A Teacher's Guide on Agroforestry Landscape Analysis

Curricular Framework and Case Study Materials

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Foreword

Decisions about land use are primarily based on people's understanding of the functions of a landscape, or nested levels of landscapes. Increasing our understanding of landscape functions, can, therefore, contribute to increased livelihoods options for smallholder farmers and improved environmental services for the society. In Southeast Asia, the rapid changes occurring in the region's uplands brought about by a variety of economic, demographic, and policy factors makes understanding these functions increasingly complex yet important. For this reason, since 2004 the World Agroforestry Centre (ICRAF) in collaborations with the Southeast Asian Network for Agroforestry Education (SEANAFE) has been promoting the landscape approach in agroforestry through research and training with various partners, including universities.

This *Teacher's Guide on Agroforestry Landscape Analysis (AFLA)* is the contribution of SEANAFE, facilitated by the World Agroforestry Center (ICRAF). It is intended to be used to enhance understanding of this approach and provide practical skills to academics and practitioners throughout Southeast Asia. AFLA is one of SEANAFE's themed projects during Phase 2 of its implementation (2005-2009), with funding support of the Swedish International Development Cooperation Agency (SIDA). The project aimed to increase the knowledge and skills among agroforestry lecturers and graduates in Southeast Asia on the functions and dynamics of agroforestry landscapes. It was also designed to respond to the lack of tertiary education courses that address socio-economic and environmental impacts of land use decisions and the functions of landscapes in most academic programs in Southeast Asia.

The Guide is a product of the experiences and insights of people and organizations involved in SEANAFE's AFLA project. Research outputs of project country teams from Indonesia, Laos, Philippines, Thailand and Vietnam form the basis for the AFLA curricular framework and case study materials for teaching. The Guide is divided into three parts. Part 1 provides an overview of the project processes and outputs. Part 2 describes the AFLA curricular framework, and Part 3 contains the case study materials.

Through this Guide, ICRAF and SEANAFE hope that higher learning institutions will be encouraged to either incorporate the concepts and principles of AFLA into their existing courses or offer it as a separate course in a particular academic program.

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ICRAF-SEA Regional Coordinator

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- Duncan McLeod for revising and editing the country teaching case study materials.
- Jess C. Fernandez for revising and finalizing the Notes for Teachers for each case study teaching material and packaging of the Guide.
- Josef Arinto for the design and layout.
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Some Notes on Using this Guide

This guide is intended primarily for university lecturers but could also be used by Extensionists and community development workers who wish to conduct training on the subject matter.

This guide is divided into three major sections, namely: 1) The SEANAFE's Agroforestry Landscape Analysis Project Overview; 2) The SEANAFE's Agroforestry Landscape Analysis Curricular Framework; and the 3) Country Teaching Case Study Materials.

Section 1 provides a brief background on SEANAFE AFLA Project highlighting the salient processes through which this guide was generated.

Section 2 discusses in detail the components of the AFLA curricular framework.

Section 3 presents the country cases and offers ways to effectively use them for teaching AFLA. It provides suggestions for encouraging critical thinking among students, including guide questions and discussions, suggested teaching activities and references. This, however, should not limit the users. Instead, they are encouraged to further explore the other potential applications of the cases as teaching materials.

The curricular framework does not claim to be complete and comprehensive. However, SEANAFE considers it adequate to help enhance the knowledge, skills, and appreciation of students and other users on AFLA toward a more sustainable use and management of natural resources. The teaching case study materials also do not cover all the aspects of AFLA as a result of the kind of available data gathered by the country teams from their respective case study sites. Thus, users are encouraged to make assumptions about information absent from the cases and/or use other relevant cases to help teach AFLA concepts fully.

The guide assumes that the users have considerable experience in using case study as a teaching method. First timers to this approach are encouraged to read the Notes for Teachers well in advance before giving the case study materials to their students. The effectiveness of the case study materials relies on how well the users have grounded themselves on its suggested use and internalized the basic information therein.

Acronyms

AFLA	Agroforestry Landscape Analysis
ICRAF-SEARO	World Agroforestry Centre Southeast Asia Regional Office
SEANAFE	Southeast Asian Network for Agroforestry Education
Sida	Swedish International Development Cooperation Agency
RECOFTC	Regional Community Forestry Training Centre

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1. The SEANAFE's Agroforestry Landscape Analysis Project

Project Overview

Southeast Asia's upland landscape is changing rapidly and a variety of economic, demographic, and policy factors are causing the change. The ability of such landscape to provide secure livelihoods for their inhabitants and environmental services for society depends on their economic, social, and biophysical 'connectivity' and the way they are managed. For example, many agroforestry systems can protect the soils better than mono-cropping systems. Integrated solutions that can optimize land use across the different zones of the landscape are thus required. This underscores the importance of understanding the function of an entire landscape, or nested levels of the landscape. However, academic courses that address environmental impacts of land use decisions and the functions of entire landscapes are usually lacking in most university programs. With the focus being more on plot-level management, rather than in the larger landscape, the off-site effects of land use decisions on water quality, nutrient losses, agrochemical contamination, and biodiversity are usually ignored. Many universities fail to consider that integrating different land use disciplines is likely to lead to an overall healthier landscape. In view of this situation, the Southeast Asian Network for Agroforestry Education (SEANAFE) identified Agroforestry Landscape Analysis (AFLA) as one of the three themed projects for its Phase 2 implementation (2005-2009) with funding support from the Swedish International Development Cooperation Agency (Sida).

Implemented in 2007-2009, the project was aimed to increasing the knowledge and skills among agroforestry lecturers and graduates in Southeast Asia on the functions and dynamics of agroforestry landscapes. It had the following objectives:

1. To review the principles of mosaic agroforestry landscapes and understand how they function.
2. To identify and characterize the key drivers behind landscape change, and be able to use participatory tools and methods for studying landscape dynamics.

3. To strengthen the teaching of landscape agroforestry in universities and colleges in Southeast Asia, by developing teaching materials and curriculum modules in English and national languages using the case study approach.

4. To enhance the teaching capacity in universities and colleges on agroforestry landscape analysis.

These objectives were geared toward helping realize SEANAFE's mission of improving the livelihood of poor farming families in the region through quality agroforestry education.

Figure 1 shows the project's three envisioned education impacts. On the short-term, the project expected to enrich agroforestry teaching materials in SEANAFE institutions through the adoption of the teaching case study materials. On the mid-term, the project hoped to stir more curriculum development and reviews among universities and colleges within and outside the Southeast Asian region to incorporate AFLA themes in existing agroforestry curricula. On long-term, SEANAFE looks forward to the offering of AFLA curriculum as a separate course within agriculture and/or forestry academic programs in its member institutions.

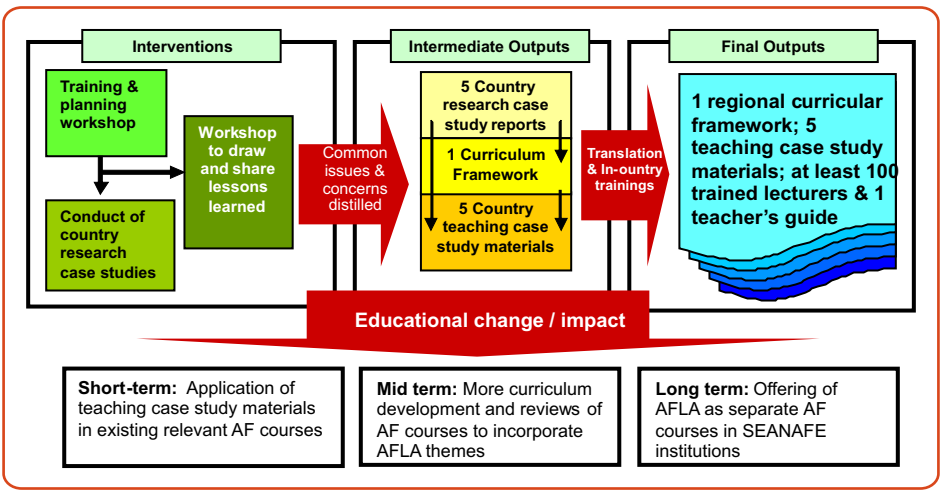

Figure 2. SEANAFE Project Framework

To help achieve the project objectives, SEANAFE formed country teams in Indonesia, Laos, Philippines, Thailand, and Vietnam. Each team consisted of at least four members from SEANAFE member institutions. Developed by the SEANAFE Board, the criteria for composing the project country teams were: (1) gender

representation, (2) related expertise on the subject matters, and (3) participation of younger lecturers. The team members were selected based on the following qualifications: (1) engaged in teaching and/or research in SEANAFE member institutions; (2) working knowledge of oral and written English language; and (3) available throughout the project duration.

As a capacity building activity of SEANAFE, the project adopted the team and participatory approaches. The following were the expected outcomes of such approach:

- Maximized experiential and peer-based learning among country team members while undertaking the various project activities toward producing the expected project outputs;
- Opportunity for participatory curriculum development by involving as many respondents as possible especially during sharing of research insights and experiences by country teams during the project workshops;
- Maximized consensus-building among country teams to heighten ownership of the project outputs toward enhanced advocacy of AFLA concepts and tools; and
- Enhanced interaction among SEANAFE member institutions.

The teams undertook several activities in two project phases as shown in Figure 2.

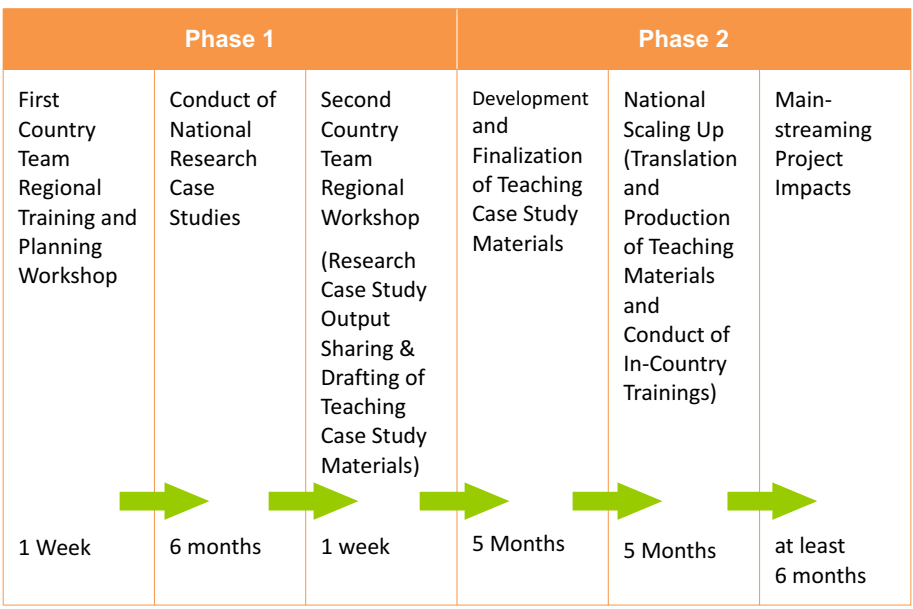

Figure 2. SEANAFE AFLA Project Activity Flow

Phase 1 Implementation

In March 2007, Phase 1 of the AFLA Project was officially launched via the first regional training cum planning workshop in Chiang Mai, Thailand in collaboration with World Agroforestry Centre-Southeast Asia Regional Office (ICRAF-SEARO). The workshop had the following objectives:

1. To level off working knowledge and experiences and update the country team members on the concepts, principles and issues of AFLA;
2. To enable the country teams to collectively identify the competencies that students should acquire on AFLA and identify the educational gaps toward drafting a curricular framework;
3. To provide direction and guidance to the country teams as they finalize their research topics and drafting concept proposals on the same for their respective country research case studies; and
4. To formulate effective working arrangements and schedules for both SEANAFE and the country teams in conducting project activities.

SEANAFE developed the AFLA curricular framework in a deductive process. That is, the country teams identified the key themes based on the lectures received and the workshop outputs on identifying the knowledge, attitude, and skills competencies that students must acquire related to AFLA. These key themes guided the conduct of the country team's research case studies to generate observations, issues and concerns on their respective topics.

The underlying purpose of all the activities of the training cum planning workshop was the building of teamwork among the members. Thus, all opportunities were maximized to enable them to learn about each other's personal and team work styles, particularly in decision-making, especially during small group workshops and discussions.

After the training cum planning workshop, the country teams received technical backstopping from SEANAFE and its project partner institutions as they finalize their proposals. Letters of agreements were then signed between SEANAFE and the respective institutions of the country team leaders to carry out the teams' research activities for six months.

As indicated above, these country research case studies were intended to provide the context and content for developing the curricular framework and teaching materials on AFLA. The teams used various methods ranging from secondary data sourcing to focused group interviews to realize their research objectives.

Information were gathered from as many types of respondents as the teams differed in the levels of their study sites (i.e., either at village, district, municipal or provincial levels). This situation enabled the surfacing of more relevant issues and concerns about AFLA, which served as critical inputs in the finalization of the curricular framework.

To keep the research activities on track, SEANAFE provided sustained technical assistance to the teams through e-mails. The teams were also required to submit progress reports; these were referred to ICRAF experts for critiquing and advice. Further, at least one coordinators' meeting was conducted to discuss and address the technical and logistical concerns of the teams.

The country teams had their second regional workshop in Thailand on 25-29 February 2008. The workshop was generally aimed to: (1) present and compare the research results and experiences of the teams, (2) finalize curricular framework, and (3) convert the research case study reports into appropriate teaching materials.

During this workshop, SEANAFE allotted adequate time to enable the country teams to draft their respective teaching case study materials. To accomplish this, SEANAFE tapped two case study writers from the Regional Community Forestry Training Centre (RECOFTC) to guide the team members in distilling the key issues and messages of their research reports and consolidate them into teaching case studies. Following the peer-based learning approach, the country teams critiqued and gave suggestions to improve each other's outputs. A month after the workshop, the country teams submitted the improved versions of the teaching case study materials to the case study writers for final editing. After the revisions, SEANAFE finally packaged the teaching case study materials for translation into the local languages of the country teams during the second phase implementation.

Phase 2 Implementation

Phase 2 implementation of the AFLA project focused on the translation of the teaching case study materials into the local languages of the country teams and the conduct of in-country training courses on using the project outputs.

To help achieve the targets of phase 2, SEANAFE conducted a team coordinators' meeting on 28-30 April 2008 in Hanoi, Vietnam. The meeting was generally aimed to: (1) revisit and finalize the scopes of the key themes of the curricular frameworks; (2) finalize the teaching case study materials for translation into the local languages of SEANAFE member countries; (3) finalize the country team proposals and terms of reference for project phase 2 implementation; (4) agree on the major processes and basic activities that the country team would undertake for Phase 2, including the design of the in-country training course; (5) orient the country teams on some

practical tips in organizing and implementing an in-country training course; and (6) agree on the Project's timelines.

The SEANAFE Technical Adviser and an editor finalized and packaged the case study materials for translation. The country teams either hired experts to translate the case study materials and curricular framework in their respective local languages or translated these themselves.

Although a common in-country training design was agreed among the country coordinators, the country teams were still given flexibility in adopting various approaches in implementing their respective training activities. SEANAFE recognized that the country teams differed in their working knowledge of implementing a training course. In discussing the key themes of the curricular framework, the country teams either served as the resource persons or invited experts to give lectures on the themes. A plenary or small group discussion approach, on the other hand, was adopted to sample the case study materials.

A total of 90 lecturers and researchers from 71 SEANAFE member institutions participated in the AFLA in-country training courses conducted in the five member countries of SEANAFE. Table 1 below provides the details.

Table 1. Details of the AFLA in-country training courses

Country	Date of Training	No. of Participants	No. of Institutions Involved
Indonesia	30 October – 2 November 2008	17 (14 males; 3 female)	17
Laos	24-28 December 2008	17 (15 males; 2 females)	9
Philippines	1-5 September 2008	29	26
Thailand	20 – 24 October 2008	24 (17 males; 7 female)	10
Vietnam	17-23 August 2008	18 (10 males; 8 females)	9
Total		90	71

Overall, the project helped build the capacity on AFLA of 106 lecturers and researchers, including the members of the project teams, in SEANAFE member countries.

2. The SEANAFE's Curricular Framework on Agroforestry Landscape Analysis

Introduction

The AFLA Project was SEANAFE's attempt to generate curriculum framework and teaching materials on the subject matter using a case study approach. This Guide integrates the project's outputs as a result of the experiences and insights of the various people and organizations involved. SEANAFE conducted in-country trainings in 2009 to orient faculty members from various member institutions about the curricular framework, including the use of the teaching case study materials. Being newly developed, the curriculum framework is open to further development, pilot testing, and evaluation to ensure that it meets the needs of potential users. Some of its parts have been found relevant by some SEANAFE member institutions that availed themselves of the small grants to mainstream the AFLA project outputs. SEANAFE hopes that the curriculum framework will be useful for adoption and would continue to solicit further interest from as many learning institutions in the Southeast Asian region and elsewhere to integrate it in any relevant existing courses.

The Context

Landscapes change due to change in land use practices, which in turn are driven by a range of economic, social and policy factors. The direction and speed of such change are critical as they affect peoples' livelihood and the environment.

Sometimes, landscapes change dramatically and brutally due to natural disasters such as the 2004 tsunami that battered Asia's coastal zones as well as recent floods and landslides in many countries in Southeast Asia. In such situation, it is often the poor people in marginal areas that suffer the most. Usually, upland dwellers are blamed for causing environmental degradation that results in natural disasters such as landslides. On the other hand, science may indicate different and more complex causes. Recently, extreme weather has become more frequent as a result of climate change. But the weather is only one factor.

Across the Southeast Asian region, land use in upper tributary watersheds is being restricted for environmental reasons, thus depriving the poor of traditional

livelihood activities. However, policy decisions are often made with insufficient recognition of research. One example is the relation between forest cover and water flow, where misconceptions abound – such as that each landslide is usually attributed to illegal logging.

The way landscapes are used and managed contributes both to the maintenance of existing environmental services, and to the rebuilding of services that may have been lost through unsustainable practices. For example, many agroforestry systems can protect the soils better than mono-cropping systems. Integrated solutions are required that can optimize land use across the different zones of the landscape.

While economic growth is unevenly distributed and often bypasses the upland poor, upland areas serve as hosts to a variety of biodiversity hotspots that are of global importance. These include the forests of the Lower Mekong and rainforests of Indonesia's Sumatra and Kalimantan islands. Policymakers are now becoming increasingly interested in watershed protection in these areas as they try to balance land use issues, head off natural disasters caused by environmental degradation, and provide downstream communities with adequate drinking water.

Complicating these issues is the fact that areas designated as national parks, conservation areas, and protected watersheds have increased significantly. Rural poor and ethnic minorities may be the ones paying the price for international and national conservation efforts. Additional problems arise as traditional land use systems are modified and local knowledge disappears without adequate attention given to the socio-economic impact of such changes.

Under current circumstances, landscapes tend to be viewed as either 'forestry' or 'agriculture', a phenomenon that can be traced back to colonial times. Adding to the confusion, land classification and land use are frequently quite different. For example, steep slopes are often classified as forest areas, but are used by poor farmers for upland crops or pastures. In the past, agroforestry focused primarily on the plot and farm levels and on the rehabilitation of degraded land, controlling erosion, and restoring soil fertility. The prevailing view of agroforestry still tends to be somewhat narrow, dominated by plot-level technologies such as alley cropping. The focus on plot-level management, rather than the larger landscape, ignores the off-site effects of land use decisions on water quality, nutrient losses, agrochemical contamination, and biodiversity. This view is common in many of the region's best universities.

In reality, many landscapes can accurately be described as a 'mosaics' of forests, rice paddy fields, upland fields, fallows, agroforests, and gardens. The term '*landscape agroforestry*' has recently emerged to describe this dynamic. In recent years, the

World Agroforestry Centre has conducted detailed studies on these processes and has developed tools and methods for participatory landscape analysis at the watershed and local levels and at different spatial and temporal scales. Learning about how landscapes change and understanding the drivers behind these changes are a central challenge for educators and for those concerned about sustainable development.

In the upland landscape continuum, agroforests are those areas with man-made mixtures of trees and agricultural crops and/or grasses, areas that are between what is recognized as pure forest and as pure agriculture. These mosaics of land uses produce forest and agricultural goods while providing vital environmental services, two functions that are essential in maintaining the integrity of the uplands subjected to farming activities (van Noordwijk *et al*., 2001). Thomas (2003) defined landscape agroforestry as a mosaic pattern of land use involving annual crops, tree crops and/or forest components, along with associated settlements and infrastructure. In addition to the characteristics of individual components, landscape agroforestry seeks to examine interactions among components, which are often influenced by their relative location in the landscape unit.

The scale of an agroforestry landscape can vary according to the scale of analysis and management (Thomas, 2003). Moving beyond the individual field level in upper tributary watershed contexts, for example, agroforestry landscapes can be viewed and assessed at levels such as: (1) local village areas, (2) multi-community sub-watersheds, (3) river sub-basins, (4) river basins, and (5) entire river systems. It is therefore critical that the scale of analysis of the landscape be defined at the start of any investigation on an agroforestry landscape.

This landscape view of agroforestry will bring to the fore answers to such issues as:

- What is the relation between land use, agroforestry trees, their position in the landscape, and the impact of natural disasters such as landslides and floods?
- What is the relation between different types of land use patterns and landscape functions, in upland areas as well as in coastal zones?
- What are the ecological and economic impacts of different land use options?
- Can the concepts of “landscape agroforestry” or “agroforestry landscape mosaics” offer a better or complementary paradigm for land management, compared with the current forestry/agriculture dichotomy?
- How can an integrated landscape approach be used in decision-making to assist communities in rebuilding their livelihoods after natural disasters?
- What methods do we have to study such relations? How can these methods be integrated into education programs?

The intensification of land use in Southeast Asia will continue as population increases, and as the increased standard of living raises demand and changes consumption patterns. But with a healthy 'mosaics' of a variety of land uses, landscape can still provide watershed services, hold biodiversity values, and store carbon, while their inhabitants earn a decent living. An agroforestry landscape approach, along with the active participation of stakeholders, can simultaneously consider four relational aspects, namely: (1) trees and markets; (2) farmers' land management practices; (3) multi-functional landscapes; and (4) governance. These relationships may provide an overall healthier landscape to ensure socioeconomic development and environmental sustainability.

The Curricular Framework

The AFLA curricular framework reflects its multidisciplinary nature as a subject matter. As an introductory course, the AFLA curricular framework is envisioned to enhance the learner's appreciation and understanding on the subject matter's basic concepts and principles and its practical applications to address current socioeconomic and environmental issues. It is also designed to stimulate critical thinking among students as it encourages them to draw insights from various sources of information that determine land use changes in a given landscape through the use of a variety of methods and approaches. It also expects to build the interest of the students to engage themselves in AFLA activities after graduation.

The curricular framework covers five modules, namely:

1. Introduction to Landscape Agroforestry
2. Characterizing Agroforestry Landscapes
3. Drivers of Change in Agroforestry Landscapes
4. Tools, Methods, and Approaches in Agroforestry Landscape Analysis
5. Planning and Managing Agroforestry Landscapes

Module 1 deals with basic concepts and principles of landscape agroforestry and mosaics of forest, agriculture, and agroforestry. It tackles relationships with concepts developed in related fields of study such as farming systems, community forestry, agroforestry systems, agroecosystems, watershed management, landscape architecture, and landscape ecology. Emphasis includes the roles of historical change, spatial scale and system boundaries. Starting point is the dynamic landscape where trees help people make a living, where water flows connect upstream and downstream areas and where 'environmental services' are generated and appreciated. From the way practice interacts with policy and institutions (e.g., importance of forest 'boundary' and 'definitions'), the need for

scientific analysis and clarification of issues may follow logically. Social, economic, geographical, ecological, hydrological, and policy perspectives need to be recognized as all contributing to a new synthesis. These perspectives are discussed in the succeeding module.

Module 2 touches on approaches to identifying, assessing, and understanding important properties, characteristics, patterns and dynamics of agroforestry landscapes. It introduces the three complementary approaches to 'knowing' and 'understanding' that are embedded in local knowledge, public/policy discourse, and science (of various disciplines). The three knowledge systems are compared to enable the identification of landscape elements, structures, and functions as well as interactions among elements. Attention is given to understanding heterogeneity and diversity in landscapes, including the degree to which agriculture and forest components and functions are and may be segregated or integrated. A simple scheme is provided to classify landscape configurations. Diversity includes both biophysical and human dimensions of landscape elements and processes.

Module 3 focuses on identifying and understanding the forces and processes that drive change(s) in configuration and/or dynamics in agroforestry landscapes. Forces may be based in biophysical, environmental, social, economic, cultural, institutional or political realities and at local to global levels over a given period of time. Indicative examples may include climate change, biodiversity, soil and water conservation, local livelihood or household economy needs, local to national policies, laws or regulations, economic markets or institutional arrangements at local to global levels. The distinction between five types of capital or assets (i.e., natural, human, sociopolitical, infrastructure, and financial) is used to understand the types and rates of 'conversion' that drive change in agroforestry landscapes.

Module 4 provides an overview of available tools, methods, and approaches potentially useful in defining and characterizing agroforestry landscapes and the forces driving changes in configuration or dynamics in an interdisciplinary way. It may start with approaches introduced by 'Participatory Rapid Appraisal' followed by the many variants. It introduces methods to spatial analysis (e.g. GIS, remote sensing) and the way publicly available data (e.g., 'Google Earth') are interpreted.

Module 5 centers on the potential roles of landscape assessment, planning, management, and monitoring in negotiations among stakeholders on rules and incentives that influence drivers of change. It discusses options to reconcile the different perspectives and achieve outcomes acceptable to all assuming that various stakeholders can define their preferred configurations of landscape patterns and processes.

Table 2 shows in detail the learning objectives, desired learning outcomes, suggested teaching tools and methods, duration and coverage for each of the themes and subthemes. Table 3 contains the suggested reference materials.

Table 2. Details of the SEANAFE AFLA Curricular Framework

Themes	Scope/Sub-themes and Suggested Duration	Learning Objectives (At the end of the module/session, students should be able to:)	Desired Learning Outcomes	Suggested Teaching Tools and Methods
Theme 1: Introduction to Landscape Agroforestry	Deals with basic concepts and principles of landscape agroforestry and mosaics of forest, agriculture, and agroforestry, including relationships with concepts developed in related fields of study; emphasis includes how the resources are viewed and used, and the roles of historical change, spatial scale and system boundaries. 3 hours	1. Explain the basic concepts and principles of landscape agroforestry and mosaics of forest, agriculture, and agroforestry 2. Compare and contrast landscape agroforestry concepts and principles with related fields of study	Students become articulate in clarifying terms and definitions associated with landscape agroforestry and related fields of study	• Lecture-discussions • Video presentation • Maps and diagrams
Theme 2: Characterizing Agroforestry Landscapes	Subtheme 2.1 Components of Agroforestry Landscapes and Their Interactions 6 hours	1. Identify the biophysical, economic, sociocultural, and institutional properties and structures of agroforestry landscapes including their functions and dynamics 2. Apply typology and classification system to a series of landscape examples	Students become knowledgeable on the terms and typology in characterizing agroforestry landscapes and are able to apply them accordingly using any of the three knowledge systems.	• Lecture-discussions • Video presentation • Visit to a nearby landscape

Table 2. Details of the SEANAFE AFLA Curricular Framework (cont.)

Themes, Subthemes and Suggested Duration	Scope/Sub-themes and Suggested Duration	Learning Objectives (At the end of the module/session, students should be able to:)	Desired Learning Outcomes	Suggested Teaching Tools and Methods
Theme 2: Characterizing Agroforestry Landscapes (cont.)	**Subtheme 2.2** Knowledge systems in Characterizing Agroforestry Landscapes 3 hours	Explain the differences and complementarity among the 3 knowledge systems in characterizing agroforestry landscapes		• Lecture-discussions • Case study analysis
Theme 3: Drivers of Change in Agroforestry Landscapes	**Subtheme 3.1** Biophysical and Environmental Drivers 1 hours	1. Identify and understand the forces and processes that drive changes in configuration and/or dynamics in agroforestry landscapes 2. Determine the types, rates, and impacts of conversion that drive changes in agroforestry landscapes	Students become critical on analyzing the drivers that change landscapes and acquire the ability to formulate actions to mitigate/moderate these drivers, where possible, for the overall benefit of the landscape and its inhabitants.	• Lecture-discussions • Slides/Video presentation
	Subtheme 3.2 Economic (macro, meso, micro), social and Cultural Drivers 2 hour			• Lecture-discussions • Case study analysis
	Subtheme 3.3 Institutional and Political Drivers (local & higher levels) 1 hour			• Lecture-discussions • Case study analysis
	Subtheme 3.4 Interaction Among Types of Drivers of Landscape Changes and Their Resulting Overall Impacts 2 hours			• Lecture-discussions • Slides/Video presentation

Table 2. Details of the SEANAFE AFLA Curricular Framework (cont.)

Themes, Subthemes and Suggested Duration	Scope/Sub-themes and Suggested Duration	Learning Objectives (At the end of the module/session, students should be able to:)	Desired Learning Outcomes	Suggested Teaching Tools and Methods
Theme 4: Tools, Methods, and Approaches to Agroforestry Landscape Analysis	**Sub-theme 4.1** Basic Concepts of Participatory Appraisal in Multi-stakeholder Environment 1 hour	1. Identify and understand the forces and processes that drive changes in configuration and/or dynamics in agroforestry landscapes 2. Apply appropriate tools, methods, and approaches in analyzing agroforestry landscapes 3. Generate geo-based information from publicly available data sources in analyzing agroforestry landscapes	Students acquire the skill in using appropriate tools, methods, and approaches and in accessing publicly available data in analyzing agroforestry landscapes with multi-stakeholders toward a more sustainable environment. Among the tools and methods will include: 1. Participatory Landscape Analysis (PALA) 2. Participatory Analysis of Poverty, Livelihoods, and Environment Dynamics (PAPOLD) 3. Rapid Appraisal of Drivers of Land Use Change (DriLUC) 4. Rapid Agrobiodiversity Assessment (RABA) 5. Rapid Appraisal of Agro-Forestry Practices, Systems and Technology (RAFT) 6. Rapid Hydrological Appraisal (RHA) 7. Rapid Market Appraisal (RMA)	• Lecture-discussions
Theme 3: Drivers of Change in Agroforestry Landscapes	**Sub-theme 4.2** Common Tools, Methods, and Approaches in Defining and Analyzing Agroforestry Landscapes 9 hours			• Lecture-discussions • Field exercises (e.g. in using appropriate tools and methods and dialogue with stakeholders)
	Sub-theme 4.3 Introduction to Spatial Analysis and Use of Publicly Available Data 2 hours			• Lecture-discussions • Computer hands-on exercises

Table 2. Details of the SEANAFE AFLA Curricular Framework (cont.)

Themes, Subthemes and Suggested Duration	Scope/Sub-themes and Suggested Duration	Learning Objectives (At the end of the module/session, students should be able to:)	Desired Learning Outcomes	Suggested Teaching Tools and Methods
Theme 5: Planning and Managing Agroforestry Landscapes	**Sub-theme 5.1** Rationale and Importance of Landscape Planning, Management and Monitoring, including for whom and by whom 1 hour	1. Articulate the rationale and importance of planning, managing, and monitoring landscape use for optimum benefits to the users 2. Determine appropriate approaches and processes and tools for agroforestry landscape planning, managing, and monitoring 3. Determine the contributing and limiting factors toward effective agroforestry landscape planning, managing, and monitoring in planning and managing a landscape	Students acquire the landscape approach mind set in developing a given natural resource particularly in determining what area is suitable for agroforestry, and are able to foresee their future roles in advocating it after graduation. All these may have to be reflected in a small group project report that they would submit toward the end of the semester.	• Lecture-discussions
Theme 3: Drivers of Change in Agroforestry Landscapes	**Sub-theme 5.2** Principles, Approaches, and Processes and Tools for Agroforestry Landscape Planning, Managing, and Monitoring 1 hour			• Lecture-discussions • Case Study Analysis
	Sub-theme 5.3 How to Negotiate Among Multiple Stakeholders over a Specific Configuration of a Landscape 9 hours			• Lecture-discussions • Field exercises • Small group project
	Sub-theme 5.4 Designing a Landscape Agroforestry System 1 hour			• Group Report

Table 3. Suggested reading materials on AFLA

Modules	Suggested Reading Materials
Introduction to Landscape Agroforestry	Boyce, Stephen. 1995. Landscape Forestry. John Wiley and Sons, Inc., New York, USA. p.239. Forman, R.T.T. and M. Godron. 1986. Landscape Ecology. John Wiley and sons, N.Y., USA. p619. Forman, R.T.T. 1995. Land Mosaics: The Ecology of Landscapes and Regions: Cambridge University Press, Cambridge, UK Farina, Almo. 2007. Principles and Methods in Landscape Ecology: Towards a Science of the Landscape. 2nd Edition. Dordrecht: Springer. p.414. Hobbs, R. J. 1994. Landscape Ecology and Conservation: Moving From Description to Application. Pacific Conservation Biology 1: 170-6. Nair, P.K.R. 1993. An introduction to agroforestry. Dordrecht, the Netherlands, Kluwer Academic Publishers Wyant, 1996. Agroforestry-an ecological perspective. Agroforestry Today. 8:1
Characterizing Agroforestry Landscapes	Baudry, J. 1989. Interactions between agricultural and ecological systems at the landscape level. Agric. Ecosystems Environ. 27: 119-30. Thomas, David E., Pornchai Preechapanya, Pornwilai Saipothong. 2002. 'Landscape Agroforestry in Upper Tributary Watersheds of Northern Thailand'. Journal of Agriculture (Thailand), Volume 18 (Supplement 1): S255-S302. van Noordwijk, M., P.M. Susswein, C. Palm, A. Izac, and T.P. Tomich. 2001. Problem Definition for Integrated Natural Resource Management in Forest Margin of the Humid Tropics: Characterization and Diagnosis of Land Use Practices. ASB Lecture Note 1. The World Centre for Agroforestry (ICRAF), Southeast Asian Regional Research Programme, Indonesia. p47.
Drivers of Change in Agroforestry Landscapes	Conway, G. R. 1985. Agroecosystems Analysis. Agricultural Administration 20:31-55. Elsevier Applied Science Publisher, Ltd., England. Thomas, David E., Pornchai Preechapanya, Pornwilai Saipothong. 2004. Landscape Agroforestry in Northern Thailand: Impacts of Changing Land Use in an Upper Tributary Watershed of Montane Mainland Southeast Asia. ASB Thailand Synthesis Report: 1996 - 2004. Chiang Mai: World Agroforestry Centre (ICRAF). 184 p. Xu Jianchu, Jeff Fox, David Melick, Yayoi Fujita, Attachai Jintrawet, Qian Jie, David Thomas, Horst Weyerhaeuser. 2006. 'Land-use transition, livelihoods and environmental services in Montane Mainland Southeast Asia'. Mountain Research and Development 26(3): 278-284.

Table 3. Suggested reading materials on AFLA (continuation)

Modules	Suggested Reading Materials
Tools, Methods, and Approaches in Analyzing Agroforestry Landscapes	Fernandes, E. C. M. and Nair, P. K. R. 1986. An evaluation of the structure and function of tropical homegardens. Agricultural System. Volume 21, Issue 4, Pages 279-310. Thomas, David, Horst Weyerhaeuser, Pornwilai Saipothong. 2003. 'Improved Tools for Managing Agroforestry Landscapes in Northern Thailand: Pilot Application of Spatial Analysis and Negotiation Support Systems'. In: Xu Jianchu, Stephen Mikesell (Editors), Landscapes of Diversity: Indigenous Knowledge, Sustainable Livelihoods and Resource Governance in Montane Mainland Southeast Asia. Kunming, China: Yunnan Science and Technology Press. p. 381–400.
Planning and Managing Agroforestry Landscapes	van Noordwijk, M., T.P. Tomich, H. De Foresta, and G. Michon. 1997. To Segregate or to Integrate? The Question of Balance Between Production and Biodiversity Conservation in Complex Agroforestry Systems. Agroforestry Today 9(1):6-9. Dramstad, W.E., J.D. Olson and R.T.T Forman. 1996. Landscape Ecology Principles in Landscape Architecture and Land Use Planning. Harvard Univ. Grad. School of Design, Island Press and Am. Soc. of Landscape Architects. Thomas, David E., Pornchai Preechapanya, Pornwilai Saipothong. 2004. Developing Science-Based Tools for Participatory Watershed Management in Montane Mainland Southeast Asia. Report for the Rockefeller Foundation. Chiang Mai: World Agroforestry Centre (ICRAF). 103 p.

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Thomas, D.E. 2003. Landscape Agroforestry in the Upper Tributary Watersheds of Northern Thailand: Knowledge Underpinning Water and Forest Policy in Thailand. Social Research Institute, Chiang Mai University, Thailand.

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3. The SEANAFE Agroforestry Landscape Analysis Case Study Materials

Introduction

The thematic approach, the key design feature of SEANAFE's Phase 2 implementation, led to the adoption of the case study and team approaches in developing the curricular framework and teaching materials on AFLA.

SEANAFE observed that most curriculum designs are subject-centered which means that they usually consider only activities that would fit with a given set of learners and tend to use concepts that do not relate much to the experiences of the learners. Considering the limitation of this approach, SEANAFE thought that developing a curricular framework using the case study approach would be more problem-oriented and broad field-centered (http://webinstituteforteachers.org/curriculumTerms/extra.htm)

Being broad field-centered means that several separate concepts related to the subject matter are considered into an interdisciplinary framework. This puts the subject matter in a wider perspective and generates fresher insights and experiences that could be organized to formulate a curriculum. In the process, it provides the basis for activities in which learners can compare and contrast related areas, developing interdisciplinary understanding and appreciation of the subject matter based on real-world conditions. On the other hand, being problem-oriented refers to being interdisciplinary and participatory, highlighting life situations and engaging learners to think more critically about the subject matter.

As defined by Yin (1984), a case study is an "empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used." Following this definition, SEANAFE relied on the case study's ability to deal with a variety of evidences collected from various sources which could be triangulated toward producing the desired project outputs. Following Stake's (1995) argument also, taking the case study approach for the projects is "not so much of a methodological choice but a choice of what is to be studied."

Case studies can be classified into two: a research case study and a teaching case study. A research case study contains a full description of the case being studied, including analysis, conclusions, and recommendations. Its main purpose is for the reader to fully understand the case being studied and generate experiences and lessons. On the other hand, a teaching case study deliberately does not include much analysis, conclusions, and recommendations on the case being studied. This is for the purpose of testing the learner's behavioral skills in analysis and critical thinking on what actions to take if they are in the same situation described in the case (Librando, undated).

Brief Overview of the Case Study Materials

The five teaching case study materials produced by the AFLA project are as follows:

1. Appropriate Agroforestry Landscape Practice and Policy Implementation toward Improved Landscape Quality in Mendalam River Basin, West Kalimantan, Indonesia
2. Influence of Government Policies on Livelihoods and Landscape in the Nam Thone Watershed, Lao PDR
3. The Role of Secure Land Tenure in the Adoption and Development of a Sustainable Farming System in the Cambantoc Sub-watershed, Laguna, Philippines
4. Landscape Agroforestry Mapping and Planning for Sufficiency Economy in Huairaeng-Khlong Peed Watershed in Eastern Thailand
5. Land Use and Market Dynamics in Son La Province of Vietnam: The Case of the Maize-based Farming Landscape of Chieng Hac Commune

Each teaching case study material in this Guide is divided into two parts, namely: (a) Notes for Teachers and (b) the case itself. The cases presented here are the repackaged versions of the original research case study reports of the country teams. They are suggested to be used in teaching any of the AFLA curricular themes as shown in Table 4.

Table 4. Suggested use of country case study materials according to AFLA themes.

Themes	Country Case Study Materials				
	Indonesia	Laos	Philippines	Thailand	Vietnam
Characterizing Agroforestry Landscapes	✓		✓		✓
Drivers of Change in Agroforestry Landscapes	✓	✓	✓	✓	✓
Tools, Methods and Approaches in Agroforestry Landscape Analysis				✓	
Planning and Managing Agroforestry Landscapes				✓	

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http://webinstituteforteachers.org/curriculumTerms/extra.htm

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Stake, R. E. 1995. The Art of Case Study Research. Thousand Oaks, CA: Sage Publications.

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Teaching Case Study Material 1:

Appropriate Agroforestry Landscape Practice and Policy Implementation Toward Improved Landscape Quality in Mendalam Riverbasin, West Kalimantan, Indonesia

A. Notes for Teachers

Aims and the Methodology Used in Generating the Case Study

The case study material was based on a research conducted in Mendalam River Basin located in the upper stream of Kapuas Watershed, West Kalimantan Province, Indonesia as part of the SEANAFE Agroforestry Landscape Analysis (AFLA) project.

The research had the following objectives:

1. To describe and analyze the landscape characteristics of Mendalam River Basin including the existing agroforestry practices, and occurrences and impact of natural disasters such as landslides, floods, etc to the landscape;
2. To define the factors that drive landscape changes and their impacts on the different land use options in Mendalam River Basin;
3. To determine the ideal agroforestry landscape agroforestry for Mendalam River Basin toward having a sustainable watershed; and
4. To develop the study results as learning materials relevant to the formulation of an Agroforestry Landscape Analysis Curriculum.

Data were collected from 1 April 2007 to 30 January 2008 from secondary data sources, field survey, group interview, and actual field observations. The research team was composed of lecturers/researchers from Bogor Agricultural University (IPB), Gadjah Mada University (UGM), and Lampung University (UNILA).

Problem Statement/Key Issue of the Case

Mendalam river basin is a part of “conservation district” within a forest reserve in Kapuas Hulu District, a national park in Indonesia. Despite having about 90 percent forest cover and three percent farmland of the total land area, the river basin suffers substantial environmental impacts due to inappropriate land use practices. The primary environmental issues are declining water quality and quantity arising from sedimentation, erosion and pollution. With different tribes, a mix of traditional and introduced farming practices, and a high poverty rate, achieving sustainable resource management in the river basin is a challenging prospect. The most likely

opportunity to address these issues is to have an appropriate agroforestry system in tandem with an effective implementation of a Payment for Environmental Services (PES) scheme.

Key Learning Themes of the Case

This case is a good material in learning about the following themes: (a) characterizing agroforestry landscapes; and (b) planning and managing agroforestry landscapes to meet the needs of the stakeholders in a sustainable manner. The guide questions provided in this case will help determine which learning theme teachers would like their students to learn. Other questions can be formulated for the same purpose. Teachers are encouraged to develop mini-cases on specific key themes if deemed necessary.

Expected Learning Outcomes

After discussing the case, the students are expected to gain better appreciation on the importance of characterizing a landscape in order to provide sound options to manage it properly. The students should have also understood the function of having an appropriate agroforestry system in a river basin toward sustaining the environment and providing livelihood to the inhabitants.

Guide Questions and Suggested Discussions

Questions	Discussions
1. What factors contribute to the current land use patterns in the Mendalam River Basin?	Among the factors contributing to the current land use patterns in the Mendalam river basin are: 1. Culture of the tribes inhabiting the area in relation to their land ownership and land use practices 2. Government policy to increase national rubber production 3. Increasing population in relation to the limited available land 4. Limited on-farm and off-farm opportunities for the inhabitants
2. Describe the major environmental problems present in the Mendalam River Basin and enumerate their causes.	The following are the major environmental problems and their corresponding causes present in the Mendalam River Basin: 1. Meandering of the river basin caused by extensive forest clearing for agriculture and ongoing lateral incisions in the riverbanks 2. Soil erosion and sedimentation due to shifting cultivation, gold mining, illegal logging, and establishment of shortcuts for boat transportation. 3. Poor water quality due to soil erosion and sedimentation and gold mining 4. Presence of farming activities and inappropriate farm practices beyond allowable distance to the river banks due to poor implementation of government policy, population increase, and poverty among the inhabitants
3. What type of appropriate agroforestry system/s should be implemented on the riverbank to stabilize it and, at the same time, provide the community with additional income? If possible, describe the system including suggestions on the plants to grow.	Technical experts advise that maintaining river bank stability requires a combination of trees that have deep roots (anchoring function) and shallow roots (binding function). Examples of trees that have moderate to deep roots are durian (*Durio zibethinus*), petai (*Parkia speciosa*), jati kertas (*Gmelina arborea*), candlenut (*Aleurites moluccana*), pasang (*Quercus lineata*), and mahagony (*Swietenia macrophylla*). Examples of trees that have shallow roots are bamboo, semantung (*Ficus padana*), surian (*Toona surenii*), and gamal (*Gliricidia sepium*). Wild coffee (*Coffea canephora var. Robinson*) has both binding and anchoring properties. On the other hand, a complex agroforestry system i.e., Agrosilvopastural, Agrosilvofishery, Tembawang, Pekarangan, Mixed Gardens (Kebun Campuran), Forest Gardens (Talon) could support a sustainable livelihood to the community.

Questions	Discussions
4. Could Payment for Environmental Services (PES) system help improve the landscape quality in the river basin? How?	PES can help improve the landscape quality in the River basin. The basic principle of PES is that those who provide environmental services should be rewarded for doing so through both financial and non-financial incentives. One of the major types of environmental services is watershed protection. This includes soil protection, maintenance of forest and other dense vegetation in the upper part of the watershed to avoid erosion, regulation of water flows to avoid extreme drought and floods in the lower part of the watershed. The availability of these services to external beneficiaries depends very much on the land use practices by those in the uplands. By adopting appropriate land use practices, upland farmers can significantly contribute to soil conservation and water cycle (ICRAF, undated; Gouyon, 2002)

Suggested Readings

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Rachmad, H.M. 2002. Kapasitas Infiltrasi Pada Berbagai Tingkat Umur Bekas TPn di Tanah Podsolik Merah Kuning Areal HPH PT Benua Indah Nanga Suruk Kab. Kapuas Hulu. Skripsi Fak. Kehutanan Universitas Tanjung Pura Pontianak (unpublished).

Rafdinal et. al. 2003. Kajian Potensi Perempuan Dayak Serta Peluang Pemberdayaan Dalam Rangka Konservasi Keanekaragaman Hayati di Taman Nasional Betung Karihun (TNBK) Kalbar Laporan Penelitian, Fahutan, Untan.

Roslinda, E., Yuliantini, V. Sasmitawidjaja and Chrstine Wulandari. 2007. Cost and Benefit Analysis of Payment for Watershed Services in Mendalam Sub Watershed. WWF-Indonesia and Care International Indonesia, Jakarta.

Sardjono, MA, T. Djogo, H.S. Arifin, N. Wijayanto. 2003. Klasifikasi dan Pola Kombinasi Komponen Agroforestri. Bahan Ajaran Agro-forestri 2 (World Agroforestry Center – ICRAF, Southeast Asia Regional Office), Bogor.

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B. The Case

Appropriate Agroforestry Landscape Practice and Policy Implementation Toward Improved Landscape Quality in Mendalam River basin, West Kalimantan, Indonesia

Introduction

Like all other watershed areas in Indonesia, the Mendalam river basin is faced with a challenge to achieve sustainable natural resource management considering that the approximated 5,000 people inhabiting its 157,900 ha total land area are living in poverty. Despite having a forest cover of some 90 percent and farmland consisting only three percent of the total land area, the landscape dynamics in the river basin vary over time as a result of several internal and external factors including among others the land use practices of its inhabitants. These land use practices bring about environmental impacts, beneficial or otherwise, to the river basin and to its inhabitants.

Landscape Characteristics of the Mendalam River Basin

The Mendalam river basin is located in Kapuas Hulu District in West Kalimantan Province of Indonesia. Some 46 percent of the landscape is predominantly flat, around 30 percent gently sloping, and the rest are either in steep or very steep slopes. The Mendalam river runs for about 75km in the basin and has an overall elevation level of 80 meters from the upstream to the downstream. This means that the river has a very low gradient (0.001). Since the area is dominantly occupied by *kerangas* (heath) forests, any change in vegetation cover is not easily recovered. If vegetation cover is lost, the thin humus of the *kerangas* is susceptible to erosion, burning, and oxidation. When such degradation occurs, the remaining parent material is white sand, which is unfavorable for vegetation when exposed to the sun. One result of forest clearing for agriculture in the area has been the extensive and ongoing lateral incisions in the riverbanks, leading to the Mendalam river meandering. Significant land use changes and subsequent environmental impacts have occurred in the upstream areas of the river basin. Table 1 summarizes the landscape characteristics of the Mendalam river basin.

Table 1. Landscape Characteristics of Mendalam River Basin

Aspects		Data
Catchment area size		157,900 ha
Population		Approximately 5,0000 people
Land form		plain - undulating
Slope		flat to very steep
Land use		forest, *tembawang* system (mixed garden), rubber system, mixed tree system (rubber, cacao and fruit trees), shrubs, dry land agriculture
Riparian condition		little vegetation cover
Villages/ Tribes	Upstream	Nanga Hovat (Dayak Bukat)
	Mid-region	Pagung Uma (Dayak Kayan), Suling (Dayak Kayan), Teluk Telaga (Dayak Kayan)
	Downstream	Tanjung Karang (Dayak Kayan), Lung Minting (Dayak Kayan), Semangkok (Dayak Taman), Nanga Sambus (Malay)
River uses		transportation, fishing, drinking water, communal toilet, washing
Water source		river
Farmers' group		Bukit Balio
Main cultivated crops		Annuals: rice (rainfed paddy), cucumber, maize, groundnut and long-bean Tree-system: cacao, rubber *Tembawang: tengkawang* (*Shorea sp.*), durian, langsat, rambutan, *kelengkeng* (*Dimocarpus longa*)

Land Ownership and Land Use

There are three Dayak tribes and one Malay tribe inhabiting the Mendalam river basin. These tribes have their own customs, though they are often difficult to differentiate from each other. For the Dayak tribes, there is no private land ownership and the occupied land belongs to the tribe as a whole. Each member of the community is allowed to manage a certain parcel of land, but to do so would require permission from the community board. The Dayak people move around the area due to their use of a shifting cultivation system and shift fields either annually or biannually. They return to the original land after about seven years. In contrast, the Malay tribe allows its members to manage their own land with permanent cultivation.

The settlements of the tribes are usually found close to the river from the upstream to the downstream of the river basin. Figure 1 shows the distribution of these settlements and the land use type of each kampong.

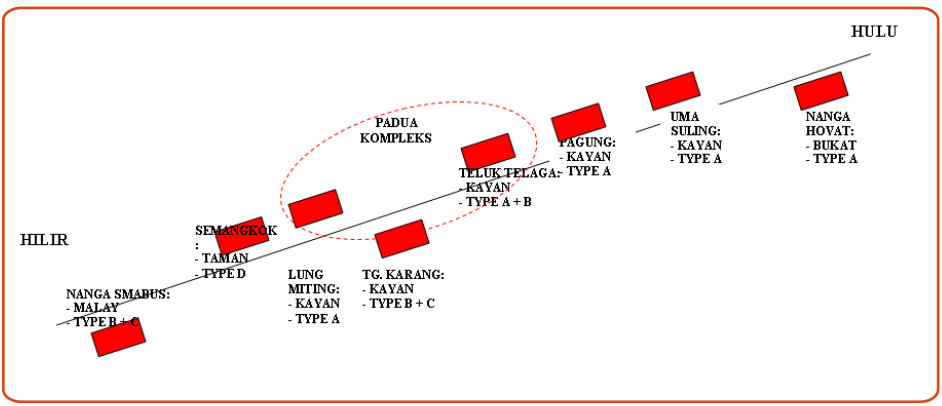

Figure 1. Distribution of settlements in the Mendalam river basin.

Figures 2 to 5 show the land use types commonly practiced by each tribe. Tables 2 and 3 list the types of agroforestry system and vegetation found along the river basin.

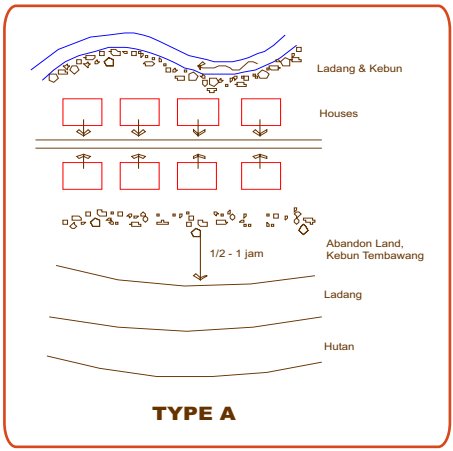

Figure 2. Type A landscape mosaic

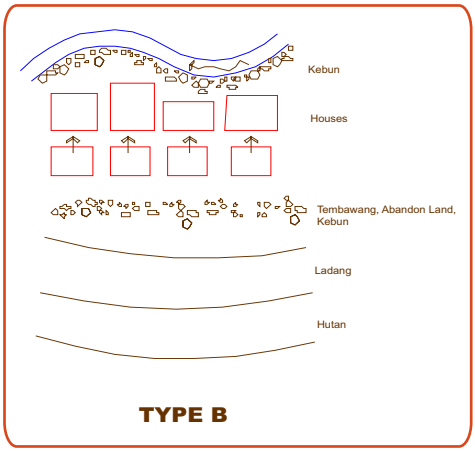

Figure 3. Type B landscape mosaic

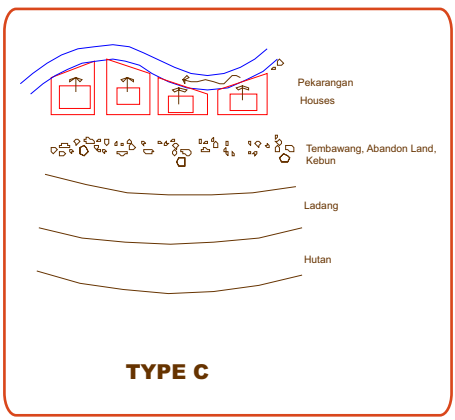

Figure 4. Type C landscape mosaic

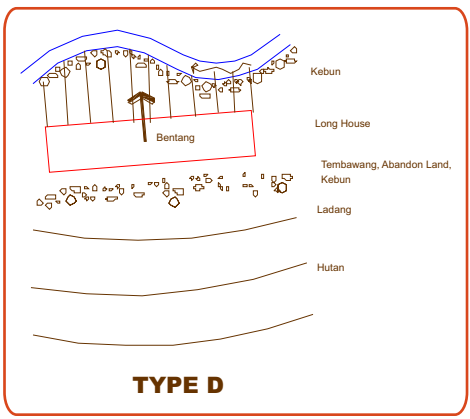

Figure 5. Type D landscape mosaic

Table 2. Types of agroforestry system and vegetation structure in the Mendalam River Basin.

No	Type of Agroforestry	Vegetation Structure Pattern	Remarks
1.	Tembawang (mixed gardens) in river side	Durian, fern (*paku ikan*), palm sugar, coconut, tengkawang, banana, sweet potato, peanut, green bean.	Cash crops are cultivated intensively
2.	*Pekarangan* (home gardens)	Durian, rambutan, pamelo, coconut, pumpkins, pepper, *juna* (Dayak onion), taro, vegetable ginger (*Alpinia sp.*), poultry	Cash crops are cultivated intensively.
3.	*Kebun Tanaman*/ Perkebunan (plantations)	Rubber, coffee, cocoa	Cultivated semi-intensively
4.	*Ladang* (drylands)	Rice (*Oryza sativa*), corn (*Zea mays*), vegetable ginger (*Alpinia sp.*), cucumber, pepper (*Pepper nigra*), cassava (*Manihot utilissima*)	Cultivated extensively
5.	*Hutan* (forest)	Mangosten, cekalang, pandanus, star fruit (*Belimbing darah*), rambutan, bamboo, rottan, tengkawang (*Shorea stenoptera*), trees for honey bees (*Lebah madu*)	Cultivated extensively

Table 3. Landscape mosaic types of the tribes in Mendalam river basin.

No	Settlement	Ethnicity and Main Activity	Current Land Uses Type	Former Land Use Type	Environmental Impact due to Land Use Change
1.	Nanga Hovat	Dayak Bukat (hunting and gathering)	Type A	No Data	No Data
2.	Uma Suling (Padua Kompleks)	Dayak Kayan (planting)	Type A (since 1960s)	Type D	Due to the growing population, demand for land to cultivate increased. But because available lands were limited, forest fragmentation, and sedimentation became prevalent.
3.	Pagung (Padua Kompleks)	Dayak Kayan (planting)	Type A	Type D	
4.	Teluk Telaga (Padua Kompleks)	Dayak Kayan (planting)	Type A & Type B	Type D	
5.	Tanjung Karang	Dayak Kayan (planting)	Type B & Type C	Type D	
6.	Lung Miting	Dayak Kayan (planting)	Type A	Type D	
7.	Semangkok (Ariung Mendalam)	Dayak Taman (planting)	Type D	Type D	
8.	Nanga Sambus	Malay (trading)	Type C	Type C	

In the upstream and midstream areas of the Dayak settlements, most farmers plant rubber trees due to its better economic returns rather than tengkawang or other indigenous species. Rubber became popular in the area during the 1980s when community rubber plantation schemes were introduced by the national government to increase national rubber production. However, two settlements in the river basin do not have rubber plantations. The furthermost upstream village of Nanga Hovat remains reliant on hunting and gathering, and the Malay village of Nanga Sambus, the most downstream village, has shifted from agriculture to cattle grazing.

Environmental Problems in the Mendalam River Basin

A major hydrological issue is the impact of forest cover loss on the quality and quantity of river flow. Soil erosion and sedimentation in the area have resulted from inappropriate farming practices such as shifting cultivation and slash and burn. Gold

mining, logging, and boat transportation have also contributed. River bank collapses are common and the establishment of shortcuts for boat transportation has also added to the sedimentation problem.

Since boats are the main transport for people in the area, stable and sufficient river depths is desirable. However, water levels in the river have been observed to increase and decrease quickly within one day following a rain particularly during the long dry spells. Water quality issues in the area are related to water turbidity due to erosion and sedimentation, as well as pollution. Gold mining activities along the river have contributed to this substantial turbidity problem. The Public Water Service (PDAM) of Putussibau, the capital of Kapuas Hulu, validated this problem and thus most PDAM consumers do not use piped water for drinking, but only for other domestic purposes.

Changing cultivation practices in the Mendalam river basin have caused significant soil erosion and have created meandering river issues. This is most prevalent in the midstream areas where changing cultivation practices occur most commonly. The impacts of this meandering river include the loss of established riparian areas and their "buffer" functions, losses in farmland, and high levels of sedimentation in river which decrease the quality and quantity of water.

Some Dayak communities have been tilling their land right up to the river's edge despite the regulations from the Ministry of Forestry only permitting land tilling no closer than 30 meters to the river. Some Dayak people argue that their land conservation methods, based on an inheritance system, have proven sustainable up to now and do not violate any government regulations. This may indicate that government policies are not well disseminated and implemented in the area.

Some changes in land use practice that have led to environmental problems include:

- Shortened cycle of land cultivation due to population increases. This has caused forest land to be cleared for new cultivation areas. Most of these lands became permanent land for perennial crops such as rubber.
- Crop rotation changes within specific land areas, such as those occurring in *tembawang* system, were usually driven by economic factors. The introduction of new cultivating systems and crops such as rainfed paddy fields (sawah) and rubber, has resulted in multiple cropping systems changing to an almost monoculture system.
- Illegal logging since 1970s because of economic factors
- Intensive cultivation along the river bank, especially from tembawang system to *ladang* system without applying conservation techniques to stabilize the river bank. Cash crops are more dominant than perennial plants.

Gold mining activities have created pollution from toxic mercury. Until now, people from Putussibau are not too aware of the dangers of this despite the fact that mercury content, particularly 950 km downstream of Putussibau, is well above the permissible amount. Water pollution has also been caused by the use of poison for fishing, particularly during the dry season. Since most communities use the river for drinking as well as for washing and communal toilet, stomach problems and skin diseases are common among the villagers.

The government's plan to build a road along the Mendalam River from Putussibau to the upstream of the river basin could bring both positive and negative effects to the area. While the said road may benefit the community to have better access to markets and other places, it may also provide easier access for outsiders to exploit the river basin's natural resources.

Possible Solutions for Environmental Issues in the Mendalam River Basin

A strong focus on sustainable land use management involving communities, government, and other stakeholders is needed in the Mendalam River Basin. Integrated planning and development in the area should be harmonized from the upstream to the downstream. Planning and development guidelines should be established for each specific land use system. At a more micro level, local communities should consider more suitable agroforestry practices and increase utilization of indigenous species for better management of their land. This would help to mitigate the negative environmental impacts of existing practices.

Technical experts advise that maintaining river bank stability requires a combination of trees that have deep roots (anchoring function) and shallow roots (binding function). A combination of various strata of plants including trees, shrubs, bushes, herbs, and grasses would creat “vertical diversity.” This type of agroforestry could include various fruit plants, vegetable crops, spice crops, medicinal plants, industrial plants, starchy crops, ornamental plants as well as miscellaneous plants for fuel woods, feeds, and timber. The products would provide the communities with both additional nutrition and income while, at the same time, the system would provide environmental benefits, too.

Many of the negative environmental impacts associated with land use changes have affected the water resources in the Mendalam river basin. To resolve problems associated with both the quality and quantity of water resources, and with their management, requires collaboration between all stakeholders. There is the potential for communities in the Basin to be involved in, and benefit from, a Payment for Environmental Services (PES) scheme. The basic principle of PES is that

those who provide environmental services should be rewarded for doing so through both financial and non-financial incentives. PES schemes are most widely used for watershed management in Kapuas Hulu district under collaboration among district government, communities surrounding the sub watershed and WWF-Indonesia.

The community has indicated a strong interest to be involved in such a scheme with an expectation that erosion, sedimentation, and disease problems would be reduced. Engagement in a PES scheme has the potential to enable the sustainable management in the Mendalam river basin, and improve landscape quality and the livelihoods of local communities.

Guide Questions

1. What factors contribute to the current land use patterns in the Mendalam river basin?
2. Describe the environmental problems faced by the Mendalam river basin and enumerate their causes.
3. What type of appropriate agroforestry system/s should be implemented on the riverbank to stabilize it and, at the same time, provide the community with additional income? If possible, describe the system including suggestions on the plants to grow.
4. Could Payment for Environmental Services (PES) system help improve the landscape quality in the river basin? How?

Teaching Case Study Material 2:

Influence of Government Policies on Livelihoods and Landscape in the Nam Thone Watershed in Lao PDR

A. Notes for Teachers

Aims and Methodology Used in Generating the Case Study

This case study is based on a research that was conducted in Nam Thone Watershed in central Lao PDR under SEANAFE's Agroforestry Landscape Analysis Project. The case study illustrates the influence of Lao PDR government policies on the livelihoods of local villagers and on natural resource utilization in the watershed. The data were generated mostly field observations, GIS spatial analysis, and focus group interviews. The interviews were carried out at the village, district, and provincial levels. The GIS data were use to look at land use changes in the watershed.

Problem Statement/Key Issues of the Case Study

The following are the three key issues of the case:

1. Infrastructure development attracted migration to the watershed due to accelerated trading opportunities for local residents with outsiders.
2. The natural forest has been affected by various government policies, especially land investment for industrial tree plantation.
3. Livelihoods of local people in both the upstream and downstream are improving through increased natural resource use.

Key Learning Theme/s of the Case Study

This case study could be used as a good example to explain to students about the role of government policies as drivers in influencing forest resources and agriculture land use, as well as the impact of such policies on local livelihoods, which also shape the community landscape. The case study could also provide more understanding for students to learn and share experiences on the implementation of policies at the local level.

Expected Learning Outcomes

This case would enable students to understand some fundamental problems on natural resource management brought about by the implementation of certain government policies and programs. The students would also enhance their critical thinking capacity in analyzing the impacts of policies and programs, especially those related on markets, within the landscape of both upstream and downstream areas of Nam Thone Watershed.

Guide Questions and Suggested Discussions

Questions	Discussions
1. What are the factors contributing to the land use changes in the watershed?	Foremost of these factors are the following: • Policy on poverty alleviation contributes to expanded agricultural land for case crops • The land link policy increases attractiveness for migration and leads to increased natural resource use • Land investment increases forestland conversion for plantation purposes
2. What changes have there been in the livelihood of the local farmers as a result of the various government policies implemented in the area?	Development of infrastructures (e.g., roads, electricity, and irrigation) influenced changes in population and migration. The number of villages increased from 26 to 30 during the last 10 years. Villagers built their houses along the road or nearby Local livelihoods are changing towards market-oriented farming. The farming system has changed from subsistence-based to a commodity cropping system. Decreasing forest cover and resources affect the availability of non-timber forest products (NTFP). This also affects the livelihood of the poor household. Land investment policies encouraged the establishment of industrial tree plantations. The impact of shifting cultivation stabilization policy in the Northern provinces is the cause of village relocation to the watershed.
3. How have the up and downstream farming systems changed in response to these policies?	Upstream farming continues to depend on swidden cultivation, livestock raising, and NTFP gathering. Villagers tend to grown more commodity crops. On the other hand, downstream areas have started growing cash crops such as tobacco, maize, and pineapple.
4. What could be done to strengthen policy implementation toward more effective natural resource management and socioeconomic development in the area?	There is a need to have a better coordination mechanism among national and local government institutions and private agencies in implementing programs and policies. Policy development needs to have the full participation of stakeholders.

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B. The Case

Influence of Government Policies on Livelihoods and Landscape in the Nam Thone Watershed in Lao PDR

Introduction

As economic development in Lao PDR has grown dramatically, the condition of the natural environment has increasingly been threatened and degraded. In an attempt to prevent further natural resource loss and damage, and to sustain socioeconomic development, the Government of Laos issued and implemented a number of policies and programs during the last twenty years. These included the New Economic Mechanism, Natural Resource Conservation, Poverty Reduction, International Trade, and Land Investment policies.

This case study presents the main findings from research conducted in the Nam Thone Watershed from August–December 2007. The watershed covers an area of 73,000 hectares and is located in Pakading District in Bolikhamsay Province, which is in the centre part of Laos. The research investigated how changes in government policies and programs influenced the farming systems and livelihoods of local villagers in Nam Thone. In Pakading, several policies and programs were issued to help socioeconomic development and preserve natural forest resources within this region similar to other parts of the country. For example, the policy on natural resource conservation was proclaimed to establish the Pakading Biodiversity Conservation Area and to conduct the Land and Forest Allocation Program. The Government of Laos also introduced the land investment policy to open land to investors for plantation development. In addition, the Government implemented the international trade policy by upgrading road connections which resulted in Pakading District being linked with the borders of both Thailand and Vietnam.

In order to explore and understand the influences of those policies and programs in the Nam Thone watershed area, an integrated methodology of GIS and socioeconomic analyses were used. Interviews were also carried out with relevant local authorities on how they put government policies into practice, and discussions were held with village leaders and local farmers in four villages within the watershed. Two of these villages were located in upstream areas and the other two in downstream areas of the watershed. The major finding of the study was that government policies played an important role in improving the socioeconomic status of the local villagers in all four villages, but in doing so, threatened the natural forest land. The key findings are summarized in the following sections.

Infrastructure Development and Population Increase

Following the introduction of the New Economic Mechanism policy in the mid-1980s, improvements were made on infrastructure development (especially road and irrigation systems) to facilitate socioeconomic development. A road connecting Thailand and Vietnam was completed in 1998 (Road Number 8), which led to increased immigration into the watershed and a dramatic population increase in the area.

The vast majority of these immigrants settled down in new villages close to Road Number 8 as communication and other infrastructure were well developed. With widespread irrigation systems in the watershed, immigrants had an opportunity to be involved in agricultural production as a livelihood option. In the meantime, land use planning in the area was not yet well organized, and capacities to effectively manage the natural resources were not ready to accommodate the influx of people. As a result, much forest encroachment by immigrants occurred.

Farming Systems and Livelihoods

The land-link policy which saw road connections with neighboring countries contributed to economic growth and an increase in market availability. A number of government projects were implemented to encourage local villagers to focus on agricultural production and created opportunities for local farmers to produce and sell crops on expanded open markets. Several forms of agricultural promotion, plus health and education improvements were introduced by both government and NGOs to overcome inadequate rice consumption, food insufficiency, health issues, and to minimize illiteracy among local villagers. In the 1990s, the Government opened investment on agriculture and forestry for both foreign and domestic investors. This investment policy contributed to the boom in land concessions in Bolikhamsay Province, and to the subsequent degradation of forest areas, including the conversion of some forest into plantations. Local villagers gained some benefits from the plantation development although there is still controversy about its negative impacts.

Currently, farming in the watershed can be distinguished into two major systems. In upstream areas, farming continues to depend on swidden cultivation, livestock raising, and non-timber forest products. Besides these, villagers grow commodity crops integrated in their agricultural fields as well such as corn and sugarcane. Nowadays there are more opportunities in comparison to the past in terms of market access and information via agricultural extension. In contrast, the farming system in downstream areas is increasingly dependent on plantations and the intensive production of cash crops such as tobacco, maize, cucumber, and

pineapple. Overall, the livelihoods of both upstream and downstream areas appear to be improving and poor people have more opportunities to access education, sanitation, electricity, and health services. Moreover, local people have more opportunities to gain income from various activities in agriculture and forestry. However, it is noticeable that natural resource extraction has increased, including the taking of a range of non-timber forest products for both domestic use and export.

Forest Cover Decreases

In the mid-1990s, forest cover in the watershed was dominated by primary forest with about 12% of the total forested area defined as protection and conservation forest. Since then, the primary cover has declined through disturbance by many activities related to socioeconomic development. Many villagers have been concerned about the increase in forest degradation experienced since 2000 following the development of infrastructure and the opening up of land investment to both foreigners and locals. Figure 1 below shows the results of a GIS analysis that looked at forest cover and agricultural land use changes in Nam Thone Watershed over an eight-year period. The analysis distinguishes land use and forest cover into six categories including dense forest (primary forest), secondary forest, shrub land, agricultural land, water, and rock.

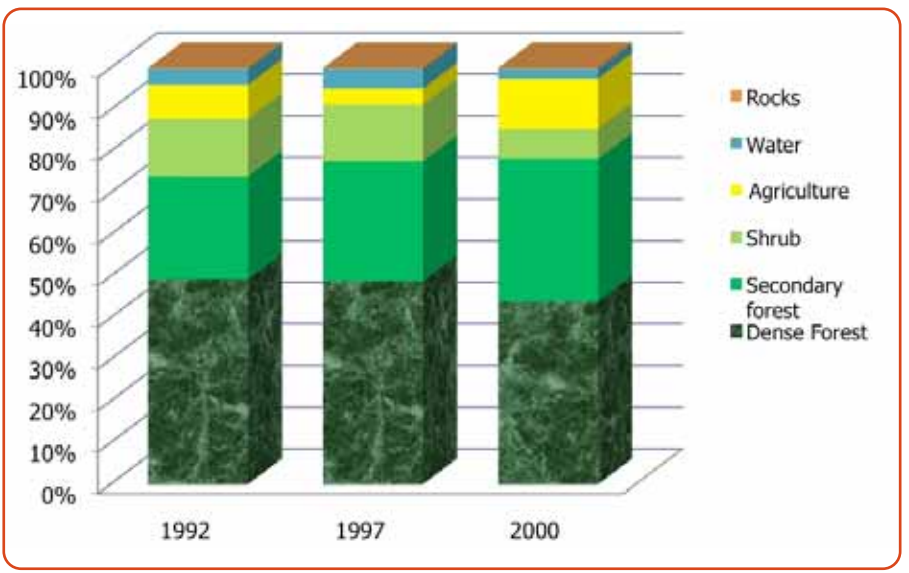

Figure 1. Land Use and Land Cover Change 1992–2000

The dense forest cover declined from 48% in 1992, to 42% in 2000. This meant nearly 1% of primary forest was lost every year. In contrast, secondary forest increased from 24% to 33% during those eight years. The main cause of primary forest destruction was due to conversion to swidden and tree plantations. In Pakading District, swidden cultivation remained a common practice, especially in upstream areas alongside Road Number 8. According to village interviewees, swidden cultivation was mainly conducted by new immigrants as they lacked paddy rice fields.

The land cover change process that occurred in the watershed is illustrated in detail in Figure 2 below. There were two main ways by which primary forest was converted into other land use types. They were (i) primary forest converted into plantation, and (ii) primary forest was converted into shifting cultivation and other land use types. Conversion of forest into plantation means there is little chance for the land cover returning to natural forest, while in contrast, natural forest that is transformed into shifting cultivation land has a potential to return to secondary forest and eventually primary forest if it is free of human disturbance for a long period of time. Generally, converting primary forest into shifting cultivation areas will produce fallow forest and lowland rice areas. Following this, areas used for shifting cultivation might be transformed to several types of land uses such as plantations and/or cash crops.

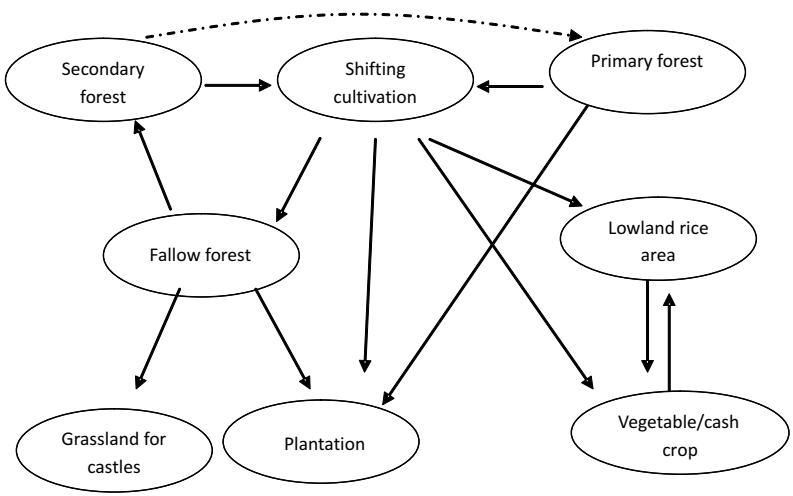

Figure 2. Land Conversion Process

In conclusion, the government policies had a significant role in influencing natural resource use and local livelihoods. The opening up of large-scale investment opportunities such as through land concession for plantation, has more pronounced impacts on the local natural resources, and revenues from the investment goes to outsiders. Alternatively, small-scale investment is more likely to be implemented by local people enabling them to receive better benefits from the resource use. When investment from outside occurs, there needs to be carefully considered mechanisms to ensure equitable benefit sharing. The current situation indicates that there is need for all concerned sectors and institutions to collaborate together in the watershed to address the challenges of having both socioeconomic improvement and sustainable natural resource management.

Guide Questions

1. What are the factors contributing to land use changes in the area?
2. What changes have there been in the livelihood of local farmers in the area as a result of the implementation of various government policies (e.g., land and forest allocation, land investment, poverty reduction, agricultural community promotion, etc)?
3. How have the up and downstream farming systems changed in response to these policies?
4. What could be done to strengthen policy implementation toward more effective natural resource management and socioeconomic development in the area?

Teaching Case Study Material 3:

The Role of Land Tenure Security in the Adoption and Development of a Sustainable Farming System in the Cambantoc Subwatershed, Laguna, Philippines

A. Notes for Teachers

Aims of and the Methodology Used in Generating the Case Study Material

Field research was conducted in two subwatersheds of the Makiling Forest Reserve Los Baños, Laguna, Philippines during August–December 2007. This research was conducted under a SEANAFE project on Agroforestry Landscape Analysis with the following objectives:

- To describe the biophysical and socio-economic/cultural conditions in the two subwatersheds;
- To characterize the structures and functions of agroforestry and other land use systems in the two subwatersheds;
- To define and analyze the forces that influenced the development of the subwatersheds towards integrated and segregated landscapes; and
- To formulate policy recommendations towards more sustainable agroforestry-based land uses in the two subwatersheds.

This case study focuses only on one of the watersheds, the Cambantoc Subwatershed which is considered as an integrated upland landscape. Specifically, the case study illustrates the influence of security of land tenure as one driving factor of land use change in the evolution of a sustainable farming system in the said subwatershed.

The research project involved five major activities, namely: (1) reconnaissance survey and collection of secondary data from literature and other sources, (2) validation of available information, (3) identification of information gaps, (4) gathering of primary data to fill research gaps, and (5) analysis of data. A team of lecturers from the University of the Philippines Los Banos, Don Mariano Marcos Memorial State University and the Visayas State University conducted the research.

Problem Statement/Key Issue of the Case

The sustainability of most watersheds in the Philippines is usually threatened by the people inhabiting them. In the case of the Cambantoc Subwatershed in Makiling Forest Reserve, secure land tenure proved to be a major driver for the evolution of a sustainable farming system by the inhabitants and the transformation of the area into an integrated upland landscape.

Key Learning Themes of the Case

The case study enables students to learn and develop skills for critical and analytical thinking about biophysical, socioeconomic, institutional, and political drivers of agroforestry landscape changes. These sub-themes are not discussed as separate headings in the case study, but the guide questions provided will help determine which learning theme teachers would like to focus on. Other questions can be formulated for the same purpose. Teachers are encouraged to develop mini-cases on specific key themes if deemed necessary.

Expected Learning Outcomes

After discussing the case, the students should have identified and obtained a better understanding of the different drivers and their roles and significance in landuse change. Particularly, students should have a good understanding of how secure land tenure drives agroforestry landscape changes and influences the evolution of a sustainable farming system in the Cambantoc Subwatershed.

Guide Questions and Suggested Discussions

Questions	Discussions
1. What influenced the introduction of different crops and farming systems into the Cambantoc subwatershed?	The following factors can be considered to have influenced the introduction of various crops and farming systems into the subwatershed: a. Good biophysical attributes of the subwatershed b. Market demand for the crops c. National government policy in promoting fruit crops d. Provision of land tenure to the settlers by the municipal government
2. What important roles did secure land tenure play in the adoption and development of a sustainable farming system in Cambantoc Watershed?	Security of land tenure allowed the settlers to become permanent farmers in the subwatershed. It also made them recipients of social services from the municipal government and technical assistance from UP Los Banos which owns the Makiling Forest Reserve. In the process, farmers developed the sense of involvement in the conservation and management of the forest reserve and better appreciation of the value of crop diversification, i.e., planting fruit trees and other perennials, in their farmland.
3. What factors led to the secure land tenure of people in Cambantoc subwatershed?	The increasing population in the area influenced the official recognition of the community as a "barangay" or village and secured the land tenure of the households.
4. Ideally, a watershed should not be inhabited by people. But in cases where there are settlers, does secure land tenure ensure an integrated and sustainable landscape in a watershed? Why?	In the case of the Makiling Forest Reserve, secure land tenure ensured an integrated landscape in Cambantoc subwatershed. It served as incentive for farmers to be more productive by planting permanent and perennial crops for their livelihood, and at the same time, involve themselves in conserving the forest reserve. However, it may have worked well together with having an organized community, appropriate capacity building, and good governance from local authorities.

Suggested Activities

This case study describes a real situation with all the associated complexities. This is also the likely environment many students will find themselves after graduation in their professional career. The following activities are selected to help equip the learners with some tools to understand and analyze on-the-ground realities, and to formulate plans for interventions.

1. Based on the case study, conduct a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis for the two sets of policies (i.e., UPLB on conservation and Local Government Unit on production) and on land tenure security as a major driver in the evolution of a sustainable farming system in an integrated agroforestry landscape.
2. A short group research may be conducted to find out how these two conflicting policies evolved and implemented in the subwatershed.
3. The class may be divided into two teams to discuss the results of the research through a debate format in the context of the land tenure security of the inhabitants to ensure a sustainable integrated landscape in the subwatershed.

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B. The Case

The Role of Land Tenure Security in the Adoption and Development of a Sustainable Farming System in the Cambantoc Subwatershed, Laguna, Philippines

Introduction

In the upland landscape, agroforests are those areas with man-made mixtures of trees and agricultural crops and/or grasses that lie between what is recognized as a pure forest and pure agriculture (van Noordwijk *et al.,* 2001). These mosaic of land uses produce forest and agricultural goods while also providing vital environmental services such as soil and water conservation, and biodiversity promotion. These services are essential to maintain the sustainability of farming activities in the uplands.

The Cambantoc Subwatershed (Zone 5 in Figure 1) is one of the six subwatershed zones in the Makiling Forest Reserve (MFR), located in Los Banos, Laguna Province, Philippines. This subwatershed has an approximate area of 1100 hectares (ha) and has an elevation ranging from 40–1100 meters above sea level. Some 70% of the watershed ranges from 40–400 meters above sea level. Areas on these elevations slope gently (often around 30%) and are therefore attractive for farming and settlement. Another factor that drives people to migrate to the area is accessibility brought about by the presence of the road.

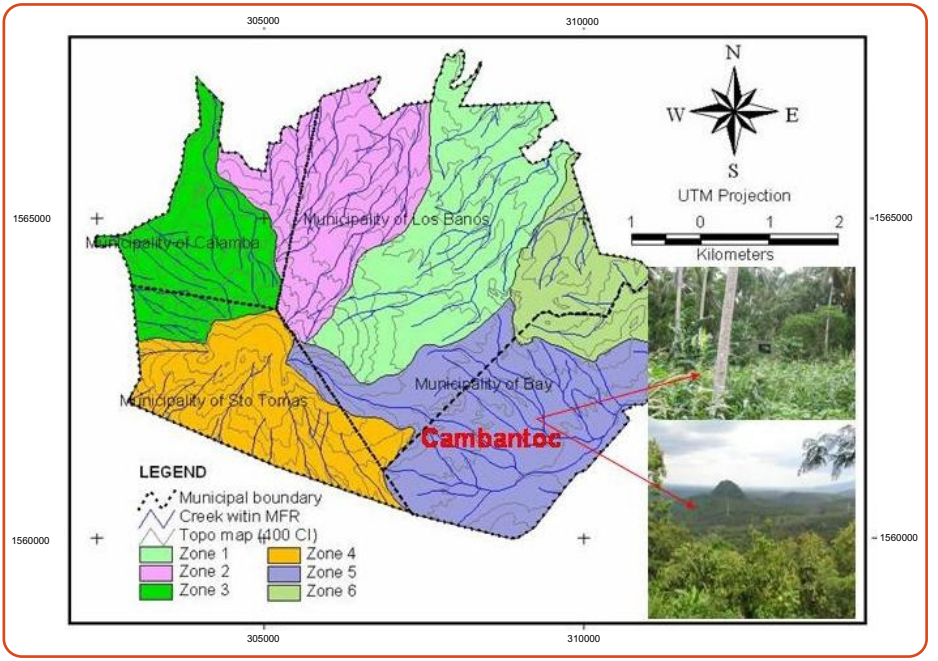

Figure 1. Map and Photos Showing the Cambantoc Subwatershed

Despite the Cambantoc Subwatershed being part of the Makiling Forest Reserve, upland communities moved into it during the 1930s and began clearing some forest to establish agricultural crops for the people's survival. During the 1950s, interest in the growing of perennials began with the introduction of citrus, which then started to replace upland rice and garlic. This change was also influenced by the Republic Act 3701, a policy issued by the Philippine Government that encouraged the planting of fruit trees to reduce the cutting of forest for farmland. The establishment of coconut plantations also started in earnest during this decade due to a citrus tree disease, high market demand for coconut, and the favorable biophysical characteristics of the area.

The increasing population in the area influenced the Municipal Government of Los Banos to officially constitute it as a *barangay* (village) in the subwatershed in 1974. This recognition allowed the settlers to become permanent farmers and resulted in most farmers building permanent houses. However, the households were not given the right to own the farmlands but were planting crops that will give them additional income as they are entitled to all profits made from their farms.

As permanent settlers, the farmers within the subwatershed created an organization called *Samahan ng Bagong Pag-asa sa Paanan ng Bundok Makiling*

(SMPBM – translated as Organization of New Hope in the Foothills of Mt. Makiling). By becoming a *barangay* and with the formation of this farmers' organization therein, the villagers received more opportunities and better access to government services and decision making process in the affairs of the municipality. The municipal government established a village school, health centre, day-care centre for children, and village hall. On the other hand, households were able to voice out their opinions in various undertakings of the municipality through their barangay officials.

Because of these types of services and participation mechanism, the local people acquired a sense of belonging with the local government system and activities, which led them to be more involved in the conservation and management of the subwatershed. In addition, the local people developed a better appreciation of the value of long-term land use planning, through planting of perennial crops, despite the fact that the land is owned by the University of the Philippines Los Baños (UPLB). This good relationship with the local government and UPLB has encouraged farmers in the community to integrate more crop components such as forest trees and fruit trees on their farmland. It has also enabled the community to be more innovative in their farming techniques to ensure their livelihood and, at the same time, the sustainability of the watershed. The adoption of crop combinations may also be attributed to the increased awareness of the farmers on the value of crop diversification, a central theme in most of the trainings that UPLB conducted for them.

During the 1980s and into the 1990s, the high demand for fruits in Los Banos, Laguna encouraged the farmers to introduce high value fruit trees such as *rambutan* and *lanzones* in the subwatershed. These fruit trees were interplanted between coconut trees. Later on, annual crops were also integrated mainly for the households' daily needs. This created a coconut-based multi-story agroforestry system in the area.

This coconut-based multistory agroforestry system still exists today, and represents a climax stage in the subwatershed as it is the last farming system adopted in the area. It evolved from a long process of trials and field experiences by the farmers resulting from being permanent farmers in the area. Further, the system has not only become the primary source of livelihood for the people but it has also proven to promote ecological stability and biodiversity in the Cambantoc Subwatershed. As shown in Table 1, net annual farm income and the total agroforestry area have increased by 16 percent and 384 percent from 1992 to 2006, respectively. Despite the increase in population in the subwatershed, the total forest cover is maintained and is gradually increasing.

Table 1. Land use and socioeconomic conditions in the Cambantoc Subwatershed

Year	No. Of Occupants	Total Area (ha)	Population Density (no. of person/ ha)	Total Forest Cover (ha)	People/ Forest Cover (no. of person/ ha)	Total Agro-forestry area (ha)	People/ Agro-forestry area (no. of person/ ha)	Net farm income/ ha/ annum
1992	480	1102.75	0.43	228.56	2.10	874.19	0.55	PhP 19,348.00
1999	565	1102.75	0.51	89.64	6.30	1010.92	0.56	PhP 45,500.00
2006	641	1102.75	0.58	90.50	7.08	1011.50	0.63	PhP 93,739.00

The crops planted within the existing farming system may change depending on the need of the community and the market but the subwatershed would remain an integrated upland landscape. It is believed that as long as the local and national governments have control over the land tenure security given to the community, there will be sustainability of this farming system in the Cambantoc Subwatershed, otherwise it will become purely a forest reserve.

Guide Questions

1. What influenced the introduction of different crops and farming systems into the Cambantoc subwatershed?
2. What important roles did secure land tenure play in the adoption and development of a sustainable farming system in the Cambantoc subwatershed?
3. What factors led to the secure land tenure of the villagers in the Cambantoc subwatershed?
4. Ideally, a watershed should not be inhabited by people. But in cases where there are settlers, does secure land tenure ensure an integrated and sustainable landscape in a watershed? Why?

Teaching Case Study Material 4:

Landscape Agroforestry Mapping and Planning for Sufficiency Economy in Huairaeng-Khlong Peed Watershed in Eastern Thailand

1. Notes for Teachers

Aims and Methodology Used for the Case Study Material

This case study highlights the results of a research conducted in Khlong Phu-Khlong Pook watershed, Trat province, Eastern Thailand as part of Phase 1 implementation of the Agroforestry Landscape Analysis (AFLA) Project of the Southeast Asian Network for Agroforestry Education (SEANAFE). The research had the following objectives:

1. To identify and classify land use patterns and factors driving land use changes in the watershed;
2. To evaluate the suitability of agroforestry patterns existing in the watershed and conduct a participatory agroforestry planning for sustainable land use, and
3. To find out and recommend a sustainable and appropriate landscape agroforestry plan for the watershed under the sufficiency economy.

Data were gathered through primary and secondary sources. Land use types and changes were analyzed based on historical aerial photographs and satellite images and interpreted using GIS software. Survey questionnaire and group discussions were used to gather ecological and socioeconomic data, including drivers of landuse changes, and characterizing the major farming systems (i.e., Natural Forest, Monoculture farms, and agroforestry farms) in the Khlong Phu-Khlong Pook watershed. The data obtained were also used to compute for the agroforestry and suitability indexes of the farming systems against the sufficiency economy program of the Thai Government. A group meeting among local administrative officers, foresters, landowners, and researchers was held to generate a participatory landscape agroforestry map of the watershed using the agroforestry and suitability indexes obtained. The map produced, together with the results of a SWOT analysis conducted also during the meeting, served as inputs to developing an agroforestry landscape plan for the watershed

Key Issues of the Case

Achieving a sustainable land use development is difficult without a meaningful participation from stakeholders and appropriate technological information from which to base stakeholders' decisions and actions. In Khlong Phu-Khlong Pook subwatershed, monoculture systems, particularly on rubber, pineapple and other fruit orchards, have been in existence since 1995 and occupy large patches of land within. These monoculture systems exist primarily due to market demands linked to addressing the economic needs of the farming community within the subwatershed. They were, however, observed to contribute significantly to severe soil losses in the subwatershed which are also aggravated by the regular occurrence of heavy rains. Further, the incomes derived from the monoculture farms are relatively low compared to the cost of production that farmers incur. There is a need to come up with a more integrated natural resource management plan for the watershed to ensure economic and environmental sustainability in line with the Thai Government's sufficiency economy program.

Key Leaning Themes of the case

The case study provides a good material for students to understand better the key role of effective planning for economic and environmental sustainability of a particular landscape such as a watershed. In the process, it will open the opportunity for them to think critically on how to implement a plan generated from a participatory process.

Expected Learning Outcomes

After discussing the case, the students are expected to (1) gain better appreciation on the steps in sustainable landscape planning process particularly on participatory land use evaluation and landuse mapping in a watershed within a given national development framework; and (2) better understand the relevance of agroforestry systems in such context.

Suggested Guide Questions and Discussions

Questions	Discussions
1. What factors drive farmers to change land use in the subwatershed?	The soil fertility in the subwatershed has been decreasing through the years due to monoculture farming. This is also aggravated by the frequent soil erosion occuring in the area. These conditions have resulted to low productivity. To help address these concerns and increase their income, the farmers decided to introduce agroforestry in the subwatershed.
2. What indicators are needed to come up with a sound land use evaluation?	A land use system must be evaluated in terms of its economic viability, social acceptability and environmental sustainability.
3. How important is stakeholders' participation in land use mapping/ planning?	Allowing the stakeholders to participate in the land use planning process means recognizing their importance and providing them the sense of ownership of the plan. Stakeholders are also good source of additional information that planners usually do not possess. Their involvement in the planning process would help ensure their cooperation and commitment in the eventual implementation of the plan.
4. Aside from the recommendations given by the research team, what other ways do you think the recommended agroforestry systems could be implemented effectively?	

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B. The Case Study

Landscape Agroforestry Mapping and Planning for Sufficiency Economy in Huairaeng-Khlong Peed Watershed in Eastern Thailand

Introduction

Achieving a sustainable land use development is difficult without a meaningful participation from stakeholders and appropriate technological options from which stakeholders' could base their decisions and actions. Under the "Sufficiency Economy" philosophy which the Thai Government advocates in all its development efforts, appropriate involvement of the populace at all levels is an important consideration in choosing a balanced development strategy for the country to modernize and guard against the forces of globalization while anticipating inevitable impacts that may arise.

Agroforestry, which promotes the purposive integration of trees into crop and livestock operations, has been regarded to be a viable strategy in promoting sustainable land use within a given landscape. It has also proven to help address many of the environmental, economic and social demands of landowners and society.

The Khlong Phu-Khlong Pook subwatershed, located within the the Huairaeng-Khlong Peed Watershed in Trat Province, eastern Thailand (Figure. 1), experiences the absence of a sustainable land use system. Most of its 3,532 ha land area are rendered infertile due to severe erosion and heavy rainfall averaging 3,325 mm annually. The existing monoculture plantations have been recorded to contribute significantly to soil losses in the area such as rubber (242.68 t/ha/yr), pineapple (606.71 t/ha/yr) and fruit ochard e.g., rambutan (338.02 t/ha/yr), cashew (270.40 t/ha/yr), and jackfruit (444.95 t/ha/yr) (Keawpromta, 2003).

The subwatershed is inhabited by 34 farming households who have been living there since the early 80s. Most of the families are poor earning an average annual income of B34, 225 from agriculture. This income is much lower than the farming expenses they incur (B38, 370).

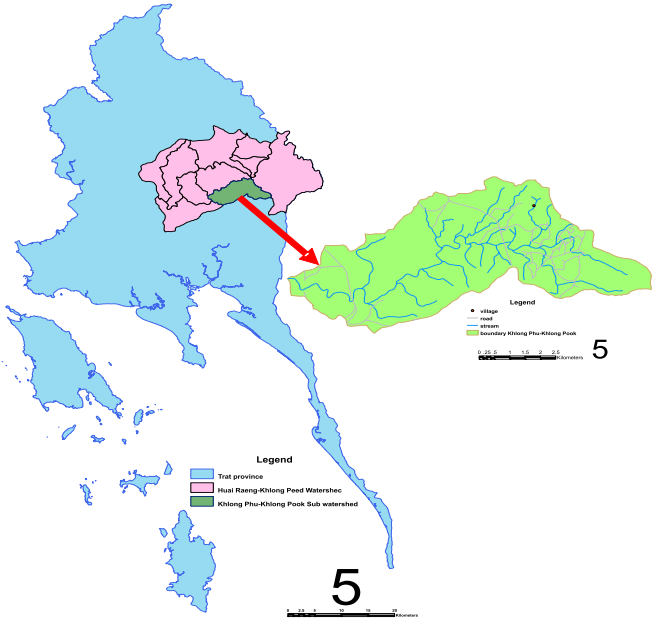

Figure 1. Location map of Khlong Phu-Khlong Pook subwatershed

This case is based on a research conducted in the said subwatershed by a team of researchers from Kasetsart and Chiang Mai universities as part of the Agroforestry Landscape Analysis (AFLA) Project of the Southeast Asian Network for Agroforestry Education (SEANAFE). It highlights the process and importance of participatory mapping as a tool in helping develop a sustainable agroforestry landscape within the subwatershed.

Changes and Drivers of Change of Land Uses and Ownership in the Subwatershed

Nine types of land uses exist in the watershed since 1995 up to present, namely: 1) natural forest/reforestation; 2) grass/abandoned land; 3) fruit orchard; 4) mixed fruit orchard; 5) pineapple plantation; 6) rubber plantation; 7) rubber and pineapple mixed plantation; 8) reservoirs; and 9) residential areas (Table 1). Although natural forest area occupies the largest portion of the subwatershed at 1,101ha (31.18%), it has nevertheless decreased since 2003. Likewise, a steady decline in fruit orchard and mixed fruit orchard was observed since 1998. These are attributed to the expansion of areas for monoculture rubber and pineapple production and mixed rubber and pineapple production caused by market demand, the price drop for some fruit commodities, and the government's permission given to investors to establish more rubber and biofuel plantations.

Interestingly, the residential area had also decreased from about 25 ha in 2003 to about 17 ha in 2007. It was found out that some farmers had sold their residential lands to investors to establish rubber and oil palm plantations. Surprisingly, however, an average of 5,200 has. remain as grassland/abandoned land within the watershed since 2003 up to present.

Table 1. Land uses in Khlong Phu-Khlong Pook Subwatershed from 1995-2007

Land Use Type	1995		1998		2003		2007	
	Ha	%	Ha	%	Ha	%	Ha	%
Natural Forest/ Reforestation	11.93	33.77	11.71	33.14	1224.1	34.66	11.01	31.18
Grass/Abandoned land	1046	29.62	392	11.11	516.6	14.60	528	14.94
Fruit orchard	238	6.73	664	18.79	455.6	12.90	407	11.52
Mixed fruit orchard	207	5.85	137	3.87	74.3	2.10	113	3.20
Pineapple plantation	267	7.55	106	3.01	274.1	7.76	256	7.25
Rubber plantation	507	14.35	1023	28.96	872	24.69	8.13	23.02
Rubber and pineapple mixed plantation	39	1.11	0*	0*	21.5	0.61	280	7.92
Reservoirs	8	0.23	34	0.98	70.2	1.99	18	0.50
Residential	28	0.79	5	0.14	24.6	0.70	17	0.47
Total	3532	100	3532	100	3532	100	3532	100

**Not classified in the digital map*

Assessment of the Suitability of Land Uses in the Subwatershed in relation to Thailand's Sufficiency Economy Philosophy

The research team assessed the suitability level of seven existing land uses in the watershed in relation to the sufficiency economy philosophy of the Thai Government. The land use categories evaluated included natural forest, rubber plantations, pineapple plantation, fruit orchard, mixed fruit orchard, mixed tree plantation, and complex agroforestry. They were assessed on 3 major indicators, namely: (i) environmental indicators which included soil loss, organic matter, and plant diversity, (ii) economic indicators which included income, time dispersion of income, and input self-sufficiency, and (iii) social indicators which included risks and uncertainties, and food security. The indicators on soil erosion, organic matter, plant diversity, and income were estimated based on both field data and secondary data. The rest of the indicators, i.e., time dispersion income, input self sufficiency, risk and uncertainties, and food security were estimated using a participatory ranking process with farmers in the watershed. All indicators were rated within a scale of 1-5 with 1 as having lowest suitability and 5 as having highest suitability.

The results obtained were used to determine the Agroforestry Index (AFI) of the land uses using a given equation and plotted against an Agroforestry Index Classification (AFIC) to eventually determine their suitability/sufficiency level in the subwatershed. A specific land use is rated as having highest suitability/sufficiency level in the subwatershed when its AFI falls within AFIC 1 while it gets the lowest suitability/sufficiency level when its AFI falls within AFIC 5.

As Table 2 shows, complex agroforestry was found to be the most suitable land use system in the watershed. Generally, complex agroforestry has a multi-layered cropping system and all species within it are considered useful for several purposes. Ecologically, the nutrient and energy balance within this system is similar to that of the natural forest. Even though this complex agroforestry system gives lower economic benefits compared to other cultivation patterns, its environmental and social aspects are better in the long-term in terms of providing sustainable income, food sufficiency, and low risk due to crop diversity. The combination of environmental, economic and social variables observed in complex agroforestry makes it a high potential model for an ecologically and socio-economically sustainable system.

Table 2. Agroforestry Index (AFI), Agroforestry Index Classification (AFIC) and Sufficiency Level of the Different Land Use Systems in Khlong Phu-Khlong Pook Subwatershed.

Land Use	AFI	AFIC	Sufficiency level
Natural forest	3.83	2	High
Rubber plantation	2.94	3	Moderate
Fruit orchard	2.19	4	Low
Mixed fruit orchard	2.64	3	Moderate
Mixed tree plantation	2.64	3	Moderate
Pineapple plantation	1.58	5	Lowest
Complex agroforestry	4.39	1	Highest

Developing Land Suitability Classification for appropriate Agroforestry Systems in the Subwatershed

After determining the suitability of the various land use systems in the subwatershed, it is equally important to classify the land where these land use systems would be appropriately practiced, thus, producing a landscape agroforestry suitability classification (LAFSC). To do this, the research team

developed an equation to determine first the suitability index (SI) of a particular land area by ranking the following variables: the class of watershed present, slope, elevation percentage, and distance from stream as shown in Table 3. Ranking of all variable characteristics were mapped by using GIS software.

Table 3. Ranking Used on Variables Required to Determine Suitability of Land for Agroforestry in the Khlong Phu-Khlong Pook Subwatershed.

Ranking	Variable Characteristics Relative to Land Area Being Classified			
	Watershed	Slope	Elevation Percentage	Distance to Stream
5	1	>35%	>80 %	>2 km
4	2	25-35%	60-80 %	1.5-2.0 km
3	3	15-25%	40-60 %	1.0-1.5 km
2	4	5-15%	20-40 %	0.5-1 km
1	5	<5%	<20 %	<0.5 km

Overlaying of all variable class maps which were weighed by priority of each variable (Figure 2) produced the SI and LAFSC as shown in Table 4.

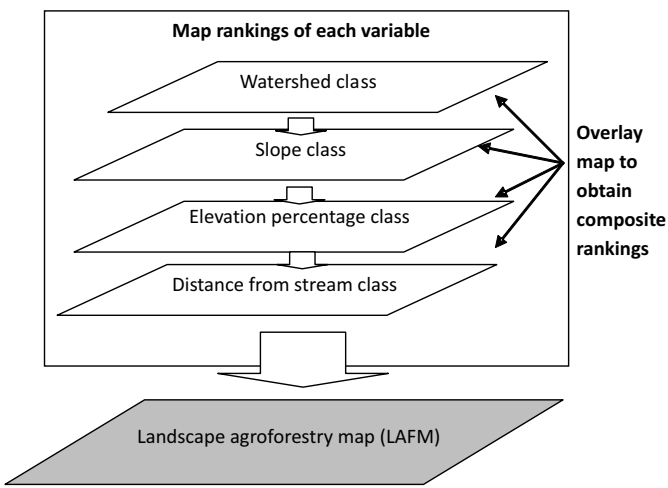

Figure 2. Overlay of watershed, slope, elevation percentage and distance from stream class maps to obtain composite rankings for Suitability Index.

Table 4. Suitability index (SI) for landscape agroforestry classification (LAFSC) in Khlong Phu-Khlong Pook Subwatershed

Landscape Agroforestry Suitability Classification (LAFSC)	Suitability index (SI)
I	>30
II	25-30
III	20-25
IV	15-20
V	<15

Conducting a Participatory mapping and agrofestry landscape planning for the Subwatershed

The formulation of LAFSC and SI served as inputs to conduct a participatory mapping exercise. The exercise was carried out within a series of meetings and consultations among the farmers, local authorities, other landowners, and researchers working in the subwatershed. The exercise produced a landscape agroforestry map (LAFM) for the watershed as shown in Fig.3. This map, the AFI, and the results of a SWOT analysis conducted in one of the meetings by the stakeholders were used to design appropriate agroforestry-based land management regimes for the subwatershed as shown in Table 5.

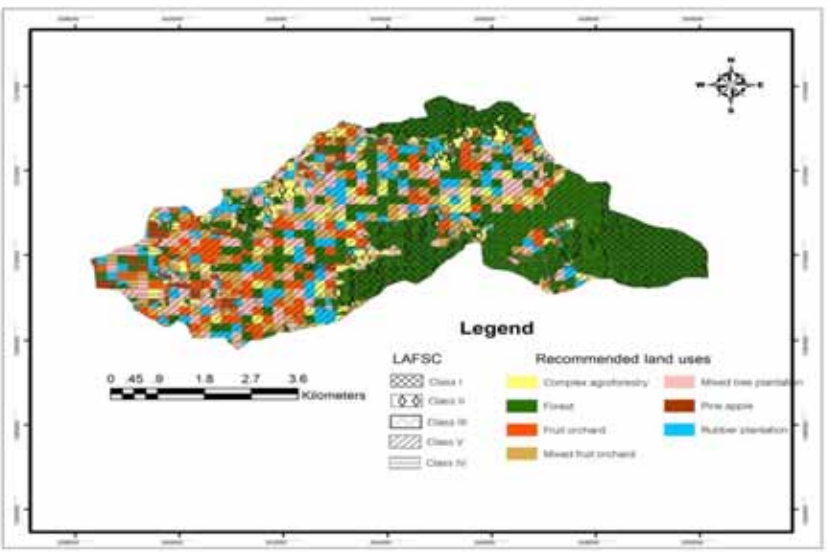

Figure 3. Participatory Map of Land Suitability Classification in the Khlong Phu-Khlong Pook Subwatershed.

Table 5. Agroforestry-based Land Management Regimes Recommended for Khlong Phu-Khlong Pook Subwatershed resulting from a participatory planning among stakeholders.

LAFSC	AFI	Recommended Land Management Regimes
I	4.2-5.0	Complex agroforestry
II	3.4-4.2	Complex agroforestry and forest,
III	2.6-3.4	Complex agroforestry, forest, rubber, mixed fruit orchard, and mixed tree plantation
IV	1.8-2.6	Complex agroforestry, forest, rubber, mixed fruit orchard, mixed tree plantation, and fruit orchard
V	1.0-1.8	Complex agroforestry, forest, rubber, mixed fruit orchard, mixed tree plantation, fruit orchard, and pineapple

The challenge now is how to effectively use the research outputs and implement the recommended land management regimes to ensure economic and environmental sufficiency in the subwatershed. Among the opportunities seen by the researchers toward this include (1) capacity building of farmers on tree nursery establishment and management, marketing, value adding and effective marketing, (2) strengthening community participation and commitment, (3) establishing community forests, and (4) providing continuous technical and institutional support.

Guiding Questions:

1. What factors drive farmers to change land use in the subwatershed?
2. What indicators are needed to come up with a sound land use evaluation?
3. How important is stakeholders' participation in land use mapping/planning?
4. Aside from the recommendations given by the research team, what other ways do you think the recommended agroforestry systems could be implemented effectively?

Teaching Case Study Material 5:

Land Use and Market Dynamics in Son La Province of Vietnam: The Case of the Maize-based Farming Landscape of Chieng Hac Commune

A. Notes for Teachers

Aims and the Methodology Used in Generating the Case Study

This case study presents the findings of a research on Upland Maize-based Landscape Agroforestry in Son La Province, Northern Vietnam as part of SEANAFE's Agroforestry Landscape Analysis Project. The research had the following specific objectives:

1. To characterize the existing land uses of the study area;
2. To characterize the drivers and stakeholders interference to land use dynamics;
3. To identify the main driver's influence on agroforestry landscape in the study area;
4. To find out the advantages and disadvantages of upland maize-based agroforestry;
5. To find out how the existing land uses can affect the people's livelihood in the short and long terms.
6. To determine the scenario of landscape agroforestry of the study area in the coming years.

The research was conducted in Chieng Hac commune of Son La Province by a team of 4 researchers representing member institutions of the Vietnam Network for Agroforestry Education from May to September 2007. Son La is one of four provinces of the Northwest region of Vietnam that is located within the Da River watershed. Chieng Hac commune was chosen as study site because it has great diversity of sloping land uses within a given landscape, including open upland maize fields, inter-cropping maize and forest trees, and forest areas.

Data was collected using a combination of several methods and tools such as secondary data analysis, farming systems analysis and participatory rapid appraisal tools (i.e. land use mapping and diagnosis, focused group interview, SWOT analysis, and scenario modelling).

Problem Statement/Key Issue/s of the Case

Sustaining livelihood and food security are two main challenges that farming households face in most upland areas in Northern Vietnam due to limited landholdings and opportunities to be engaged in off-farm activities. In most cases, farmers diversify the use of their limited land to meet these challenges. For Chieng Hac commune, traditional croplands were transformed into a hybrid maize intensive monoculture farms in response to the increasing market demand for corn for the feed processing and livestock industries in Vietnam.

While the current maize production in the commune has improved incomes and livelihoods of the households, it has nevertheless brought some problems on traditional cultural practices and is starting to affect the environmental sustainability of the Da River watershed. This would certainly present new challenges for researchers, government authorities, and local people in the commune.

Key Learning Theme of the Case

The case is a good material to enable students to learn about drivers of agroforestry landscape changes, particularly market. The case also provides the opportunity for students to open the discussion on how market demands should ensure livelihood and landscape sustainability. Sample guide questions are given in this case as discussion starters. However, teachers are encouraged to formulate other questions for whatever purpose it would facilitate student learning.

Expected Learning Outcomes

After discussing the case, the students should have (a) identified and understood the drivers that influenced land use changes in Chieng Hac commune; (b) appreciated the critical role that market plays in maize-based farming system in Chieng Hac commune; and (c) identified the importance of adopting appropriate soil management practices in the steep maize-based farming system to sustain the landscape in the years to come.

Guide Questions and Discussions

Questions	Discussions
1. What have been the drivers that influenced land use changes in Chie Hac commune?	The following can be considered as the major drivers that have influenced land use changes in Chieng Hac: a. Good biophysical attributes, particularly soil fertility and rain distribution, which are suited to growing maize b. High market demand for the crops c. Government agricultural and forestry reform policies
2. How has market influenced the maize-based farming system in Chieng Hac commune? What main aspect of the market is causing the most influence?	Maize has a large consumption network in the area particularly for feed processing. The market provides sure and better income to the farmers for their maize production compared to other crops in the area. Middlemen and service agencies, particularly money lenders, influence farmers' decision to stick to maize production. Middlemen play the role of market connectors for the buyers and producers from when the maize is still young in the field right through harvesting. Some of the middlemen provide capital and budget for seed, fertilizer, and even labour costs.
3. Do you think the current land use in Chieng Hac commune is sustainable? Why?	In the long run, maize-based farming system in the commune may not prove sustainable. Growing maize is considered harmful to soil because it exposes more soil surface leading to soil erosion and further degradation.
4. Assuming that the current maize-based farming system in Chieng Hac will continue to exist for several years more, what recommendations can you give to sustain the livelihood of the people and, at the same time, protect the environment around the Da River watershed?	The community must learn to adopt appropriate sloping agricultural land technologies (e.g., mulching, mini-terraces cum cover crops, and intercrop with legumes crops) to help minimize soil loss due to erosion, and for better crop integration and pest management.

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B. The Case

Land Use and Market Dynamics in Son La Province of Vietnam: The Case of the Maize-based Farming Landscape of Chieng Hac Commune

Introduction

Son La is one of four provinces in the Northwest region of Vietnam. Hoa Binh, Son La, Dien Bien and Lai Chau provinces together encompass most of the land in the Da River watershed. In 1991, the forest cover in Son La was recorded at about 9% of the total natural land area, making it one of least forested provinces in Vietnam. A long time ago in Son La, large areas of forests were converted for upland crops such as sticky rice, cassava, local maize, and soybean. Since 1995, a significant change in land use has been observed in this province. Upland maize has increased significantly, replacing traditional crops and remaining forests.

Figure 1. Son La, Location of Study

Table 1. Land Use History Line of Vang Lung Hamlet, Son La Province

Stage	Characteristics
Before 1954	There were seven households in the hamlet. The livelihood of people was based on upland rice (sticky rice) by slash and burn technique around the hamlet. There was no land use policy. Land was managed by local regulations with French colonial rules.
1954– 1959	There were 13 households in the hamlet. Major crop was upland sticky rice by slash and burn around the hamlet. Each household grew about 30 – 40 kilograms of rice seed. Other crops: maize, cassava, cotton. Land was managed by local regulations, but without French colonial rules.
1960– 1979	In 1960, there were 26 households, most of which joined an agricultural cooperative That managed land, cattle, and tools. The cooperative included an agricultural team and forestry team. The agricultural team rebuilt and expanded paddy land. Slash and burn continued and spread. Villagers of Vang Lung Hamlet began growing fruit tree species, mainly mango and tamarind. The forestry team mainly exploited timber, but in 1973, the team began to grow bamboo (the bamboo forest area is still kept and managed by the community).
1980– 1985	Households joined to a bigger commune-level cooperative. Land use and land management remained the same as in the previous period.
1986– 1995	The cooperative still existed, but land management was changed by reform policies of the Vietnamese Government. Tools and cattle were returned to the households, which cultivated as individual units. Land was managed by Vietnamese rules and community regulations. Some bans on cultivating in certain areas so households responded by using sloping land areas for “slash and burn.” In this period, Black Thai people in Vang Lung still mainly grew upland sticky rice. Black Thai began to pay more attention to upland maize. Maize seed was mainly the local variety.

Maize Production in Vietnam

Increased demand for domestic maize production has been driven by livestock production in Vietnam, which has developed rapidly during the last 10 years. In Vietnam, processed maize is the primary source of feed for livestock and thus the increased livestock production led to the establishment of new feed processing companies in lowland areas and spurred demand for maize. In response to this demand, maize cultivation areas have increased in both lowland and upland areas.

In 1995, 556,000 hectares (ha) of land was used for maize. By 2004, this had increased nearly 80% to 990,000 ha. The average yield of maize also rose, from 2.11 tons/ha in 1995 to 3.49 tons/ha in 2004. In the Northwest region, the increase in maize plantation areas has been even larger. With the 67,000 ha recorded in 1995, the area has more than doubled to 138,000 ha by 2004. Yields there also nearly doubled, from 1.44 ton/ha in 1995 to 2.78 ton/ha in 2004.

Figure 2. Landscape of Maize-Based Agroforestry in Son La Province

Maize Production in Chieng Hac Commune

Chieng Hac is a poor commune in Son La province where traditional crops were the focus of farming activities for around 1,000 years. Most common was sticky rice grown by using a shifting cultivation system. Crops were generally produced to simply meet daily food needs, but also for a little extra cash. Since 1995, an increasing demand for corn for feed processing has influenced remote villages in the uplands, including Chieng Hac. Some pioneer farmers introduced hybrid maize to the hills to replace traditional crops. Despite many local people in Chieng Hac being unsure about replacing the traditional crops they had grown for so long, the pioneers of hybrid corn farming won. Since 1995, 100 hectares of traditional cropland were transformed to a maize intensive monoculture with support from extension officers and lowland factories.

In comparison to indigenous maize, hybrid maize shows significant advantages in terms of yields and marketability. Local maize varieties give around 2 ton/ha every year while hybrid maize can contribute up to 9 ton/ha in upland areas. On average, with normal fertilizer and common cultivation techniques, farmers in Chieng Hac village harvest 5–7 ton/ha each year. Records show that some 936 ha of maize was

cultivated in 2006, totalling 5,616 tons. By 2006, maize cultivation represented some 91% of the natural land area of the commune, a six-fold increase since 1995, when only 150 hectares of land were used for maize.

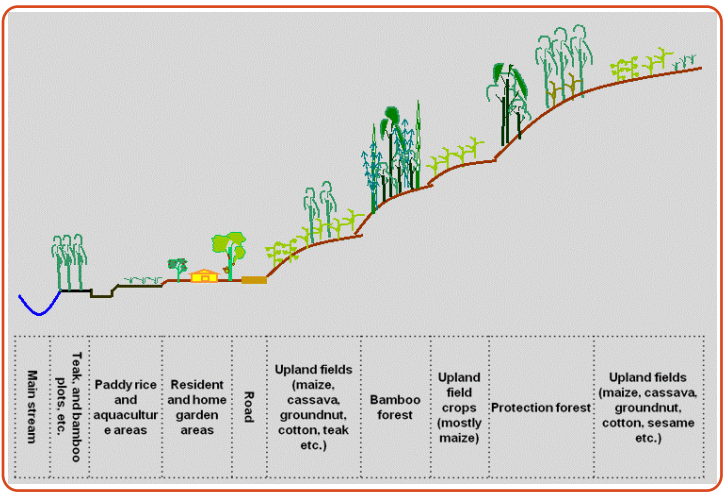

Figure 3. Landscape Transect at Vang Lung Hamlet

The harvesting season stretches from the end of August to the end of October. Local farmers collect corn ears and sell them directly from the field or home. They have no tools to do simple post-harvest processing such as shelling corn, dry seed and storage. Middlemen play the role of market connectors for the buyers and producers from when the maize is still young in the field right through harvesting. They often order corn products from the households in the early planting season. Some of the middlemen provide capital and budget for seed, fertilizer, and even labour costs. With this kind of support and demand for the product, maize areas were enlarged rapidly. Almost all Chieng Hac's forest land areas and traditional croplands were converted to maize production. Daily conversations in the commune revolve around maize topics such as seed, fertilizer, and prices.

Since 1995, demand for corn by feed processing factories has been increasing. The Vietnam Agricultural Study Institute (VASI) and CIRAD (2002) found that animal feed for pigs and poultry, which maize is a basic ingredient for, represents 60–70% of the meat production price. This has led to the price of corn increasing from 1,700 VND/kg in 1995 to 3,200 VND/kg in 2007. Local people have expanded maize fields to the top of the hills and some Hmong people have introduced maize to shifting plots in the forests. A 2007 survey recorded that some 67% of total corn products were sold to the factories through middlemen.

Figure 4. Upland Maize Cultivation at Chiang Hac

In upcoming years, with continued high demand from the market, maize crops may continue to replace other land uses such as forest plantations and remaining natural forest in upland areas. In discussions with key informants, stable yields of corn should be controlled in the study site and high hybrid intensive maize cultivation practices should be applied to reach the highest yield. This would result to high maize productivity using suitable upland areas to cultivate, lessening the need for planting on steep lands that could be used to grow trees.

Table 2. Cash Income Rate of Maize-Based Production, Son La Province

Cash-income sources of the households in Vang Lung Hamlet			
Sources	**Cash income rate (% of total)**	**Mean average cash-income**	
		VND/household/year	**USD/household/year**
Upland maize	80	16,000,000	1,000
Fruits	15	3,000,000	190
Cattle feeding	5	1,000,000	60
Total	**100**	**20,000,000**	**1.250**

Source: Focus Group Discussion exercise and Key interview exercise (2007)

Traditionally, local people in the uplands meet their daily needs and generate cash income by farming paddy rice, upland crops, garden fruit trees, and livestock. Under the recent maize-based production system, income from maize makes up a high proportion of total income. In 2007, a field survey in Vang Lung Hamlet (part of the Chieng Hac commune) recorded that 80% of local people's cash income came from corn production, while fruit and cattle feeding made up the remaining 20%. In comparison to traditional crops, maize has improved income generation for local people in the commune. According to Mr Ha Van Long, Head of Chieng Hac, living standards of local people are better. Today, the mosaic of traditional crops has been replaced by the maize monoculture. As Mr Ha Van Long proudly points out, maize is planted not only in the fields, but covers all the hills and even mountain surfaces. Today, a visitor to the commune will see maize and more maize.

The rapid development of maize production over the last 10 years has contributed greatly to hunger alleviation and poverty reduction in Chieng Hac. However, not long after intensive maize cultivation begun, environmental and social problems occurred, including soil degradation and biodiversity loss through forest cover loss, soil erosion, and overuse of water resources. Though maize has helped solve local unemployment problems and established local markets for agriculture, cultural and traditional cultivation customs have faced negative impacts. As an example, women now have heavier work to do both at home and in the fields. Despite these impacts, smiles and happy faces still appear on the farmers anyway, along with the maize ears, during the main harvesting season every September.

In conclusion, maize production increases in the Northwest region of Vietnam have been driven by the market. It has improved incomes and livelihoods in upland rural villages, and created a new market system. However, it has brought some problems for both natural resource management and traditional cultural practices. These present many new challenges for researchers, authorities, and local people.

Guide Questions

1. What have been the drivers that influenced land use changes in Chieng Hac commune?
2. How has market influenced the current maize-based farming system in Chieng Hac commune? What main aspect of the market is causing the most influence?
3. Do you think the current land use in Chieng Hac commune sustainable? Why?
4. Assuming that the current maize-based farming system in Chieng Hac will continue to exist for several years more, what recommendations can you give to sustain the livelihood of the people and, at the same time, protect the environment around the Da River watershed?

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