a deeper understanding about the procedures and methods by either attending on-the job training sessions or by actually conducting AEA in their districts under the direction of resource people with experience in the methodology. A “tool kit” of materials, documents and maps is also being prepared to complement this handbook and to assist AEA practitioners.

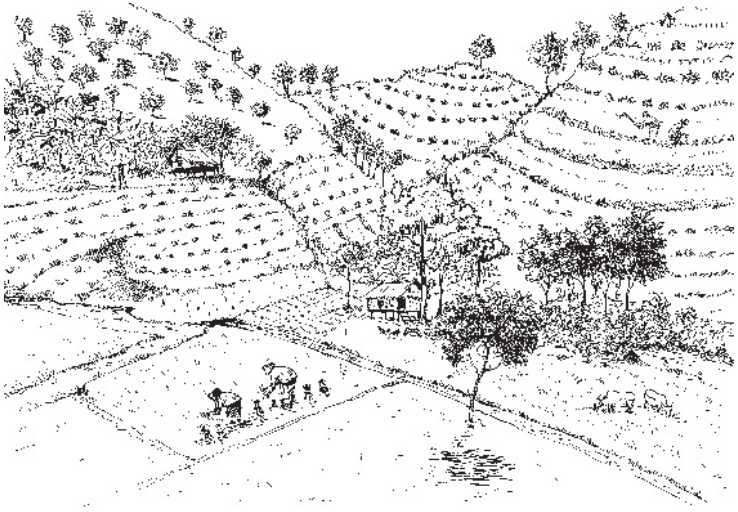
The objectives of the handbook are to:

- Provide a concise and convenient technical reference for development practitioners working at provincial, district and development zone levels
- Raise awareness about the procedures, methods and uses of AEA among researchers, extension specialists and rural development practitioners

Time and Resources Necessary

AEZ and AEA is a comprehensive process that requires substantial time and resources a matter that has caused some concerns. Nevertheless, it is important not to compromise the results of the AEA/AEZ by short-cutting the steps in the process. To deal with this issue, the model observed in Cambodia has been modified so that all steps in the exercise are conducted at district level, except preparatory activities. This reduces costs and time required while increasing efficiency. It also means that the majority of actors are from district agencies where knowledge of the study area is greatest. Initially the collection of socio-economic data was attempted from sources such as the National Statistic Centre in Vientiane, but experience has shown that it is best to source this information at the district level, where information is up-to-date, more accurate and less costly to gather. The data sets have also been streamlined so that only essential data is collected.

Another initiative currently under preparation is a dedicated training course for selected district staff who have had experience with the AEA procedure, the aim being to transfer more responsibilities to district staff thereby reducing the dependence on centrally based facilitators and resource people. Training materials are being improved and publications such as this handbook are being prepared to strengthen understanding of AEZ and AEA at the district level.



Benefits from AEA and AEZ at the district level

Activity	Outcome/Benefit
Purpose and objectives setting at the district and/or development zone levels	The district, development zone and khet staff assume ownership in planning development priorities in their areas
Secondary data gathering and organization from local sources	Valuable bio-physical and socio-economic data is systematically organized and documented, providing a convenient reference for district planners
Delineation, mapping and description of agro-ecological zones	Short and clear descriptions of zone characteristics supported by zone maps
Identification and mapping of district and development zone boundaries	Clear definition of district and zone administrative management areas
Definition and mapping of village boundaries and village points overlaid on development and agro-ecological zones	Village attribute data can be integrated and arranged for zones, development clusters and villages using GIS
Definition and mapping of protected and production forest areas	Maps facilitate forest management and biodiversity conservation activities in development zones, agro-ecological zones or village management areas
Documentation and mapping of poverty status, rural development services and infrastructure in agro-ecological zones	The documentation and mapping provide visible and easily accessible data for developing planning purposes
Ago-ecological zone analysis using productivity, sustainability, stability, and equitability factors	A more complete view of eco-systems performance is obtained which highlights where activities can be focused to improve the overall performance of the eco-system
Identification of key issues and solutions for each ecological zone and/or development zone	Agro-ecological zones are likely to have different key issues and problems which will require different solutions. Focused planning of appropriate research, extension and development activities is therefore facilitated
Priority ranking of key issues and their proposed solutions	The priority ranking permits more focused and effective planning of research, extension and/or development activities
Research issues are identified for each agro-ecological zone	Research questions can be developed from the research issues. Appropriate research activities for zones can be identified from the research questions.
Multi-disciplinary participation in AEA by district and development zone agencies.	Inter-sectoral co-operation is improved and potential exists for better inter-agency planning
Technology domain descriptions (suitable conditions) within agro-ecological zones	Technology requirements can be matched to the conditions described in the agro-ecological zones which facilitates the expansion of suitable technologies emerging from research.

Part 1: What is Agro-ecosystems Analysis?

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 systems approach to gather bio-physical and socio-economic information and to identify key issues or problems within the eco-system that may be used for planning and implementing research, development, and extension programs. Experience has shown that important issues identified cover a range of sectors including agriculture, forestry, livestock, land and water use, infrastructure, community services, social, economic and marketing. It is preferable to use AEA at the operational levels, i.e., district and development zone, where issues identified can be addressed by district planning systems.

AEA has the following attributes:

- ❑ Can be conducted at provincial, district, or development zone levels
- ❑ Uses multidisciplinary teams
- ❑ Uses available secondary data
- ❑ Follows a systems approach

Poverty indicators such as village poverty ranking, opium addiction, availability of community services such as water supplies, health posts, and schools and infrastructure assets such as irrigation systems, roads, and access tracks are identified, recorded in data bases and mapped. This organization of secondary data and spatial representation on maps can be used by district authorities and planners to identify appropriate locations or villages in which to focus the limited district resources available. This ensures a more objective approach to poverty alleviation. The priority issues and problems identified from AEA can be used by district staff to identify work plan activities at development zone (khet), village development group (khum ban patana) and or village level. The village boundary and village point maps and other physical maps facilitate the planning processes.

Key Actors in the AEA process

The most important participants in the AEA process are staff from district agencies and representatives of the administrative zones (khet), including:

- ❑ Governor and Deputy Governors,
- ❑ Planning Office
- ❑ District Agriculture and Forestry Extension Office
- ❑ Other agencies including health, education, and the Lao Women's Union (LWU).
- ❑ The zone or khet representatives are important because they have intimate knowledge of the villages in their areas of responsibility.
- ❑ Villagers are key actors when gathering additional secondary data in the defined zones.

An "AEA Resource Core Team" needs to be established to organize and facilitate the AEA exercises. They also have a technical training role during the process. The Core Team is a multi-disciplinary group of specialists.

In the case of a research program these resource people are drawn from forestry inventory, forestry research, farming system and socio-economic disciplines. In cases where AEA exercises are conducted by an extension organization it would be appropriate to utilize subject matter specialists from the PAFES office. It is preferable to have access to GIS specialists to assist with preparation of maps. These specialists can be sourced either from central or provincial level GIS units.

Objectives of AEZ and AEA

- Identify, delineate and characterize different agro-ecological zones within a given land area.
- Obtain an improved understanding of agricultural systems in these zones and their key characteristics.
- Identify key issues related to the performance of the entire system and it's agro-ecological zones
- Identify agricultural research and extension priorities for the system
  Help plan programs, projects and development activities for the system.

Expected Outputs

- The delineation and description (biophysical and socio-economic) of agro-ecological zones (agro-ecosystems).
- An improved, holistic understanding of the major agricultural livelihood systems in each zone.
- A prioritized list of important problems and opportunities for each zone (key questions).
- A prioritized set of research and development activities to address identified problems.

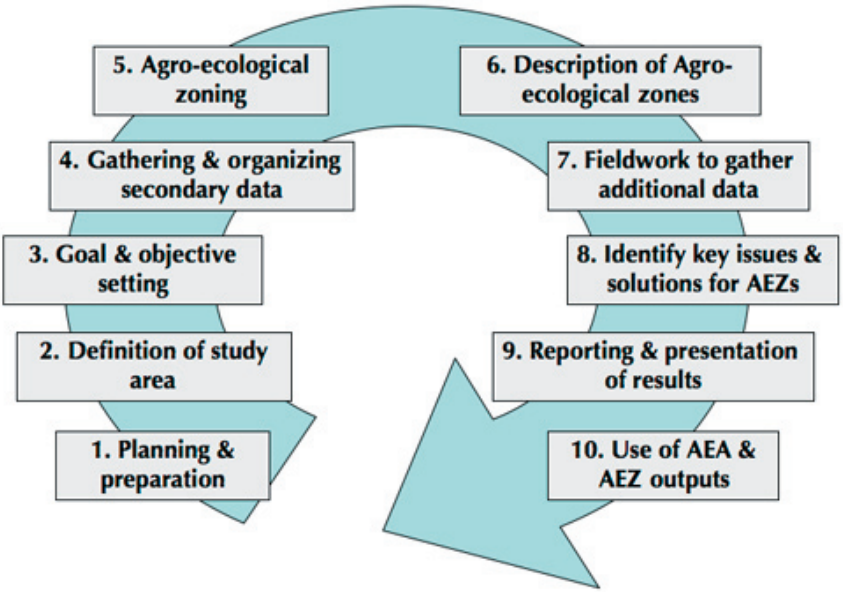
Uses and Benefits of AEZ and AEA as seen by district staff

Mr. Khamsene Sao Mong Veu, Deputy District Governor, Namor:
All agencies can benefit from the AEA information as it covers all sectors. With this data the district can be more specific with defining activities in work plans.

Mr. Bounsong Pornpasong, Head of District Education Office, Namor:
Maps at A4 and A3 scale and village data would be useful for planning the provision of education services in the development zones and also at district level

Mr. Khamtieng Soudethsansay, Governor, Phonesay District:
The results from the AEA are an important starting point for district planning. The information produced makes it convenient for planning, and the priorities identified in each zone are a reference point for poverty reduction. The data is good and we now need to use it because we have only reached the initial stages. The information should not be wasted and we should take the next steps at the "implementation levels". Implementation should follow the priorities established by the key issue analysis.

Part 2: Overview of AEA/AEZ Process



The 10 implementation steps in AEZ and AEA are shown above. The main activities, the approximate time taken, and the participants for each of these steps are briefly explained below together with illustrations or examples of each step.

1. Planning and Preparation

AEA is a multi-disciplinary activity and therefore it is important to orient staff toward the tasks required.

Main Activities: AEA team formation and organization, inform and brief partner institutions, arrange logistics, prepare spatial data (maps) at central level, or at provincial offices or project offices where map data sets are available, initiate secondary data collection with district staff

Time Required: About 3 weeks

Participants: AEA core team staff, GIS staff (GIS staff maybe sourced from NAFRI, Provincial or Project staff based in Provinces)

District staff orientation

Staff orientation is undertaken prior to determining the agro-ecological zones in the study area. The initial orientation includes:

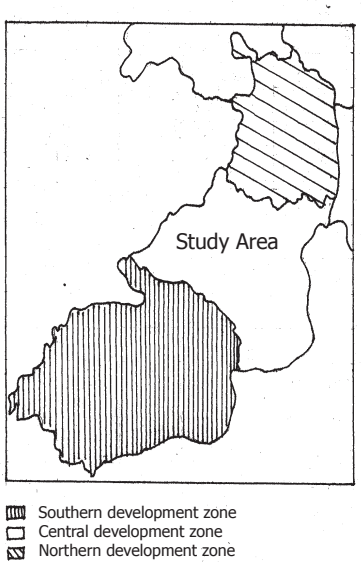
- ❑ Definition of AEA
- ❑ Objectives of AEA
- ❑ Expected Outputs
- ❑ Key AEA terms
- ❑ Uses and Benefits of AEA

Further orientation is provided when staff implement the various steps in AEZ and AEA.

2. Definition of Study Area

AEZ and AEA can be done at the district level, development zone level or at the village development group (khum ban) level. However, it is better to do AEZ and AEA at the District level first and then move down to the development zone level. The development zone selected for AEA should be a focal development zone for the district, where poverty alleviation is a priority. For example in Map 1 the central development zone was chosen as the study area because it is one of the focal development zones for the Namor district.

In Map 2, the ecosystem boundary is the administrative boundary of the Central Development Zone of Namor District. When conducting an AEA it is necessary to define the boundaries of the next administrative unit or units below the area to be studied. Therefore, in Map 2, the village boundaries and the village points are defined within the CDZ. This makes it much easier to undertake the subsequent analysis and to attribute secondary data to the individual villages.

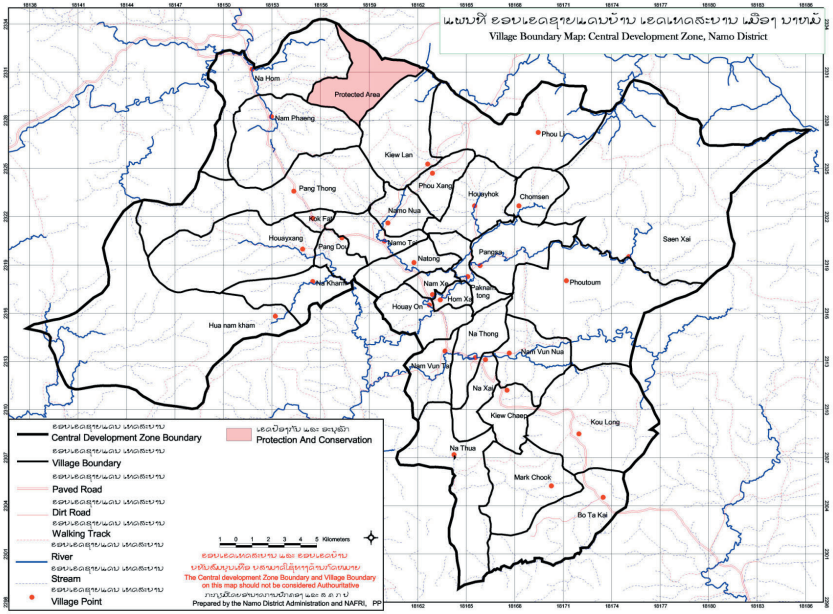


Map 1: District Development Zones

Main Activity: Defining AEA study area and boundaries, i.e., district, development zone; study area description, study area context, and an explanation of agro-ecosystem hierarchies; start to check village boundaries within the area of study (using LUP-LA maps & participant's knowledge)

Time Required: half a day

Participants: District Administration, District Planning Office, DAFEO, Education Office, LWU, Front for Construction, other District Agencies, District Administrative Zone Leaders, Project representatives



Map 2: Central Development Zone, Namor District showing village boundaries and village locations

3. Goal and Objectives Setting for the Study Area

Main Activity: Definition of AEA purpose and objectives by district multi-disciplinary team members (facilitated by the AEA core team).

Time Required: Half a day

Participants: District Administration, District Planning Office, DAFEO, Education Office, LWU, Front for Construction, other District Agencies, District Administrative Zone Leaders, Project representatives

An example from Na Mo District is illustrated below

Purpose:
"To apply the results of agro-ecosystem analysis and agro-ecological zoning in Na Mo District to assist socio-economic development planning that is appropriate to the local situation and which contributes to sustainable rural development, poverty alleviation, and environmental protection"

Objectives:

- ❑ To collate existing secondary data to facilitate AEZ and AEA
- ❑ To identify (and act on) key issues and opportunities for agricultural and forestry research and extension that contribute to sustainable agriculture and forestry development

- ❑ To assist the District with socio-economic development planning aimed at poverty alleviation
- ❑ To improve the capacities of district agency staff in implementing AEZ/ AEA
- ❑ To strengthen co-ordination between various district projects and other relevant agencies and stakeholders concerned with district development.

4. Gathering and Organizing Secondary Data

Main Activities: Forming multi-disciplinary work groups and designating responsibilities for data collection; explanation of secondary data needs; gathering, consolidation and collating secondary data including, socio-economic and biophysical information for the study area; preparation of secondary data spread sheets or lists using Excel program or other appropriate recording methods

Time Required: 2 to 3 days

Participants: Work groups comprised of AEA core team, district staff, and Administrative Zone members

There are two types of secondary data used for AEZ and AEA:

- ❑ Bio-physical data (maps)
- ❑ Socio-economic data

The range of data that may be used is indicated in tables below.

a) District Bio-physical Data: Maps

Boundary, Line & Point Maps	Climatic Maps	Topographic Ecological	Forest & Land Use	Thematic
• District boundary • District Administrative Zones • Watershed context map (showing adjoining districts) • Village point, 1999 or later • Rivers and streams • Roads and tracks	• Mean annual rainfall • Mean annual temperature	• Watershed classes • Elevation • DEM map • Slope • Soils • Geology • Indigenous soil classes	• Past land use (2000) • Forest cover (2000)	• Village water supplies • Health posts • Schools • Irrigation sites

Maps can be obtained from the NAFRI or, in some cases, from Provincial GIS Units or projects. Other maps (such as land and forest management, land use planning, land suitability, and optimum land use) reflect "intentions" or "ambitions" not actual ecological conditions, and therefore are not primary references in agro-ecological zoning

b) Socio-economic data

Up-to-data socio-economic data can usually be gathered in some detail from district sources including the data listed below

Demographic	Forest Products	Farming Systems	District Stakeholders
•Population •Poverty status •Village relocation •Opium addiction	• NTFPs • Commercial NTFPs • Production & Markets • Commercial or industrial trees	• Crop production & yields • Annual crops • Perennial crops	• Projects operating & activities • Businesses operating & activities

5. Agro-ecological Zoning

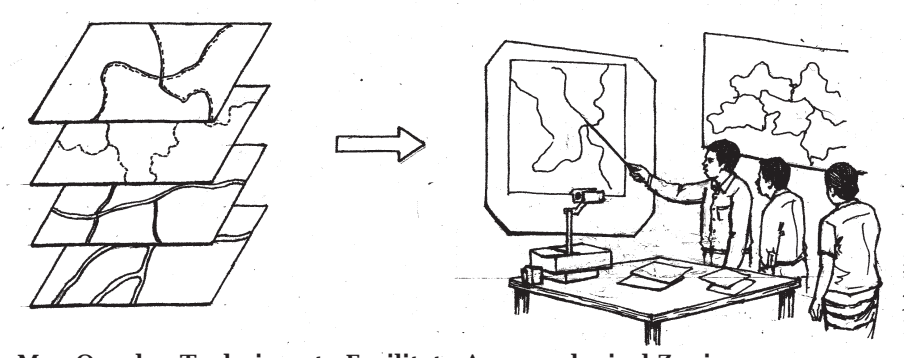
Main Activities: Explanation of digital maps used in agro-ecological zoning; explanation of zoning methods and tools; identification of boundaries of the agro-ecosystem zones using manual transparency map overlay method and multidisciplinary group discussions

Time Required: 1 day

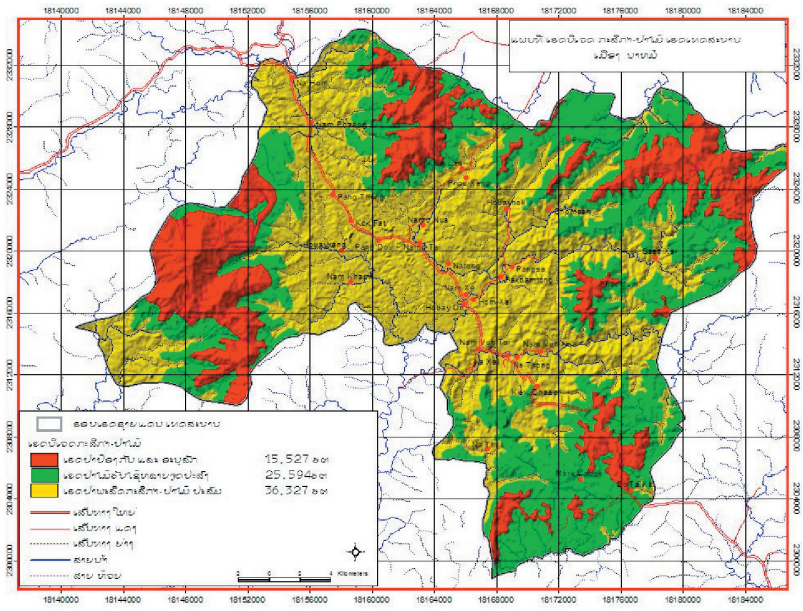
Participants: AEA Resource Team and district staff, including: District Administration, District Planning Office, DAFEO, Education Office, LWU, Front for Construction, other agencies, District Administrative Zone Leaders, and Project representatives

A manual technique is used for agro-ecological zoning using plastic map overlays on district or development zone boundary maps. An overhead projector is used to project enlarged maps for viewing, discussion and making decisions on the ecological zones that exist within the area of study as indicated in the drawing below.

Map 3 illustrates the output of the agro-ecological zoning activity.



Map Overlay Technique to Facilitate Agro-ecological Zoning



Map 3: Agro ecological Zone Map, Central Development Zone, Namor

6. Description of Agro-ecological Zones

Analyses are conducted to acquire a detailed understanding and description of each of the agro-ecological zones in the study area.

Main Activities: Explain tools for describing agro-ecological zones including, a complete set of hardcopy and transparency maps; undertake agro-ecological zone descriptions using work groups; prepare zone transect tables; prepare information on time, flow, space and decision-making for each agro-ecological zone; check village boundaries and village points using village code data, LUP-LA maps, and participant's knowledge; and if facilities and resources are available, digitize the agro-ecological zone boundaries and the village boundaries.

Time Required: 2 days

Participants: Work groups comprised of AEA core team members, District staff, and Administrative Zone members; one multi-disciplinary work group for each agro-ecological zone; one "mapping group".

The tools used to undertake agro-ecological zone descriptions are indicated below.

System Analysis Tools Used

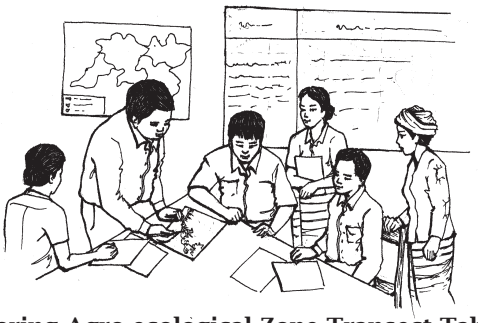
- ❑ Bio-physical maps
- ❑ Zone transect table
- ❑ Historical profiles
- ❑ Seasonal calendars
- ❑ Flow diagrams
- ❑ Venn diagrams
- ❑ System property tables

Transect tables are prepared for each agro-ecological zone. For example in the central development zone of Namor, the transect tables were prepared for the following AE zones: 1) Multiple Use Agriculture Zone, 2) Multiple Use Forest Zone and 3) Protection and Conservation Zone.

A Zone Transect Table uses a set of 16 descriptors, including:

- ❑ agro-ecosystem context
- ❑ land form (elevation and slope)
- ❑ geology and soils
- ❑ relative climatic conditions
- ❑ land and forest cover
- ❑ infrastructure and communications
- ❑ current land use
- ❑ farming systems (inc. livestock)
- ❑ wildlife, fish and fishing
- ❑ NTFPs
- ❑ farm and forestry inter-actions
- ❑ demography and ethnicity
- ❑ livelihood problems
- ❑ poverty related problems
- ❑ development opportunities.

Examples of a transect table and some of the descriptors for one zone are shown below.



Preparing Agro-ecological Zone Transect Table

Zone transect table

Descriptor	Particulars
Elevation	About 85% of the land area lies between 500 to 700 masl (approx); the remaining 15% has elevations of between 700 to 1,000 masl
Slope	Of the total land area in the zone, land areas in various slope ranges are distributed approximately as follows: 1-2 % slope: 10 % of land surface area 2-8 % slope: 40% of the land surface area 8-16 % slope: 30% of the land surface area 16-30 % slope: 20 % of the land surface
Geology	Almost exclusively Triassic-Jurassic sandstones and mudstones, with a little limestone in the central part of the zone east of Namor District office
Soils	The soils map indicates there are five soil types; the approximate distribution is as follows: Soil Unit 214 – Dystric Regosols – approx 30% Soil Unit 215 – Eutric Regosols – approx 50% Soil Units 315 and 316 Ferric and Haplic Alisols – approx 10% Soil Unit 331 – Plintic Alisols – approx 7% Soil Unit 324 - Ferric Acrisols – approx 3%

Agricultural seasonal cropping calendar from Namor District, Oudomxay Province

Activity/Month	1	2	3	4	5	6	7	8	9	10	11	12
Season												
Wet season												
Dry season												
Annual Crops												
Paddy Rice					PL-N	T	P	W	H	H	H	
Hill Rice		S	B	W-P	P	P	W	W	H	H	H	
Job's Tear		S	B	W-P	PR	P	P	W	W	W	H	
Sesame		S	B	W-P	PR	P	P	W	W	H	H	
Maize	H	S	B	P	W	W	H	H-S	B-P	P	W	W
Vegetables	H	H	B	P	H	H			P	P	H	H

B = Burn, H = harvest, N = Nursesry, P = Plant, Pl = Plouth, Pr = Prepare, S=Slash, T = Transport, W = Weed

Village transect diagrams compiled during field work provide additional information on farming systems in the Agro-ecological zones

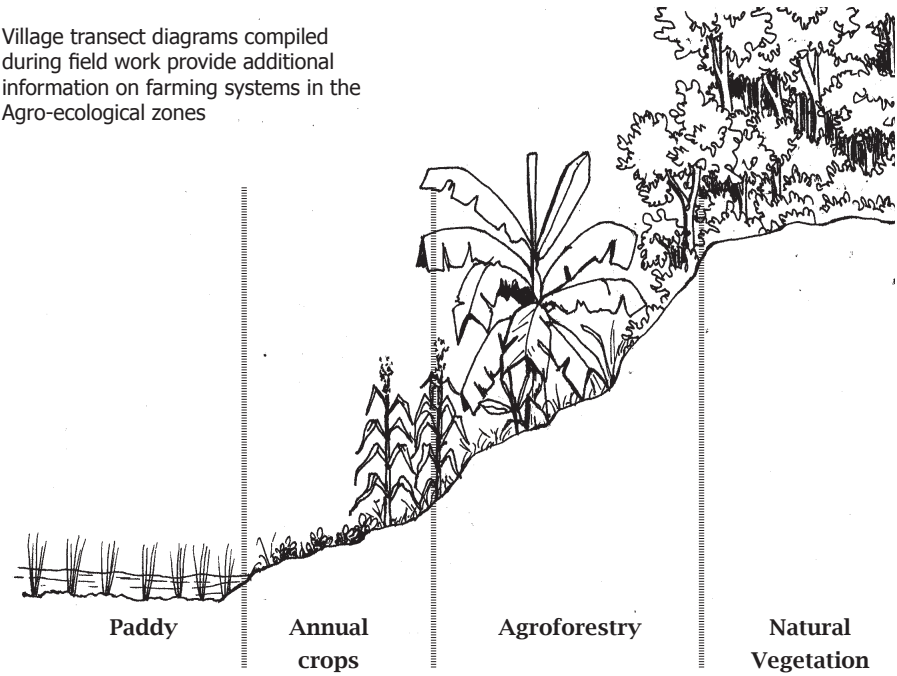


Illustration of a village transect

An example of a Systems Property Table for the multiple use agriculture zone in Namor District is presented below

Positive Aspects (+)	Negative Aspects (-)
Productivity	
• There is adequate land for commercial crops, i.e., rubber • There are opportunities to expand access tracks to village production areas • Soils are suitable for annual and commercial tree crops	• Quite rapid population increase in production areas • Irrigation water is inadequate in half of the villages in the zone • Health levels are low which reduces productivity, i.e., opium addiction and diseases • Animal disease epidemics
Sustainability	
• China provides markets for rubber, sugar and tea that appear to be secure for the next decade • Potential for agro-forestry systems in rubber planting areas, i.e., annuals (maize, job's tear, tea etc), which would be more sustainable options than mono-cropping perennial crops	• Quite rapid population increase causes a reduction in agricultural areas • The re-location of villages from the mountainous zones in the last 4 to 5 years is placing pressure on available agricultural land in the potentially productive zone • Indiscriminate harvesting of NTFPs is common
Stability	
• Potential for agro-forestry systems in rubber planting areas, i.e., annuals (maize, job's tear, tea etc) • There is some potential to improve clean water supplies in 27 of the 40 villages which would help stabilize village settlements, improve health and improve labour efficiency	• NTFP production is decreasing as population increases • Animal disease epidemics cause unexpected and major disturbances to livestock production systems • Pest outbreaks such as rice gall midge cause instability in paddy based rice systems
Equitability	
• There are employment opportunities from commercial tree crop expansion, i.e., rubber • Most families have access to adequate farming land, including some paddy land • The majority of villages have all weather road access for input supply and product marketing, i.e., 30 of the 40 villages	• Re-location and migration is impacting on the availability of suitable agricultural land for resident villagers and re-locatees • The 10 villages without access roads are disadvantaged in regard to production and market opportunities • Only 6 villages have access to health centres, and only 13 have access to clean water

7. Field Work to Gather Additional Information

Main Activities: Gather additional data to improve zone descriptions; market information, farming system information; identify key problems and opportunities with farmers and local stakeholders

Time Required: 1 to 2 days

Participants: Work groups comprised of AEA core team members, District staff, and Administrative Zone members; one multi-disciplinary work group for each field task, i.e., problem census, village transects, market information gathering etc.

Field activities are conducted to enhance the quality of the information from the initial descriptions of the agro-ecological zones. Information is verified with villagers and additional information acquired if necessary. The tools used in the field and the expected outputs from this work are summarized below.

Tools Used for Field Work

- ❑ Focus groups
- ❑ Village transect walks
- ❑ Key informants
- ❑ Problem census meetings (men and women)
- ❑ Market studies
- ❑ Observations

→

Outputs from Field Work

- ❑ Clearer definition of the boundaries of the AEZs
- ❑ Additional & more precise socio-economic and physical information for the zones
- ❑ Better understanding of the major farming systems
- ❑ More complete list of key agriculture-forestry issues & problems in each zone

Gathering information on cropping systems with villagers

8. Identify Key Issues, Proposed Solutions and Development Opportunities for AE Zones

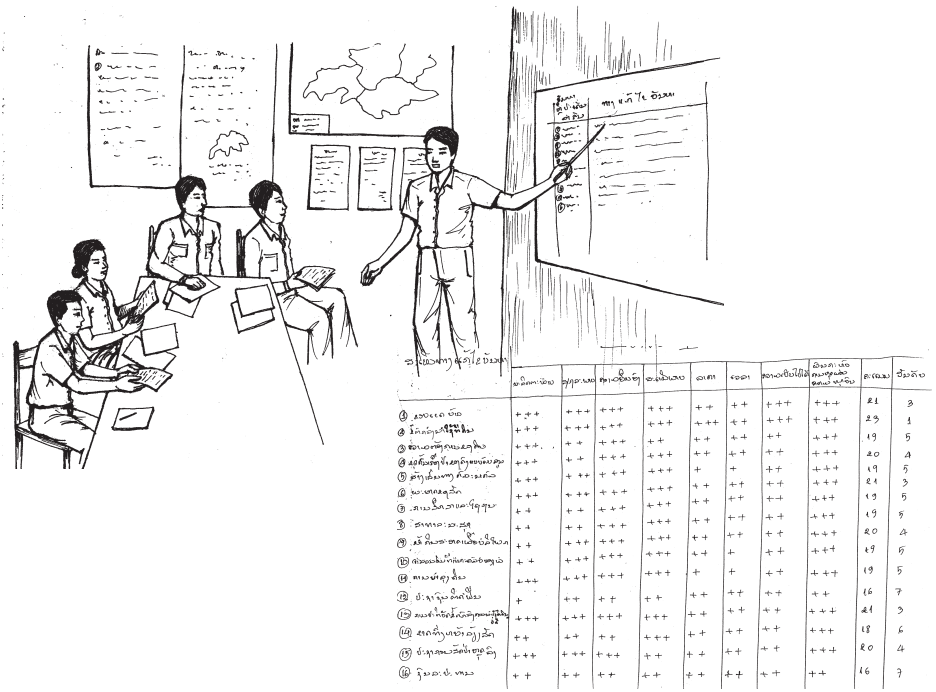
Main Activities: Key issue and development opportunity identification and recording; key issue and solution analysis; key issue prioritization and problem solution ranking, using the system property table data for each zone and information gathered in the field

Time Required: 2 days

Participants: Work groups comprised of AEA core team members, District staff, and Administrative Zone members; one multi-disciplinary work group for each agro-ecological zone

Key issues and problems for each agro-ecological zone are identified. These are ranked by the work groups.

The work groups also propose solutions for the issues and opportunities for each zone which are considered and ranked using a scoring system based on factors such as productivity, stability, sustainability, equitability, cost, time, feasibility and impact on poverty. This information is documented to assist the districts prepare poverty alleviation plans.



Ranking of Proposed Solutions to Address Priority Problems

9. Reporting and Presentation of Results

Main Activities: Translation of AEZ and AEA results; preparing agro-ecological zone and socio-economic maps resulting from the AEA; preparing socio-economic data bases and conducting data analysis and presentation; collating all data prepared during AEZ and AEA and preparing a report for management and for feedback to district authorities; presentation of findings to key stakeholders

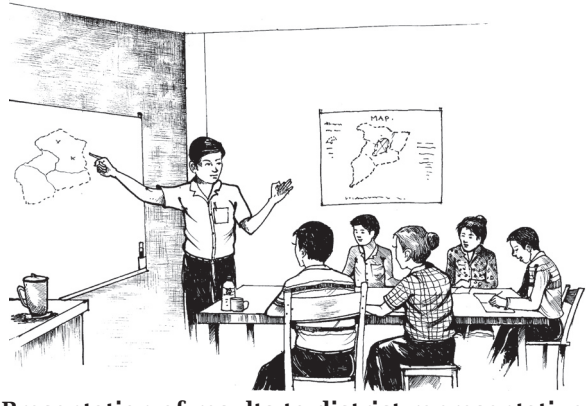
Time Required: One month

Participants: The write up and report is usually prepared by the AEA core group and distributed to relevant organisations and projects.

The results should include:

- ❑ A complete report of the AEZ and AEA activities conducted
- ❑ A set of various bio-physical maps for the study area
- ❑ AEZ zone and village boundary maps
- ❑ Agro-ecological zone descriptions (physical and socio-economic)
- ❑ Area services maps (water, schools, health centres)
- ❑ Area infrastructure maps (roads, tracks, irrigation)
- ❑ Demographic maps (village poverty status, ethnicity)
- ❑ Socio-economic data sets:
  - ♦ Registered villages, population and density, ethnicity and poverty distribution
  - ♦ Village services and infrastructure
  - ♦ Village commerce and tourist sites
  - ♦ Data on major agricultural crops and production, agroforestry, and livestock
- ❑ AEZ zone development opportunities
- ❑ Prioritized key issues and proposed solutions for agro-ecological zones or development zones

As explained in Part 3, a feedback workshop is undertaken with district representatives to present the results of the AEZ and AEA activity.



Presentation of results to district representatives

Part 3: Follow-up Activities

10. Use of the AEA Outputs

Main Activities: Feed back and follow-up workshops, support to District Authorities on using AEA information in district planning; categorizing key issues into research, extension and development categories; incorporating AEA information in on-going planning and programs with help from resource persons; follow-up on technology domain development and appropriate technology options for defined agro-ecological zones.

Time Required: On-going as required

Participants: AEA Resource Core Team

Categorising Key Issues and Proposed Solutions for AE Zones

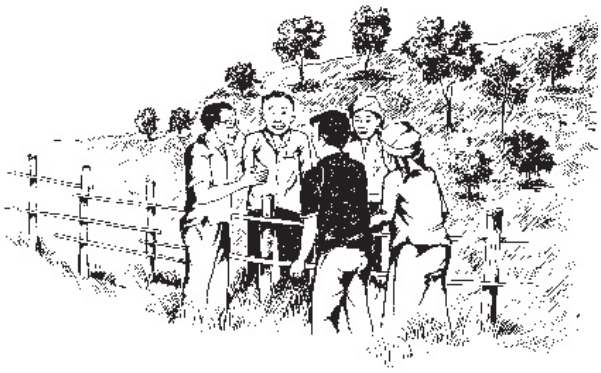
In order to provide focus for agencies undertaking development, extension and research activities, the various issues and problems from AEA are disaggregated into three categories during follow-up workshops with district staff, i.e.,

- **Research issues:** solutions need to be sought
- **Extension issues:** solutions are known and can be disseminated
- **Development issues:** can be addressed by infrastructure development

The following is an example of some of the research, extension, and development issues identified and solutions proposed to address the key issues in the Lower Elevation Potentially Productive Upland Ecosystem (Zone 1) in Phonesay District. Research, extension and development issues may be referred by district planners to the appropriate agency or project for follow-up.

Zone 1: Lower Elevation Potentially Productive Upland Ecosytsem

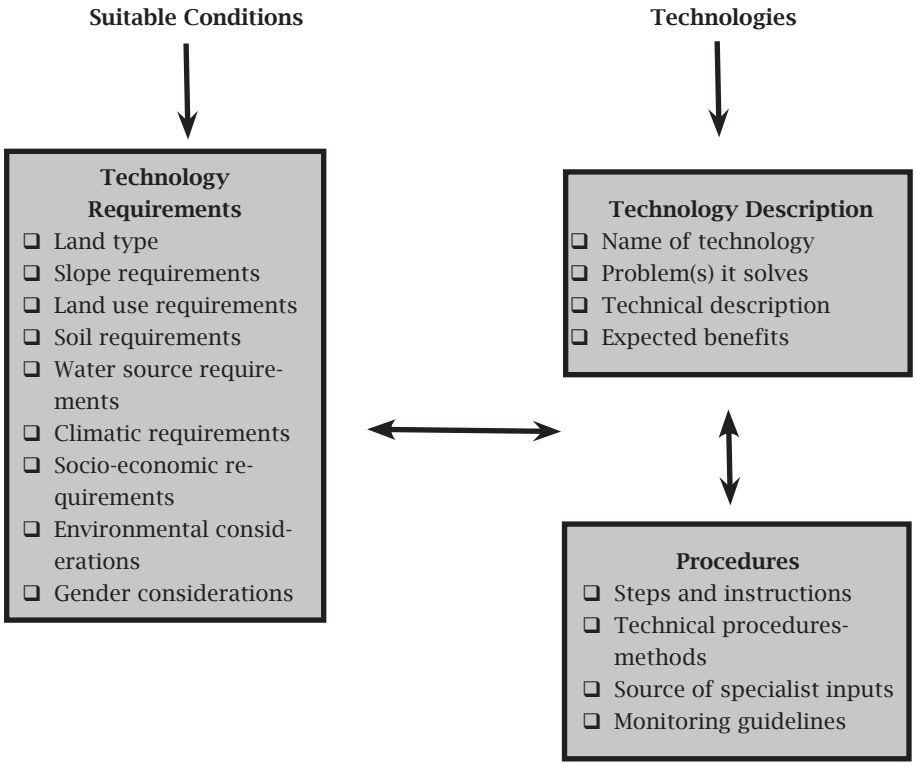
Key Issues or Problems Identified		Proposed or Possible Solutions by Category		
Key issues Identified	**Problems from Property Analysis**	**Research**	**Extension**	**Development**
Too much shifting cultivation		Cropping system research	Promote better cropping systems (from research) Promote sustainable occupations	Develop available paddy land; Expand irrigation
Depletion of stream fish		Continue research on fish depletion causes	Education programs for villagers Village Agreements and rules	Contain population expansion (family planning program)
	Improve agricultural methods	Appropriate cropping system research	Promote/extend better cropping systems (from research)	
Human disease outbreaks	Health levels low		Liase with Health Dept; medicine kits and or Health Centres	
Heavy opium consumption & addiction			Detoxification & education; Training on alternative occupations	



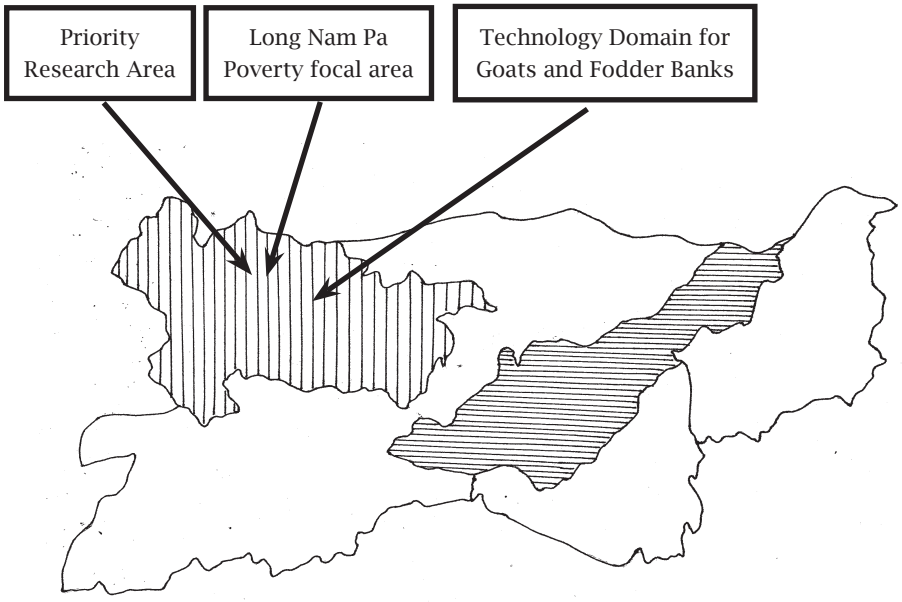
Technology Domain Development

Technology domains are "sets of conditions" that are suited to particular agricultural technologies. To facilitate the "scaling up" of technologies in ecological zones they are described and matched to the technology domains. This process is facilitated by the transect descriptions for the agro-ecological zones. Technologies emerging from research programs, for example ducks in rice fields, fish in rice fields, goats and fodder banks, rubber, fruit tree, and annual crops, fruit trees and annual crops can then be applied in other areas as illustrated in the figure below.

Matching Technologies with Suitable Areas



As AEA is a tool to assist districts with poverty alleviation it is preferable to describe technology domains in areas where there are high levels of poverty, as illustrated below.



Recommendation Domain within an Agro-ecological Zone in Long Nam Pa Focal Area, Phonsay District

Example Technology: Goat Raising and Fodder Banks

Problems Addressed

- ❑ Shifting cultivation alleviation
- ❑ Poverty alleviation among poor families
- ❑ Soil erosion reduction on sloping land
- ❑ Dry season fodder deficiencies

Factors considered when developing Technology Domains

- ❑ Land category
- ❑ Land use
- ❑ Water sources
- ❑ Socio-economic
- ❑ Environmental
- ❑ Land slope
- ❑ Soil
- ❑ Climate
- ❑ Gender

Further reading on Agro-ecosystems Analysis and Agro-ecological zoning

1. Manual: Agro-ecosystem Analysis and Agro-ecological Zoning; second draft, January 2004

2. Report on Phonesay District Agro-ecosystem Analysis, August 2004

3. Report on Long Nam Pa Development Area Agro-ecosystem Analysis, August, 2004

4. Report on Namor District Agro-ecosystem Analysis, October, 2004

5. Report on Feedback Workshop to Provincial and District Representatives on Phonesay District Agro-ecosystem Analysis, October, 2004

6. Report on Feedback Workshop to District Representatives on Namor District Agro-ecosystem Analysis, March, 2005

7. Report on Namor Central Development Agro-ecological Zoning and Agro-ecosystems Analysis, Oudomxay Province, March, 2005

8. Report on Results and Feedback Workshop to District and Zone Representatives on Central Development Zone Agro-ecosystems Analysis, Namor District, Oudomxay Province, August 2005

9. Report on the Use of AEA Information in Rural Development Planning Using Agro-ecosystems Analysis Information for the Central Development Zone Namor District, August 2005

10. Report on Long Nam Pa Development Area Agro- ecosystems Analysis (Second Iteration), Phonesay District, Luang Prabang Province, November, 2005

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The land management component is grateful for the support provided by the many people who took part in the pilot AEZ and AEA field activities and the preparation of this handbook. There are too many to mention individually, therefore the organizations, agencies and units that have participated and assisted are hereby acknowledged.

Staff and Advisers of the Lao-Swedish Upland Agriculture and Forestry Research Programme components assisted the Land Management Component in the pilot field exercises in Phonesay and Namor Districts. These include the Farming Systems Research, Forestry Research and the Socio-economic Research Components. The NAFRI GIS Unit staff and staff of the Soil Survey and Land Classification Centre (SSLC) assisted with the preparation of maps used in the zoning and analysis activities. The Socio-economic Research Component also undertook the organization and analysis of the secondary data supplied by district agencies.

At the district level support was provided by the District Governors and the District Planning officers. Staff of the district departments provided valuable assistance with the collection and preparation of secondary data and they also participated in all the steps of the AEZ and AEA activity.

We are thankful for the time devoted by development zone heads in tasks such as clarifying the location of village management areas and identifying key issues and problems in the agro-ecological zones during the zone analyses. In the field the AEA teams received support from villagers, both men and women, when gathering additional data and undertaking enquiries regarding agriculture and forest production and marketing.

The AEZ and AEA pilot activity could not have been undertaken without the valuable help of resource persons who took responsibility for staff orientation and on-the-job training activity. In particular, the efforts of Forestry Inventory and Planning Division staff and the management staff of the Northern Agriculture and Forestry Research Centre and the Forestry Research Centre are gratefully acknowledged.

Senior NAFRI staff members provided valuable comments and suggestions on the AEA activities during the course of the pilot activity in the field. They have also assisted with translations of documents and training materials. Staff members of the SSLCC have provided assistance, often in the background, on logistics and organizational matters on each occasion AEZ and AEA exercises were held.

Finally, staff members and the adviser of the Information Services Component have given very useful advice on content and presentation and have devoted considerable time and effort in preparing and publishing this handbook, which is very much appreciated.

Key Terms in Agro-ecosystem Analysis & Agro-ecological Zoning

Technical Term	Explanation
System	The system being studied and analysed and the elements assembled within it. The system could be a province, a district or a development zone. The elements of the system have strong functional relationships with each other
System definition	System definition involves identification of the system (as explained above) the system boundaries, and the system hierarchies.
Hierarchy	A description of the position of the system in the hierarchy of other systems or the range of systems above and below the system being studied. For example, in Lao PDR, a district is positioned between a province and a district development zone
Ecology	The relationship between organisms and their physical surroundings.
Agro-ecosystem	A system resulting from the actions of people during the process of agricultural development. Natural systems are modified for the purpose of food or fibre production
Agro-ecological zone	A zone with fairly autonomous or similar physical and socio-economic characteristics that distinguish it from other zones in the eco-system
Agro-ecosystem analysis	An analysis of the entire eco-system within the defined system boundary rather than it's individual components. (see "systems properties" below
System properties	The four properties used to analyse the behavior and performance of Agro-ecosystems, including productivity, stability, sustainability & equitability
Productivity	The level of production of the system as expressed in yield and net income per hectare or person hour
Stability	The degree to which productivity remains constant in spite of normal small scale fluctuations such as climate, economic conditions, and markets, or the level of variability from year to year or place to place within an eco-logical system
Sustainability	The ability of the system to maintain or increase it's productivity over the longer term or to maintain its productivity when subjected to stress (e.g., increasing soil salinity) or large disturbances (e.g., drought)
Equitability	The distribution of the benefits of the system among the local population. The more equitable the system the more evenly are the agricultural products, services and other resources shared by the population

Technical Term	Explanation
System analysis	An analysis of spatial patterns in the agro-ecosystem including space analysis, time analysis, flow analysis and decision making analysis of organizational structures within the eco-system and it's ecological zones
Space analysis	An analysis of spatial patterns in the eco-system using maps, transects and transect diagrams. For example, maps display the physical aspects of the ecosystem and transect diagrams help to describe the physical and socio-economic characteristics of the agro-ecological zones
Time analysis	An analysis of space time, flow, and decision-making patterns with the agro-ecological zones of the agro-ecosystem for example historical profiles, farming, cropping and livestock calendars, NTFP calendars etc
Flow analysis	An analysis of the flow of materials, money, information, labour etc both from outside and within the system, i.e., from village to district and province and vice versa. Expressed on a Flow Diagram
Decision-making analysis	An analysis of the relationships among agro-ecosystem communities and projects and agencies providing support to them. Expressed on a Venn Diagram
Key questions	During agro-ecosystem analysis, key questions or issues are identified to define research questions, and identify extension and development priorities for each agro-ecological zone