

# ASB Lecture Note 1

## **Problem definition for integrated natural resource management in forest margins of the humid tropics:**

### **Characterisation and diagnosis of land use practices**

Meine van Noordwijk, Pendo Maro Susswein, Cheryl Palm,  
Anne-Marie Izac and Thomas P Tomich



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# Towards integrated natural resource management in forest margins of the humid tropics: local action and global concerns

Meine van Noordwijk, Sandy Williams and Bruno Verbist (Editors)

Humanity stands at a defining moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, hunger, ill health and illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well-being. However, integration of environment and development concerns and greater attention to them will lead to the fulfilment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future. No nation can achieve this on its own; but together we can - in a global partnership for sustainable development. (Preamble to the United Nations' Agenda21 on Sustainable Development; <http://www.un.org/esa/sustdev/agenda21chapter1.htm>).

## Background to this series of lecture notes

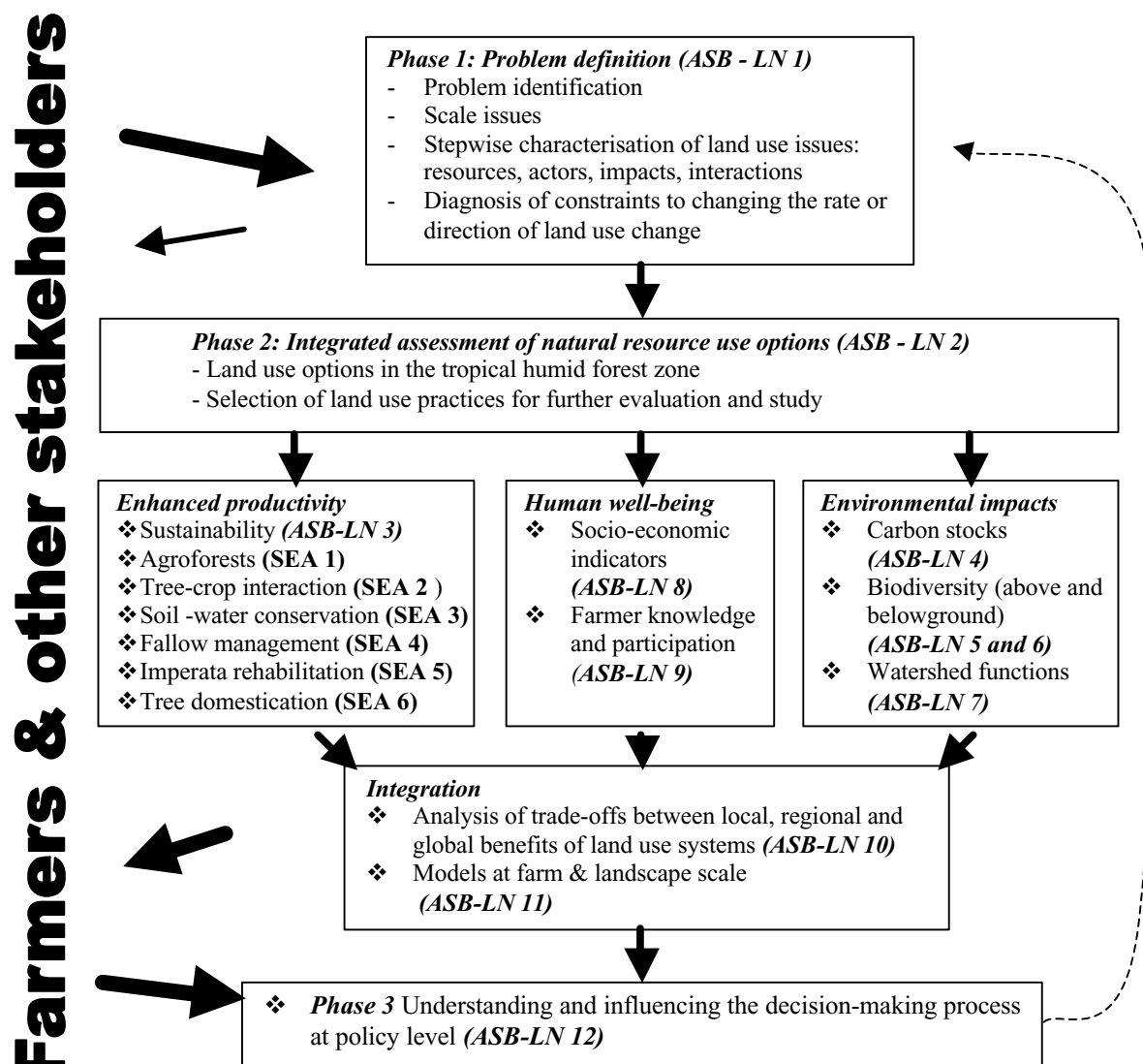
Much of the international debate on natural resource management in the humid tropics revolves around forests, deforestation or forest conversion, the consequences it has and the way the process of change can be managed. These issues involve many actors and aspects, and thus can benefit from many disciplinary perspectives. Yet, no single discipline can provide all the insights necessary to fully understand the problem as a first step towards finding solutions that can work in the real world. Professional and academic education is still largely based on disciplines – and a solid background in the intellectual capital accumulated in any of the disciplines is of great value. If one wants to make a real contribution to natural resource management issues, however, one should at least have some basic understanding of the contributions other disciplines can make as well. Increasingly, universities are recognising the need for the next generation of scientists and policymakers to be prepared for interdisciplinary approaches. Thus, this series of lecture notes on integrated natural resource management in the humid tropics was developed.

The lecture notes were developed on the basis of the experiences of the Alternatives to Slash and Burn (ASB) consortium. This consortium was set up to gain a better understanding of the current land use decisions that lead to *rapid* conversion of tropical forests, shifting the forest margin, and of the *slow* process of rehabilitation and development of sustainable land use practices on lands deforested in the past. The consortium aims to relate local activities as they currently exist to the global concerns that they raise, and to explore ways by which these global concerns can be more effectively reflected in attempts to modify local activities that stabilise forest margins.

The Rio de Janeiro Environment Conference of 1992 identified deforestation, desertification, ozone depletion, atmospheric CO<sub>2</sub> emissions and biodiversity as the major global environmental issues of concern. In response to these concerns, the ASB consortium was formed as a system-wide initiative of the Consultative Group on International Agricultural Research (CGIAR), involving national and international research institutes. ASB's objectives are the development of improved land-use systems and policy recommendations capable of alleviating the pressures on forest resources that are associated with slash-and-burn agricultural techniques. Research has been mainly concentrated on the western Amazon (Brazil and Peru), the humid dipterocarp forests of Sumatra in Indonesia, the drier dipterocarp forests of northern Thailand in mainland

Southeast Asia, the formerly forested island of Mindanao (the Philippines) and the Atlantic Congolese forests of southern Cameroon.

The general structure of this series is



This latest series of ASB Lecture Notes (**ASB-LN 1 to 12**) enlarges the scope and embeds the earlier developed ICRAF-SEA lecture notes (**SEA 1-6**) in a larger framework. These lecture notes are already accessible on the website of ICRAF in Southeast Asia: <http://www.icraf.cgiar.org/sea>

In this series of lecture notes we want to help young researchers and students, via the lecturers and professors that facilitate their education and training, to grasp natural resource management issues as complex as that of land use change in the margins of tropical forests. We believe that the issues, approaches, concepts and methods of the ASB program will be relevant to a wider audience. We have tried to repackaging our research results in the form of these lecture notes, including non-ASB material where we thought this might be relevant. The series of lecture notes can be used as a basis for a full course, but the various parts can also ‘stand alone’ in the context of more specialised courses.

## **Acknowledgements**

A range of investors (or ‘donors’) have made the work of the ASB consortium possible over the past years, some by supporting specific parts of the program, others by providing core support to the program as a whole. These lecture notes build on all these investments, but were specifically supported by the ASB Global Steering Group, with funds provided by the Asian Development Bank, the World Bank via the CGIAR, by ICRAF core funds, by the Netherlands' Government through the Direct Support to Training Institutions in Developing Countries Programme (DSO)-project and by the Flemish Office for Development Cooperation and Technical Assistance (VVOB). Both biophysical and policy research was supported by a Regional Technical Assistance Grant from the Asian Development Bank. Many researchers and organisations have contributed to the development of ideas, collection and synthesis of data, and otherwise making the program what it is today. A team at the International Centre for Research in Agroforestry (ICRAF), consisting of Kurniatun Hairiah, Pendo Maro Susswein, Sandy Williams, SM Sitompul, Marieke Kragten, Bruno Verbist and Meine van Noordwijk developed these lecture notes. A first test of their suitability was provided by a course on ‘Ecology for Economists’ organised by the Economy and Environment Program for Southeast Asia (EEPSEA) program – we thank David Glover, Hermi Francisco and all participants to that course for their suggestions. Key researchers within the consortium provided support and agreed to act as co-authors on the various chapters. Editorial comments on draft forms of the various lecture notes were obtained from Fahmuddin Agus, Georg Cadisch, Min Ha Fagerström, Merle Faminow, Roeland Kindt, Chun Lai, Ard Lengkeek, Jessa Lewis, Chin Ong, Per Rudebjer, Goetz Schroth, Douglas Sheil, Fergus Sinclair, Sven Wunder and others. Overall responsibility for any shortcomings in the lecture notes remains with the editorial team.

## **ASB-consortium members**

Details of the ASB consortium members and partner organisations can be found at:  
<http://www.asb.cgiar.org/>

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## Lecture Note 1

# PROBLEM DEFINITION FOR INTEGRATED NATURAL RESOURCE MANAGEMENT IN FOREST MARGINS OF THE HUMID TROPICS: characterisation and diagnosis of land use practices

By Meine van Noordwijk, Pendo Maro Susswein, Cheryl Palm,  
Anne-Marie Izac and Thomas P. Tomich

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# I. Objectives

- To introduce the issues of tropical forest conversion and rural poverty
- To challenge preconceptions, misperceptions, and overly simplistic views on problem definition
- To provide an understanding of the role of and methods for characterisation and diagnosis of location-specific forms of these general problems
- To introduce the Alternatives to Slash and Burn (ASB) program

## II. Lecture

### 1. Tropical deforestation -- a problem at global scale

We would like to introduce this series of lecture notes on the need and options for integrated natural resource management in forest margins of the humid tropics, by presenting side by side a number of perspectives. The issues will cover

- the need for better ways of dealing with the remaining forest resources in the humid tropics,
- climate change as a development problem,
- perceptions that shifting cultivation is part of the problem.

We suppose that the following list can easily be updated by reading the newspapers, checking WWW sites and following public debate. Please read the following text and try to relate the perspective presented to the source.

#### 1.1 President asks for reform on forest management

The following text is quoted from The Jakarta Post, Jakarta (26 October 2001)

President Megawati Soekarnoputri insisted on Thursday that Indonesian forestry officials and management must reform the entire industry to save the rapidly dwindling forests. During her opening statements at a forestry congress in Jakarta, Megawati lamented the fact that the old management system had allowed corruption and collusion between dishonest officials and timber companies. "To atone for our past mistakes, we will have to show our responsibility to the future generation by greatly improving forest management," she said.

Unchecked illegal logging and a lack of reforestation programs were blamed for the quickly deteriorating forests throughout the archipelago. According to the World Bank, Indonesia lost about 1.5 million hectares of forests on average each year between 1985 and 1997. By the beginning of 2000, Indonesia's forests had been reduced to a mere 20 million hectares, down from pre-1985 levels of nearly 43 million hectares.

Government officials are being blamed for the decrease along with farmers who employ slash-and-burn techniques in addition to a large group of illegal loggers. Non-governmental organisations point their finger primarily at companies engaged in illegal logging and their collusion with government officials for the problem.

Megawati stated that the era when forests were a major source of state revenue and livelihood for many people is over. The President said that mismanagement and the lack of proper planning with reforestation programs had ended it all. "The result of (mismanagement and corruption) is that we now face immense losses to the state budget

and a great number of people have been deprived of their livelihood," she said. "Whatever our excuse is, the over-exploitation of forests has turned vast forested land into grassland and devastated the ecosystem."

The President said that outside Java, problems such as illegal logging, encroachment and land clearing for plantation projects continue unabated. In densely-populated Java, it is difficult to protect the remaining patches of forested land. "We should keep in mind that the weaknesses in planning and co-ordination among related agencies has contributed to the loss of our forests," she said. The congress, held by the Ministry of Forestry, was attended by government officials, environmentalists, forestry experts and other forestry stakeholders.

## 1.2 Fifteen Countries Hold Key to Saving World's Forests

Copied from <http://www.ens-news.com/ens/aug2001/2001L-08-20-06.html>. The full report, "An Assessment of the Status of the World's Remaining Closed Forests," is available at: <ftp://www.na.unep.net/pub/closedforest/>

**LONDON, England**, August 20, 2001 (ENS) - Efforts to save the world's last, critically important forests, should initially focus on just a handful of countries, a new report has found. A unique satellite based survey of the planet's remaining unbroken forests, which include virgin, old growth and naturally regenerated woodlands, has found that more than 80 percent are located in just 15 countries.

The United Nations Environment Programme (UNEP), one of the key organisations behind the report, believes that targeting scarce conservation funds on these 15 key countries may pay dividends in terms of environmental results. "We have found that 80.6 per cent of the WRCF [world's remaining closed forests] are located in 15 countries," said Ashbindu Singh, regional coordinator at UNEP's Division of Early Warning and Assessment. "These are Russia, Canada, **Brazil**, the United States of America, **Democratic Republic of the Congo**, **China**, **Indonesia**, **Mexico**, **Peru**, **Colombia**, **Bolivia**, **Venezuela**, **India**, Australia and **Papua New Guinea**. Four are in industrialized countries and 11 are in the developing world."

The survey also reveals that **outside** pressures from people and population growth on most of these remaining closed forests, such as those in Bolivia and Peru, are low. Others, such as the remaining closed forests in **India** and **China**, are under more pressure from human activity and may require a bigger effort to conserve and protect, the report concludes. But overall, an *estimated 88 percent of these forests are sparsely populated*, giving focused and well funded conservation efforts a real chance of success, the authors said.

The findings have come from UNEP scientists working with researchers from the U.S. Geological Survey and National Aeronautics and Space Agency (NASA). "***The importance of healthy forests cannot be underestimated***," said Klaus Toepfer, executive director of UNEP. "Forests are vital for the well being of the planet. They provide a variety of ***socioeconomic and ecological goods and services***." These include watershed management, with forests regulating the quantity and quality of rainwater discharging into rivers, Toepfer noted. Intact forests also help counter soil erosion and the spread of deserts, and play a vital role in reducing the impacts of climate change by soaking up carbon from the air. "Forests also harbor some of the world's most precious and endangered wildlife, provide food and medicines for many local communities and indigenous peoples across the globe and support ecotourism, which can be economically important, especially in developing countries," added Toepfer.

Despite numerous international conferences, conventions and agreements aimed at protecting forest resources - including the Forestry Principles, drawn up during the Earth Summit in 1992, and the Convention on Biological Diversity - forests around the globe remain under increasing threat, the report finds. "Short of a miraculous transformation in the attitude of people and governments, the Earth's remaining closed canopy forests and their associated biodiversity are destined to disappear in the coming decades," Toepfer warned. "Knowing it is unlikely that all forests can be protected, it would be better to focus conservation priorities on those target areas that have the best prospects for continued existence. I believe this new study provides this new focus. I urge governments, communities and international organisations to act on our findings and recommendations."

The report, which the authors claim is the most comprehensive and reliable assessment ever made of global forest cover, uses satellite information to identify the extent and distribution of the world's remaining closed forests. These are defined as forests with a canopy closure of more than 40 percent. Forests biologists consider such a level of canopy closure to be vital for forest to remain healthy and able to perform all their known environmental and ecological functions. Such forests are also home to some of the world's rarest and most unique species including the elusive cloud leopard of Russia and the lion tailed macaque of the Western Ghats in India. About 88 percent of the closed forests in the key 15 countries contain low to non-existent human populations, but population pressures are high in India and China.

The report, "An Assessment of the Status of the World's Remaining Closed Forests," argues that it is vital to act now to protect these last important forests. "The low population densities in and around the majority of the WRCF areas offer an excellent opportunity for conservation, if appropriate steps are taken now by the national governments and the international community," the report authors write. "The cornerstone of future policies for the protection of WRCF should be based on protection, education and alternatives to forest exploitation." The report finds that remaining closed forests in Venezuela enjoy the highest level of official protection, with 63 percent in protected areas. No other country protects more than 30 percent of its remaining closed forests.

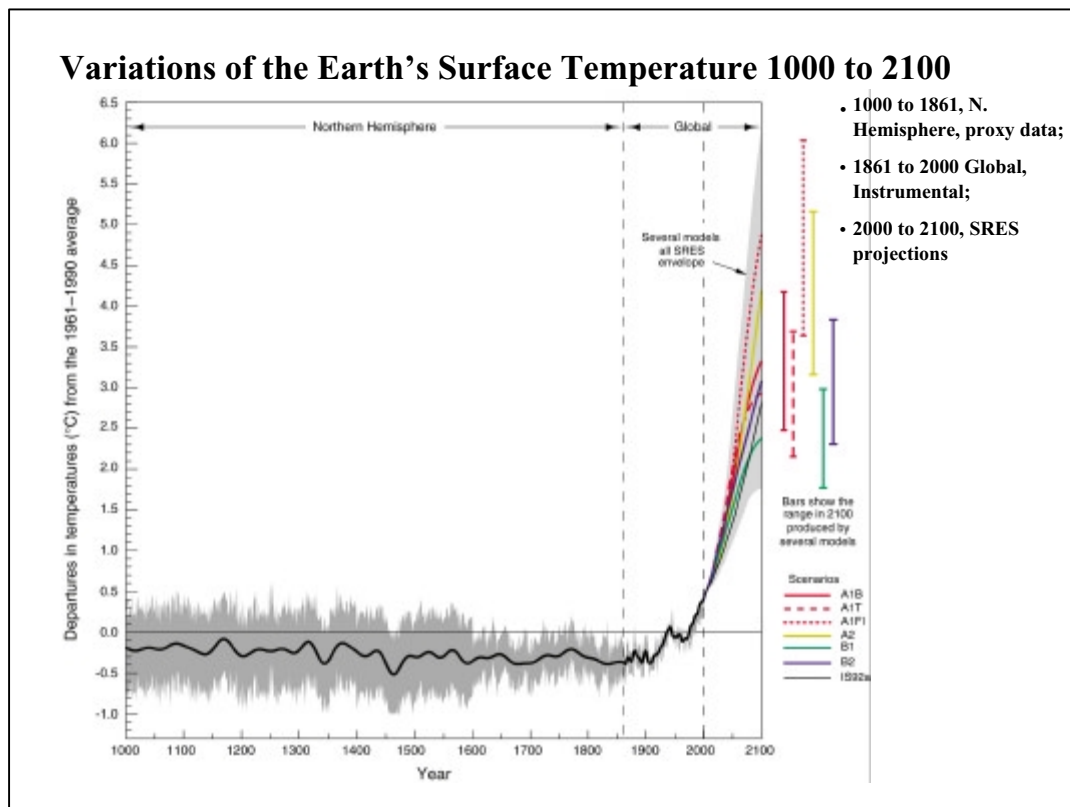
Among the 15 key countries identified in the report, Russia has the lowest level of protection with just two percent. Mexico came in second, protecting three percent of its forests, and China, which currently protects 3.6 percent of its intact forests, ranked third. In North America, Canada protects 7.4 percent of its remaining forests, which cover just over 37 percent of its land area. In the United States, where about 25 percent of the nation is under closed forests, just 6.7 percent of forested land is protected.

The UNEP report calls on governments in the key 15 countries to draft action plans detailing how they propose to conserve their remaining closed forests. The level of protected areas also need to be sharply increased, and backed by tougher policing of such sites including crackdowns on smuggling and poaching of trees and wildlife. The report also calls for road and dam construction to be subject to "rigorous scrutiny," and recommends that conversions of forest land to other uses only be allowed after other alternatives are exhausted. Wealthy countries should invest in the protection of the last remaining closed forests situated in poorer countries, the report notes. Debt for nature swaps, in which developing country debts are reduced by industrialized countries in return for closed forest protection, should be vigorously encouraged, the report recommends.

### 1.3 Climate change is a development problem

The following text is quoted from "Climate Change and the CGIAR" by Dennis Garrity and Myles Fisher, a report of the CG InterCenter Working Group on Climate Change (October, 2001).

The Third Assessment Report of the International Panel on Climate Change (IPCC) leaves no doubt that the Earth's climate is changing, and it is changing as a result of human-induced activity. The reports of three Working Groups were published in July 2001. In brief, the last sixty years were the warmest in at least the last 1000 years (Figure 1); patterns of precipitation are changing with a greater incidence of both floods and droughts.



The Third Assessment Report concluded that the observed changes cannot be explained by natural phenomena and that there is now a clear evidence of human influence. The question is not whether or not the climate is changing but by how much will it change, how soon and where will the damage be greatest.

Climate change will impact disproportionately on poorer countries. The poorest people in those countries will suffer the greatest consequences. Those least able to cope will be hit the hardest. Economic activity in these countries is principally rural-based, relying on agriculture, fisheries and forestry, which are vulnerable to the effects of climate change. It is the poor in the developing world that the CGIAR and its partners champion. It is they who will see the possibilities of escape from poverty become increasingly more difficult to achieve due to climate change brought about almost entirely by other, richer, people living elsewhere.

There are determined efforts to place climate change more centrally within the context of sustainable development, and to assess its linkages with the other global environmental issues. There is also increasing emphasis on the regional aspects of

climate change. These trends make research vital. The repositioning of agricultural systems and forestry in developing countries in response to climate change is not currently part of the international agricultural research agenda.

Climate change will cause many places to encounter climates that do not exist today. Varieties of food crops adapted to these new climates will be needed, although many crops in the tropics are already at or above the temperature thresholds at which yields decline seriously. The effects of temperature and rainfall are anticipated to be different among regions. The needs will be different in parts of Southern Africa and the Mediterranean region, which are anticipated to be both hotter and drier than at present, than in Central Africa and other tropical regions where increased temperatures will predominate.

## 1.4 We have started a new geological era: the anthropocene

Mankind is rewriting geological history and there are serious proposals to consider that we have now entered the 'anthropocene'. The term was proposed by Prof. Creutzen (atmospheric chemist and Nobel price winner for Chemistry). School books on geology will have to be revised:

Period	Epoch	Million years before present	Climate, dominant life forms
Quaternary	<i>Anthropocene</i>	0.000001	<i>For the first time in geological history a single species, Homo sapiens, modifies global climate (by recycling of stored carbon in fossil reserves and vegetation)</i>
	Holocene	0.000001 - 0.01	Generally benign climate; rise of humans; domestication of plants and animals; extinction of many genera of large mammals
	Pleistocene	0.01 - 1.6	Great climatic fluctuations, four major ice ages in Eurasia, evolution of genus <i>Homo</i> ; extinction of many genera of large mammals
	Pliocene	1.6 – 5	Cooler, drier climate, widespread savanna conditions in what used to be humid forests
Tertiary	Miocene	5 – 26	Relatively warm and wet; Great diversification of mammals; Hominidae (human-like apes) first appeared
	Oligocene	26 – 38	Warm climate; diversification of mammalian herbivores; first monkeys and apes
	Eocene	38 – 54	Climate warm and wet; southern continents separated from northern
	Paleocene	54 - 65	Mild climate; diversification of mammals
Cretaceous		65 - 140	flowering plants become dominant; dinosaurs reached peak and became extinct
Jurassic		140 - 200	Dinosaurs larger and specialized; first primitive birds and mammals
Triassic		200 - 245	First dinosaurs; conifers dominant plants
Permian		245 - 290	
Carboniferous		290 - 365	Extensive coal-forming forests with first coniferous trees
....		.....	.....

## **1.5 Democracy or Carbocracy? Intellectual corruption and the future of the climate debate**

The following quotes may represent a view that the link between tropical forest issues and climate change is misrepresented and overstated, and that once again tropical countries are dominated by the rest of the world. The full text, submitted on October 2001 by The Cornerhouse, can be obtained from:

<http://cornerhouse.icaap.org/briefings/24.pdf>

“When diplomats emerged from their conference rooms in Bonn on the morning of 23 July this year (2001) to announce that they had reached agreement on how to tackle climate change, many environmentalists cheered. After being disappointed by the collapse of the climate negotiations last November in The Hague, and by US President George W. Bush’s rejection of the Kyoto Protocol in March, they were ready to celebrate. The jubilation seemed justified. Global warming is a matter of over-whelming importance. Keeping worldwide negotiations going seems critical. If nothing else, the Bonn agreement signaled that most of the world’s governments recognize that climate change is a problem and are eager to be seen to be doing something about it. Yet a soberer look may be needed. A decade ago, international climate talks could still be said to be, in part, an environmentalist initiative. But how much of that agenda remains in today’s negotiations? Many observers complain that the talks leading up to Bonn were antidemocratic and scientifically bankrupt. The truth is even worse. They were also, in many ways, counterproductive. Contrary to popular impression, most climate negotiators no longer bother discussing how to make deep cuts in fossil fuel emissions. Nor do they talk seriously about how to share the world’s limited carbon-cycling capacity. Nor do they scrutinize the underlying causes of global warming. Nor do they support the most important existing efforts to adapt to it.

Instead, they squabble over calculations they should know are unscientific — such as how much fossil fuel emissions they might claim that trees are “neutralizing” through photosynthesis. They argue over who is to receive the spoils of “climate mitigation” activities whose fraudulence is well-established — such as subsidies for tree plantations or coal-fired power plants. They lay plans for a carbon market which has no viable accounting system and which would redistribute air and land from poor to rich. Such cynical games have usurped years of negotiations. The same effort could have been more prudently devoted to practical means of addressing global warming and its effects.”

## **1.6 Slash-and-burn as the culprit?**

There is a long history to the view that shifting cultivators and slash-and-burn farmers are a major part of the deforestation issue. We have selected 10 abstracts from publications of the last 120 years about these issues in Indonesia, and ask you to try and link them to different time periods in the form of a quiz.

===== QUIZ =====

### What is new in views on forest conversion in Indonesia

=====

The following texts are abstract from articles published in Indonesia in:

1	2	3	4	5	6	7	8	9	10
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- |                   |
|-------------------|
| a. 1880-1920      |
| b. 1920-1945      |
| c. 1945-1970      |
| d. 1970-1995      |
| e. 1995 - present |

#### *1. Agricultural and economic surveys done by the forest service in the 'Outer Islands':*

Preparations for the agricultural 'colonisation' of (c.q. 'transmigration' to) the Outer islands, in particular South Sumatra. Most of the land available for colonisation is administered by the local communities, who generally are reluctant to give up the land, because it is needed for the extensive system of shifting cultivation. Intensification of the agricultural system would make more land available for colonisation. Agricultural and economic surveys are necessary as a basis for planning better land use, hydrological reserves etc. the surveys should be done co-operatively by the forest Service, the Civil Service and the Agricultural Extension Service. District authorities are very important in this work because of their local knowledge.

#### *2. Questionnaire by the Commission of inquiry into the problem of shifting cultivation:*

An inquiry is to be conducted among the officials of the Civil service, the Forest Service etcetera to collect information about shifting cultivation. The article gives the reasons for the inquiry and gives an example of the questionnaire.

#### *3. Forest reserve, agriculture and national prosperity:*

A proposal is made to add land, which has not as yet been reclaimed, to the forest reserves. When necessary it can be designated for reclamation. As a consequence, the boundaries often have to be modified. By limiting the amount of reclaimable land the local population is forced to intensify agriculture. This will have a favourable effect on national prosperity.

#### *4. Deforestation in Deli (North Sumatra):*

Predatory exploitation for the cultivation of tobacco has deprived Deli of its forest, leaving only plains of *Imperata* grassland (alang-alang).

#### *5. 'The Ladang problem in Indonesia':*

The article describes the nature of shifting cultivation (*ladang*) and measures to be taken to control erosion. Normal shifting cultivation in a primitive economy is a logical and justifiable agricultural system, provided that enough time is allowed for proper restoration of the natural fertility. A change in the social conditions brought about by the 'reclamation' of the ladang area, population increase or increase in demand disturbs the



normal process of shifting cultivation. If the population density becomes more than about 50 persons per km<sup>2</sup>, shifting cultivation has to be intensified, i.e. systematically developed into a permanent form of agriculture. At present one-third of the food produced in the 'Outer Islands' originates from shifting cultivation, which needs an area of 8 million ha, but has to be extended if the present form of shifting cultivation is to be maintained. A failure to intensify will bring about a social problem i.e. accelerated soil erosion which could wipe out a well developed agricultural soil layer within 20 years. Erosion control needs combined efforts and appropriate legislation, but it is most important to give information and guidance to the population; the smallest unit for erosion control should be a catchment area. The development of permanent agriculture is a matter of individual operational ability in which social, religious and land ownership aspects play an important role. In this development more officials will be appointed to supervise the development process so that erosion control, agricultural development and other related matters can take place simultaneously. The basic solution to the shifting cultivation problem is the establishment of mixed farming units in which animal husbandry draught animals, manure production, small livestock) can be practised. For this purpose a study has to be initiated concerning the ecology, taxonomy and nutritional potential of various grasses, the management of grazing lands and management of mixed farming units themselves.

#### 6. *'The Ladang problem':*

A description is given of the general system of shifting cultivation and the harmful ecological consequences when it is not properly managed. In the Pasemah highlands, because of the increase in population, the rotation in the system of shifting cultivation has been gradually shortened and finally the ladang fields are turned into large areas covered with grasses, ferns and useless shrubs. The 'adat' community ('adat' is customary law) has responsibility for proper land management. However, the 'adat' does not prescribe a proper maintenance of the soil, it only deals with the rights of the individual to reclaim land and it also prescribes the period that the ladang may be exploited, before the ladang is taken back by the 'marga' (adat community). The government should not leave the maintenance of soil and soil productivity to the individual. The government, up till now, has not taken measures to prevent the damage done by shifting cultivation. It is necessary to find local solutions, which can consist of, for example: 1) strict prohibition of shifting cultivation; 2) local prohibition of shifting cultivation and at the same time extension of the areas suitable for intensive agriculture (sawah's) by improving and extension of irrigation works; 3) the 'marga' authorities should have the responsibility of regulating shifting cultivation, supported by adequate information on the subject, and they should prescribe and regulate a periodical exchange of areas destined for reclamation; 4) individual obligation of each ladang farmer to replant the ladang with wood species and to use green manure; 5) appointment of officers (mantris) in several regions to help farmers improve the cultivation of ladangs and supply them with seeds for reforestation or for planting of green manure. According to the author, only solutions 2, 3 and 5 should be considered. Local economical and political circumstances will dictate the best solution.

#### 7. *'Extract from the report of the 'People's Council':*

The local population was given permission to reclaim forest areas because of the scarcity of food in the previous year. These forests and coffee reserves can only be used temporarily and must be returned in due course to the Forest Service.

#### 8. 'Forest destruction through shifting cultivation':

Shifting cultivation is the most noxious form of overcropping. Extensive forest areas are felled and burnt to cultivate one or two crops. Regeneration and humus formation are impeded by shifting cultivation. The final result is that many soils have become sterile and hydrological problems have arisen. Shifting cultivation is very dangerous, particularly when the rotation is too short. No more land should be issued to the farmers, because a more intensive cultivation (irrigated rice or *sawah*) is possible, at least when the population is really forced to do so, as was the case in the Karoo plains in Sumatra. In the existing forests, the local population must be prohibited from felling trees. The government should provide the farmers with fertiliser eventually below the cost price; agronomists should be appointed to help the farmers in their agricultural practices. The rampant growth of *Imperata* fields (known as *alang-alang*) can be combatted in the following way: in the first year the fields should be regularly rolled with heavy trunks to make the alang start to rot, this forming a humus layer; after some time green manuring crops should be sown. Sufficient fire breaks must be established to prevent the spread of possible fires. In the second year rice should be planted, preferably with some intercrops. In the following year a soil-improving crop should be sown again and the area should be left alone. The following year the field can again be cropped with food crops, and so on.

#### 9. The rapid destruction of the forests in the 'Outer Islands':

The forests of the Outer islands are rapidly devastated as a consequence of shifting cultivation. Data are presented to illustrate the problem. Intensification of agriculture is suggested as the solution. Aerial reconnaissance and survey is proposed in order to assess the real situation.

#### 10. Shifting Cultivation:

Because estate agriculture and forest reservation have reduced the free forest area, shifting cultivation is causing problems. The policy concerning shifting cultivation differs greatly between regions. The article covers principles of shifting cultivation on different soil types and the consequences for the re-vegetation with secondary forest and the values of forest for hydrology and wood production. From an economic viewpoint, the population should be convinced of the advantages of permanent agriculture over shifting cultivation. If the rotation period is too short, shifting cultivation may destroy the forest and soil capital. The local interests of the shifting cultivators conflict with the interests of the hydrology and wood supply of a much larger region. Because the forest reservation reduces the area available for shifting cultivation, no more should be reserved than absolutely necessary. Forest reservation has to be completed as soon as possible. The Agricultural Extension Service has to pay special attention to intensifying agriculture in regions where shifting agriculture is common.

In the discussion following this lecture the following opinions were expressed: the effectiveness of adat regulations is questionable; only if regular fires occur, alang-alang fields rather than forest appear after shifting cultivation; the shifting cultivation fields are not abandoned because of soil exhaustion but because the weeding becomes too time-consuming; the appearance of pests and diseases can also be important; the value of a certain area depends not only on the quality of the soil, but also on its proximity to the village; the use of green manures stimulates natural reforestation; at the end of the discussion, a special commission is set up to study shifting cultivation and related problems; it has to report after two years.

**Answer** -- Numbers refer to 'Indonesian Forestry Abstracts, Dutch literature until about 1960'. All these articles were written before Indonesia's Independence Declaration in 1945, so they are more than 50 years old. What's new in discussion on agriculture in relation to forest conversion? Only the terminology or do we have really new solutions?

1. 5392 – 1937, 2. 5411 – 1931, 3. 5422 – 1912, 4. 5423 – 1886, 5. 5424 – 1940, 6. 5427 – 1925, 7. 5430 – 1920, 8. 5433 - 1921/1922, 9. 5445 – 1937, 10. 5453 - 1931

## 1.7 Outline of this lecture note

In this opening lecture note we will cover a number of aspects that may appear unrelated at this stage, but that we hope will set the scene for the following lecture notes. We will first consider how research can or has to challenge existing perceptions of problems in order to make progress and describe steps that are taken in the research cycle. As this series of lecture notes is focussed on the margins of tropical forests, we will discuss the nature of this 'margin' – is it abrupt or gradual? . Throughout the lectures we will consider different 'scales', and we will discuss the various concepts of scale that are used in debates on natural resource management. We will then introduce the 'Alternatives to Slash and Burn' (ASB) program, as it was developed to find solutions for the problems of tropical forest conversion, rural poverty and environmental impacts. In this lecture note we will end with the steps that the ASB program suggests to come to a characterisation and diagnosis of the location-specific form of these general problems.

**ASB** -- <http://www.asb.cgiar.org/>

The Alternatives to Slash and Burn (ASB) program researches two interlinked, global problems: environmental effects of *tropical deforestation* and persistent *rural poverty* in the tropics. It aims at identifying and promoting innovations to reduce poverty and conserve tropical forests, through a global partnership of over 50 institutions around the world.

Of course, the rural poor are not alone in using slash-and-burn to convert rainforests to other uses. Slash-and-burn is used by virtually everyone who contributes to rainforest conversion—public and private, large scale and small-scale, rich and poor—because fire is the most effective way to clear land. So, for a start, we need to distinguish between slash-and-burn as a *method* for initial land clearing and slash-and-burn as a *land use system* i.e. a form of shifting cultivation or long-fallow rotation.

## 2. Researchable problems – challenging the perception of problems

The previous section and a discussion of current views on the topic may give a picture of an alarming rate of environmental change in the tropical forest areas, potentially threatening to the world as it is today. That change may represent 'development' to some, it may represent 'destruction' to others, or the need for 'better natural resource management' to a group in between. In these lecture notes we will introduce ways to further analyze the issue, search for solutions for current conflicts, and challenge existing perceptions of the problem. We'll start with the latter.

## 2.1 Do we need research on the deforestation problem?

The world is full of problems: poverty and lack of food security, deforestation, environmental degradation, unequal access to resources and to sustainable livelihood options, to name but a few. These big problems tend to be connected, and we cannot expect to solve problems caused by conversion of tropical forests without considering the connections to poverty and livelihood issues.

Yet, initial perceptions of such connections may be overly simplistic. We need to challenge our conceptual model of these relationships in order to capture the views of all the various groups of people involved (stakeholders), to get the story right, before we can expect to work towards solutions.

Stated simply, research is a process involving formulating an initial perception of a problem, gathering appropriate evidence to test, corroborate or modify this perception, and drawing conclusions about the problem and its possible solution. It is a continuous process, involving several steps and interactions between these steps. The main challenge is to remain critical of one's own perceptions, and to keep learning from situations where the real world differs from the elegant perceptions we may have phrased.

## 2.2 Why research? Can't we just apply what we already know?

People do research for different reasons. These vary from trying to make new discoveries about certain concepts or phenomena, testing existing and/or new hypotheses or theories, to finding solutions to perceived development problems. A cynical view is that research may form an excuse not to take action as yet, as the problems are not yet sufficiently clear...

Why do **you** want to do research? What do **you** want to learn? Which of **your** elegant perceptions do you want to risk by confronting them with data collected 'out there'?

A schematic view of the research process in its general outline is summarised in Figure 2. In this figure, notice how the research process often starts with the identification of a **problem** that involves a contrast between the current situation in the 'real world' and what is seen as desirable, or possible in the 'mental model' and value system of people who can start research. In practice this also means that research has to start with identification of a problem that is large enough to get attention and obtain research funding. Target groups and other stakeholders are normally involved in the identification of researchable problems, especially if the problems are complex and the likelihood of 'impact' in the end means that a large sense of 'ownership' is needed. Yet, such ownership may lead to preconceived notions of what the outcomes are likely to be that defy the objective of the whole effort. Once the general problem has been identified with all relevant stakeholders, the research can follow a logical sequence of steps. Researchers' observations of the world around them, the views of farmers, policy makers, or outsiders should be combined with the existing body of knowledge of different phenomena, issues and concepts, in order to 'frame' the problem.

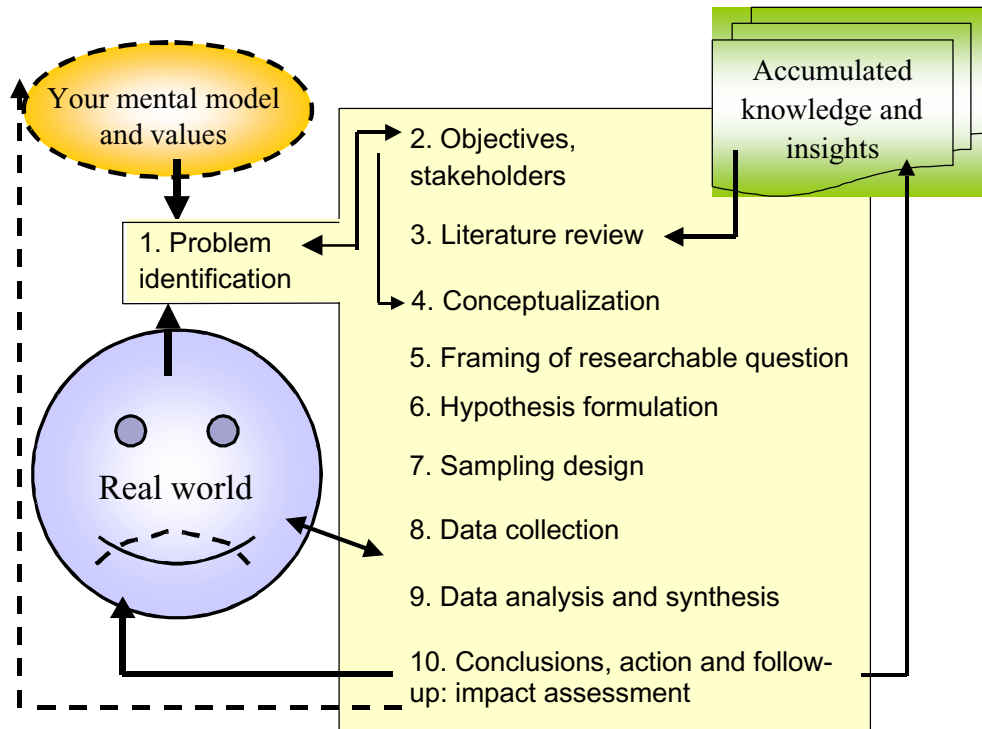


Figure 2. Schematic view of the research process and the way it spans the 'real world', personal perceptions and valuations of the world, and the accumulated knowledge and insights that are part of the intellectual capital of humankind.

The choice of research topics is thus influenced by the researcher's perception of problems in the 'real world', his/her knowledge, opinions, beliefs, interests, and constraints, among others. A researcher should try to look at things from different perspectives and phrase the problem in a way that it can be challenged by real world observations and by other researchers. Box 1 gives an example of the need to challenge one's own (outside) perspective.

Research questions can be derived in two contrasting ways:

1. Starting with 'big issues' such as poverty and deforestation and working your way down to the local manifestations and causes,
2. Starting from a local perspective in a specific site, and working your way up to the global issues that influence the options available locally.

The real challenge is to connect these two approaches.

### BOX 1. 'Conflicting Perceptions'

Is your selected research problem a problem in reality?

**Do Land use Changes in the Himalayas Affect Downstream Flooding? – Traditional Understanding and New Evidence** (This example builds on the analysis by Hofer, 1998).

Every year during the monsoon season, the Himalayan region appears in the headlines because of large-scale flooding in the plains of the Ganga and the Brahmaputra in India and Bangladesh. Peasants in and around Nepal are being blamed for the floods. They are blamed for causing deforestation in the Himalayas, which leads to devastating inundation, particularly in Bangladesh. The hypothesis regarding the impact of human activities in the Himalayas on the ecological processes in the lowlands can be summarised by the following (superficially convincing) sequence: population growth in the mountains – increasing demand for fuelwood, fodder and timber – uncontrolled forest removal in more and more marginal areas – intensified erosion and higher peak flows in the rivers – severe flooding and siltation on densely populated and cultivated plains of the Ganga and Brahmaputra. These apparently convincing conclusions have been subscribed to too carelessly by some scientists and adopted by many politicians and journalists in order to identify the so-called culprits (Hofer, 1998).

The following paragraphs show how different people view the same environmental issue (floods) from very different perspectives.

1. **Farmers** – the people affected:

- not interested in knowing whether it is the Himalayas or the Meghalaya Hills which are responsible for the floods
- view floods as just part of the life to which their ancestors, and they themselves, have learnt to adjust.

This view is reflected in one of their local sayings, 'People do not die if there are floods, people die if there are no floods.' No floods mean no crops, as floods bring fertile soils, which sustain crops, to their farms. The main problem for them is actually river erosion, which takes away the fertile silt.

2. **Politicians** – the decision-makers:

- believe floods are a problem because of the suffering they bring to people
- believe floods should be solved/eliminated by large projects involving expensive foreign aid.

3. **Engineers** – the ('scientific') solution providers:

- floods are simply a problem of high water volume, to be controlled by technical measures (for example, dams).

4. **Journalists** – the reporters of floods to the rest of the country and world:

- floods provide dramatic headlines, good for selling their story
- western media believe floods are the main problem in Bangladesh. Not the case!
- foreign media tend to misrepresent the real environmental problem in Bangladesh, that of river erosion, by not giving enough coverage to it
- the media in Dhaka (the capital city) reports on the real problem of river erosion, which the foreign media tends to miss.

- **Suggested group work:** this case can be used for a role-play where four groups adopt different perceptions on an issue. A team of students (group 5) is sent out to interact with them. This example can be adapted to local conditions and to a local environmental issue. Discuss the findings.

### Box 1 (Continued)

#### Lessons:

- While formulating your research problem, conduct a literature review, identify all the stakeholders and search for conflicting information and contrasts in views and perceptions. Analyse the different perceptions of your identified ‘problem’. Characterisation during the research design process will be helpful in identifying the different stakeholders and their interests in, and views on, your selected issues/‘problem’. Some ‘problems’ may disappear like snow under the sun once you start to look closer – other problems are like chameleons and change colour...
- Be open-minded and approachable. Learn to listen to the different views presented to you with an open mind, otherwise you might miss very important information necessary for the research. Different people may have totally different perceptions on the same issue; hear them out.
- Be flexible and patient. Research is a continuous, changing process, so be ready to change the different steps of the research as necessary. The objectives of your research should not be ‘cast in stone’ but instead should be flexible, as they may have to be changed, depending on what is found out during the course of the research. The research design is supposed to help in identifying the need for changes in the research process, and these changes may be necessary at any stage of the research.

## 2.3 Research steps (see Figure 2)

1. *Problem identification/formulation* - identifying phenomena that one wants to investigate. This is the ‘what’ of the research.

In the ASB project, the problem is the conversion of tropical humid forests globally, especially where this conversion leads to unsustainable land use practices. According to some data sources, slash-and-burn agriculture (shifting cultivation) accounts for about 50% to 75% of the 17 million hectares of tropical moist forests currently destroyed every year. Tropical deforestation is responsible for 18% of current carbon emissions (linked strongly to global warming), for sustained loss of plant and animal genetic diversity, and for threatening the stability of many watersheds.

More specifically, the ASB project started from the observation that “Rates of deforestation have doubled over the last two decades. They are likely to continue increasing. Pioneer shifting cultivation is a consequence of complex socio-economic factors that drive poor farmers and migrants into the forest margins. Sustainable alternatives to slash-and-burn would enable millions of poor farmers to make an adequate living without destroying additional forests. Research conducted at several locations for many years shows hope that for every hectare put into promising alternatives, five to ten hectares of tropical rainforest can be spared from the shifting cultivator’s axe every year”.

So the questions are *who* and *where* are the practitioners of ‘unsustainable slash and burn’ farming? *Why* do they continue this activity? *When* do they operate? Are there alternative land use practices that can help to solve or at least to reduce the problem?

**2. Objectives** – defining the aim of the research. This is the ‘why’ of the research. The objectives of the research are generally dependent on the researcher’s knowledge, constraints (financial, institutional or other), opinions, and beliefs, to name but a few. Objectives should be ‘broadly defined’ during the initial stages of the research to allow for alterations if required.

The initial set of objectives of the ‘Alternatives to Slash-And-Burn’ (ASB) project was “to reduce the rate of deforestation caused by slash-and-burn agriculture, rehabilitate degraded lands resulting from slash and burn and improve the well-being of the slash-and-burn farmers by providing alternative land use practices”.

The general research activities and questions that follow from this objective are:

- to assess the principal socio-economic and biophysical processes leading to deforestation, including government policy and decision-making patterns of farmers practising slash-and-burn
- to identify appropriate technologies and develop improved production systems that are economically feasible, socially acceptable and environmentally sound alternatives to current slash-and-burn
- to quantify the contribution of slash-and-burn agriculture and alternative land use practices to global, regional and local environmental changes, such as climate change, biodiversity, watershed quality and land degradation, to identify policy options and institutional management issues that facilitate the adoption of the improved systems and also discourage further deforestation.

**3. Literature review** – analysis of existing literature. This is an important step in the research process where the researcher reads and reviews existing literature in the same or similar field. The purpose of reviewing literature is to increase one’s knowledge of the research topic and to become familiar with any new developments in the field. Reviewing existing literature can help the researcher improve on his/her methods, ask the “right questions” and determine whether the “right answers” already exist, thus avoiding pitfalls by learning from others’ mistakes. Literature review also involves relating one’s research to the existing body of knowledge, identifying differences and similarities and the relevant linkages. We should stress here that for many issues in natural resource management recently published literature in internationally recognised journals is only a part of the material of interest. Much current work of relevance may exist only in the form of ‘grey’ literature, reports in a local language, theses contained in university libraries, or archives. As the citations in section 1 of this lecture note may show, both the old ‘colonial – days’ literature and current WWW sites may contain valuable insights. A very important aspect of ‘literature review’ is that of identifying contrasting views (‘mental models’) on the same issue, and not just the compilation of facts. The contrasting views should be articulated so that they may help in sharpening one’s own research questions.

**4. Conceptualisation** - ‘Concepts’ have different meanings, depending on the context within which they are used. In order to make sense for the research, the different concepts should be defined within the research context. The term ‘slash-and-burn’, for example, can be used to describe a land clearing method, or an agricultural system (shifting cultivation) in which land is cleared, used then left fallow, while another area is cleared. Conceptualisation draws up the theoretical framework of the research, based on available theoretical information about the research field (and/or topics), and what has been done / is being done by other researchers.



For example, the initial conceptual framework of the ASB project (Figure 2), put farmer decision-making as the central issue, recognizing that these decisions are based on resources (opportunities) and constraints, with policy potentially influencing both. Farmer decisions lead to specific land use systems, some of these leading to ‘degradation’, others to ‘sustained and/or increased production’. The aim is to get more of the ‘good’ and less of the ‘bad’ practices...

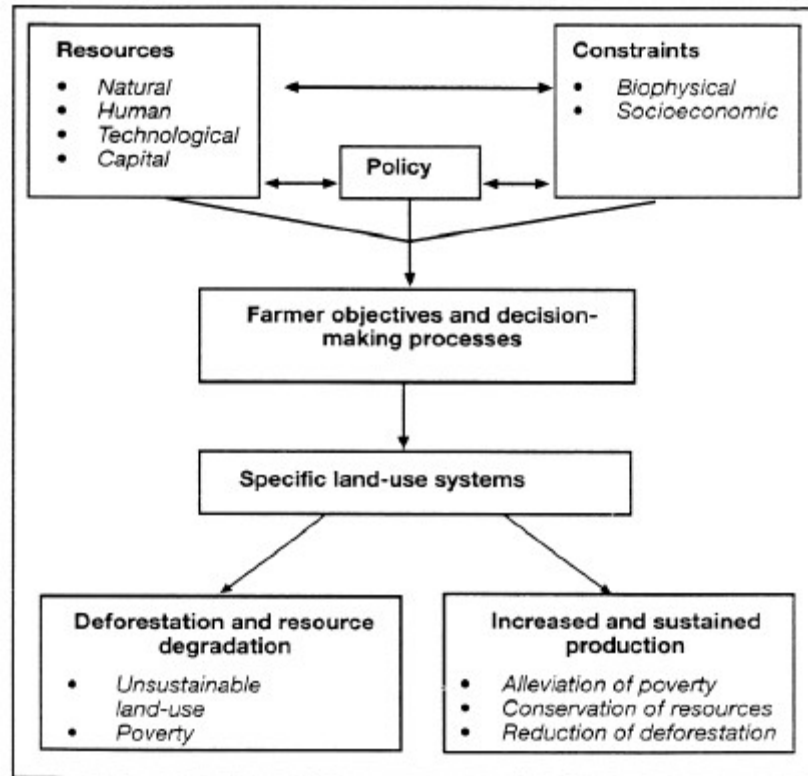


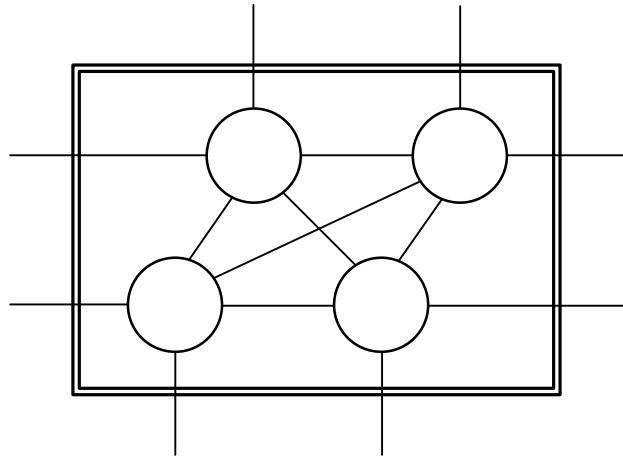
Figure 3. Conceptual framework for the development of the Alternatives to Slash-and-Burn research program

**5. Framing research questions** - before carrying out any research, questions must be formulated in a way that they are ‘researchable’. This is to make sure that the researcher really knows what he/she is investigating, the purpose of the investigation, its objectives, and what type of data, sources and treatment will be required for that particular research. You may get stuck halfway if these questions are not sufficiently clear throughout.

By ‘framing the research questions’ (Figure 4) we mean selecting only a part of the broader issue. This means acknowledging the existence of the broader issue first, then selecting a part of this issue that our research will be based on. Although in theory we can subscribe that ‘everything interacts with everything’, in practice our brains have a limited capacity to cope with information. It is thus essential to ‘frame’ issues at each scale – hoping that we can recognise the basic organising principles at each scale and also recognise that we cannot take into account all the factors and relationships outside our frame.

However, if we frame our question too tightly and go to the field with blinkers on our eyes which screen out anything outside the frame, we may fail to see the limitations of our frame, ignore all ‘discordant information’ and not learn anything really. Throughout the research formulation and design, we should be aware of the bigger picture (micro/meso/macro/mega...), and at the end of the design phase we should re-visit our frame to see whether it had been framed correctly or whether certain aspects which should have been included in our frame had been left out. If this was the case, we must re-frame the research problem and go through the research design process again.

Figure 4. Framing a research problem as part of a broader conceptual model of the world; the circles are entities related by lines or arrows, both within and outside of the ‘frame’



A simple guideline is to always include one scale level above the level of main focus (as this sets the overall boundary conditions), and one scale level below (as this represents the internal heterogeneity within the ‘frame’).

Of course there is a lot of literature on these aspects, and one can discuss this under headings such as ‘inductive versus deductive’ or ‘exploratory versus validation’.

**Exercise:** For your research problem, define all the key concepts, issues and problems. Draw up a conceptual framework to show the relationships between the concepts of the problem and research objectives. Can you identify ‘driving forces’ that act as ‘underlying causes’? Is a distinction between ‘proximate’ (direct) and ‘ultimate’ causes and mechanisms useful?

6. **Hypothesis formulation** - a hypothesis is what the research is ‘testing’; the results of this testing will be in the findings of the research. It is generally a claim, statement or supposition that a research project makes about certain concepts, relationships between different variables, or the causes of an observed phenomena or problem. The ASB hypothesis is given below. For a hypothesis to be ‘testable’ it should have an ‘alternative’ form, a counter statement that one can not offhand dispel as a possibility. A hypothesis without alternative form is not normally testable.

The global ASB program is built on the hypothesis that development forms of intensified land use as an alternative to slash-and-burn agriculture can help to alleviate poverty as well as conserve biodiversity.

The aim of these initial steps is to make a research design. This is the ‘blueprint’ of the research and will contain all the information and instructions about how the research will be carried out, what is needed for the research and how it can all be put together to fulfill the research objectives.

7. **Design of sampling scheme** Hypotheses can often be tested in multiple ways but the validity of any test depends not so much on the data collected, as it does on the choices that are made before collecting data, when you decide on a sampling scheme.

Unfortunately, the shortcomings of data sets in this respect often only come to the surface when one consults a (good) statistician at the end of the research process..... Valuable advice to be taken to heart before one goes out is provided by:

Statistical services centre. (2001). Statistical good practice guidelines. SSC guidelines series. The University of Reading, Reading, UK.  
<http://www.rdg.ac.uk/ssc/dfid/booklets.html>

The sampling approach used in the ASB program will be discussed in more detail in section 4 of this lecture note.

8. **Data collection** Methods for data collection vary with the disciplines involved. Some of the methods used in the ASB program will be discussed in the subsequent lecture notes.

For the initial characterisation and diagnosis phase of the ASB project, data was collected on:

- vegetation (land use and land cover)
- soils
- climate
- demography
- infrastructure
- economic indicators
- social indicators
- policy indicators

The appendices to this lecture note give examples of the questions used in the initial surveys.

9. **Data analysis** Analysis of data leads to rejection or adjustment of the hypotheses. Again, there is a lot of good literature on this (see also the www site mentioned under the sample design heading).

In analysing the data collected in the initial phase of the ASB program, the **characterisation** (Who is using slash-and-burn when, where and why) leads into **diagnosis** (So what? To whom does it matter? Could they do it differently? Why don't they do it differently yet? How might we get them to do it differently?) – see sections 3.1 and 3.2.

10. **Conclusions, action and follow-up.** The first question is – do we have to go back to the drawing board and revisit the stage of problem perception, the conceptual framework, and the hypotheses? Do we have results that can make a real contribution to the humanity's accumulated knowledge and insights? Do we revise our own mental models or values on the basis of what we learned? Do we have reason to try and change the 'real world' and if so do we have an idea of where to start? As most research activities will at some point be questioned for the 'impact' they have had, it is important to be clear about the different types of impact. Is the target 'publications in high quality journals', 'the number of farmers who will have better options at their disposal', 'improvement of the quality of the environment at specified spatial and temporal scales', 'improved capacity to tackle new problems', or .... ?

One view is that research that claims to have predictable outputs and impacts may not be worth doing – it is in the 'surprises' that we make real progress. Yet, if researchers are not keen on opportunities for 'impact' that arise along the way, many opportunities will be missed.

In the next two sections of this lecture note we will discuss two concepts that are crucial to our understanding of the forest conversion issue: what do we mean by *forest*? And why is 'scale' important?

### 3. Deforestation: abrupt or gradual? A question of scale?

#### 3.1 Forest definitions

We use the words 'forest', 'deforestation' or 'forest conversion' assuming that these words have a clear meaning to all – yet, there is no definition of these words that would satisfy all. Forests differ in their degree of tree cover, in the diversity of trees, in the degree of human disturbance, and many other aspects. For any of these it is difficult to give a single threshold that separates 'forest' from 'non-forest'. If we think that the term forest refers primarily to 'tree cover' (other views will be explained in lecture note 2), then we have to pick an arbitrary point in the continuum from 0 – 100%. The world over, a lot of variation exists in the cut-off points used, from 20 to – 80%. If we use the 20% criterion, the rate of tropical deforestation is quite low and many (sub)-urban areas classify as 'forest' and 'forest degradation' remains within the 'forest' category. If we use the 80% criterion, the rate of deforestation will be high, but there will be a rich variation in tree cover within the non-forest category.

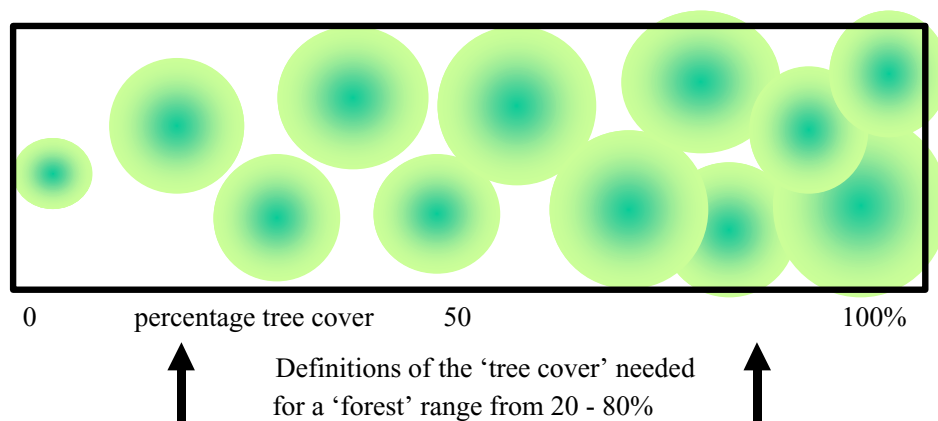


Figure 5. Continuum of tree cover from 0 – 100% and the range of thresholds that is used across the globe in defining 'forest' on the basis of tree cover.

These definitions assume that the concept of 'tree' is adequately defined, but even that leads to ambiguities when shrubs and perennials, and also woody stem but single-stemmed plants such as cassava and bamboos are considered. A legally tight definition that would stand up to scrutiny in a court case, is not as easy to derive, as it seems at first sight.

Given to the lawyers of the world, these definitions might lead to the conclusion that replacing a rainforest by a cassava field is no 'deforestation' because cassava meets the minimum definition of 'tree' and thus a cassava field can meet the definition of 'forest' ...

#### 3.2 Do we care for 'forests' or for 'forest functions'?

Closely linked to the abrupt-gradual issue of what a forest *is* is the issue of whether we care for the forest as such or for a set of 'forest functions'. In lecture note 2 we will come back to this point in more detail, but it may be clear that a 'forest function'

approach suggests a more gradual, quantitative approach to the ‘deforestation’ issue. From a ‘functional’ perspective it may make a lot of difference what type of land cover replaces the forest after conversion. This nuance, however, means that one can no longer measure the ‘rate of deforestation’ by looking at remotely sensed images.

### 3.3 Segregate-or-integrate?

The ambiguity in the meaning of the word ‘forest’ indicates that there are many forms of land cover in between ‘pure forest’ and ‘pure agriculture’. Such intermediate forms may be natural in origin, as in savanna vegetation that is a mix of trees and grass. In many situations (including many ‘savanna’s’ that replaced closed forest), these land cover types are essentially man-made and can be classified as ‘agroforestry’. They typically combine (in parallel or in series) some of the functions of agriculture (production of annual crops for local consumption or for external markets), with those of forests (provision of firewood, timber, fruits, resins, honey and other non-timber forest products, as well as ‘environmental service functions’).

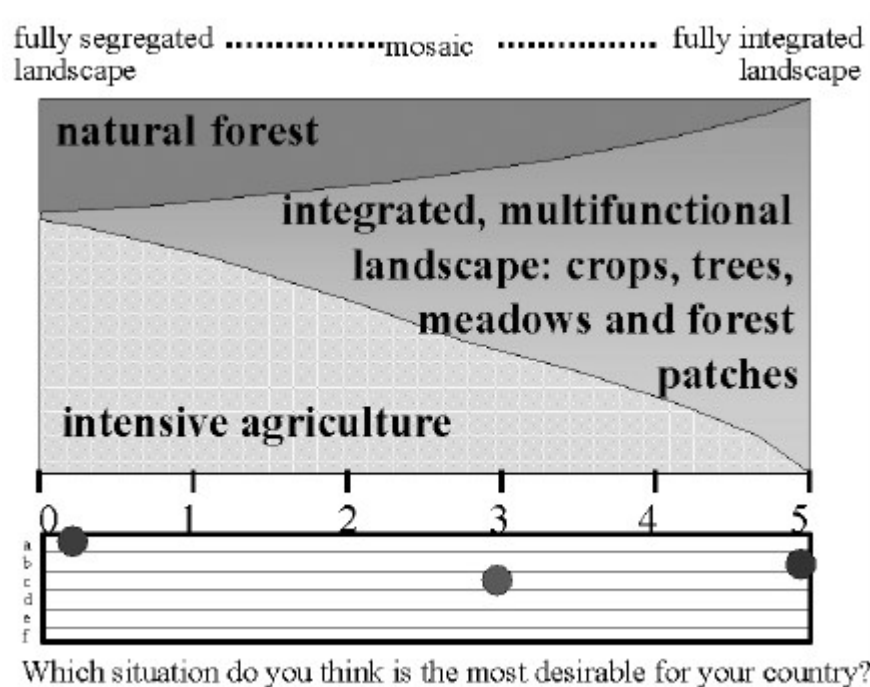


Figure 6. Choices among combinations of three major types of land uses in a landscape that has to serve both agricultural production functions and wants to maintenance of the environmental goods and services that forests provide.

#### Exercises

1. What word(s) for 'forest' are used in your country and/or language? Do they have a clear and operational definition that distinguishes it from 'non-forest'?
2. One extreme view on land use is to fully ‘segregate’ the natural forests from the agricultural lands. Another extreme is to have all land under multi-functional, or ‘integrated’ land use types. There are many intermediate solutions that involve a mosaic of patches. Where do you think the balance should be for your country (or region)? Please make your choice individually and then discuss in a group, focusing on *the reasons why* you come up with such a choice. Are there ‘researchable problems’ emerging from this discussion?

Agroforestry as a science has its roots in the often naive expectations that close associations between trees and crops can not only serve multiple functions, but also serve these functions better than a spatial segregation of agriculture and forestry. With

an increased understanding of competition that typifies many of these intimate mixtures, the definition of agroforestry and the focus in agroforestry research have evolved from plot-level interactions between trees, soils, crops and animals, to the way landscape elements (including trees and forest patches), interact to produce local (on-site) as well as external (off-site) ‘environmental service functions’. These ‘environmental service functions’ include productivity (short-term), (long term) sustainability and risk reduction (over time), the continuous supply of clean water (‘watershed functions’), maintenance of terrestrial C stocks and above- and belowground biodiversity. Some of these functions can indeed be combined at plot level, others may be better served by plot-level segregation, but landscape-level integration. These issues will again be discussed in more detail in subsequent lecture notes.

A key concept here is that of ‘Lateral flows’ (this means the movements of earth, wind, water, fire and organisms across the landscape) and filters (these are landscape elements that reduce the movement of earth, wind, water, fire and/or organisms). The relative importance of lateral flows determines the consequences of landscape- level integration of functions that are non-compatible at plot-level. For example, where high nutrient supply to agricultural crops is not compatible with quality standards for surface or groundwater, a nutrient filter by vegetation (including trees) around streams and ditches may lead to an acceptable solution. Where crops use less water than the natural vegetation they replaced and where increased groundwater flows create problems of salinisation, as in W. Australia, introduction of trees to specific zones may help. However, some parts of the ‘charismatic megafauna’ of tropical forests, such as tigers or elephants, are not compatible with human objectives in agroforestry, and a clearer spatial segregation is necessary to avoid conflict.

In subsequent lecture notes we will come back to this issue of segregate-versus-integrate and see how the various landscape functions can be met in segregated/integrated or mixed landscapes.

The segregate-integrate choice may be clear if we consider a single *scale* but in reality we deal with many – so what looks like ‘segregated’ at one scale may still be part of a patchwork that looks ‘integrated’ at another scale.

### 3.4 Scale *concepts*

There are various ways in which the word ‘scale’ is used (Box 2). In interdisciplinary research efforts we will have to anticipate and accommodate the type of confusion that can arise from the use of the same word for essentially different concepts in the various disciplines.

In section 2 we saw that research questions can be derived by starting with ‘big issues’ at global scale such as poverty and deforestation and working your way down to the local manifestations and causes, or by starting from a local perspective in a specific site, and working your way up to the global issues that influence the options locally available. We said that the real challenge is to connect these two approaches. How can we do that?

The relationships in this diagram have two-way arrows:

- Indicating that the higher levels can set the boundaries for the behaviour of the lower levels,
- Indicating that the properties at a higher level in the diagram are derived from the sum of, and interactions between, the components (the interactions mean that the total can be more than, equal to or less than the sum of the parts...).

### Box 2: Scale concepts

- Map-makers (cartographers) have a specific concept of scale: small-scale maps (e.g. 1: 1,000,000) are used for depicting large-scale phenomena (e.g. 500 km or 500,000 m) on a map of only 0.5 m width; conversely, large scale maps allow the representation of small-scale phenomena (e.g. 5 km on a 0.5 m wide map at scale 1: 10,000)
- Economies of scale: relations between ‘fixed’ and ‘variable’ costs play a role in the comparison of smallholder vs. plantation-style resource use, in the relation of farm size to resource management practices, and in the vertical integration of production, processing and marketing
- Hierarchy of scales: plots are nested in farms which are nested in landscapes, nested in nations, nested in the globe; each scale has a characteristic set of ‘drivers’ and managers, and there are important interactions between these scales
- Scaling in space: explicit scaling rules are needed for deriving quantitative statements about performance indicators at larger spatial scales, using criteria measured at smaller scales (or vice versa)
- Scaling in time: projecting and predicting longer term impacts and changes from changes measured at a shorter time scale; this involves issues of non-linear responses and of using discount rates in economic valuation
- ‘Scaling out’: replicating or extrapolating technologies or institutional approaches to other sites with similar biophysical & social circumstances, which may involve a certain degree of adaptation, but involves essentially the same type of system boundaries
- ‘Scaling up’: expanding the analysis of a system beyond replication at the same scale, to include the factors that become important at the greater temporal and spatial scales, and at the higher levels in the hierarchy

The systems hierarchy does not necessarily have to start from the global, through all the different scales, but is determined instead by the objectives and nature of the particular research topic. For example, the process could begin at the regional level to distinguish the various agro-ecological--socio-economic zones.

This concept of a nested hierarchy points to a ‘**stratified**’ sampling approach. Strata, in the statistical sense, are layers in the data that are supposed to be relatively homogeneous, but different from the other layers (compare a geological profile through layers (strata) of rocks, deposited at different times). It is more efficient to sample within each of the strata identified, if we want to get an overall picture, rather than take observation points ‘randomly’ with the risk of missing certain strata completely.

So, wherever we want to go to a more specific, lower level in the hierarchy, we also have to consider the stratification question within the unit in question, that is: do we have *a priori* reasons to recognise ‘types’, ‘zones’ or ‘layers’ describing the diversity within the ‘unit’ in question?

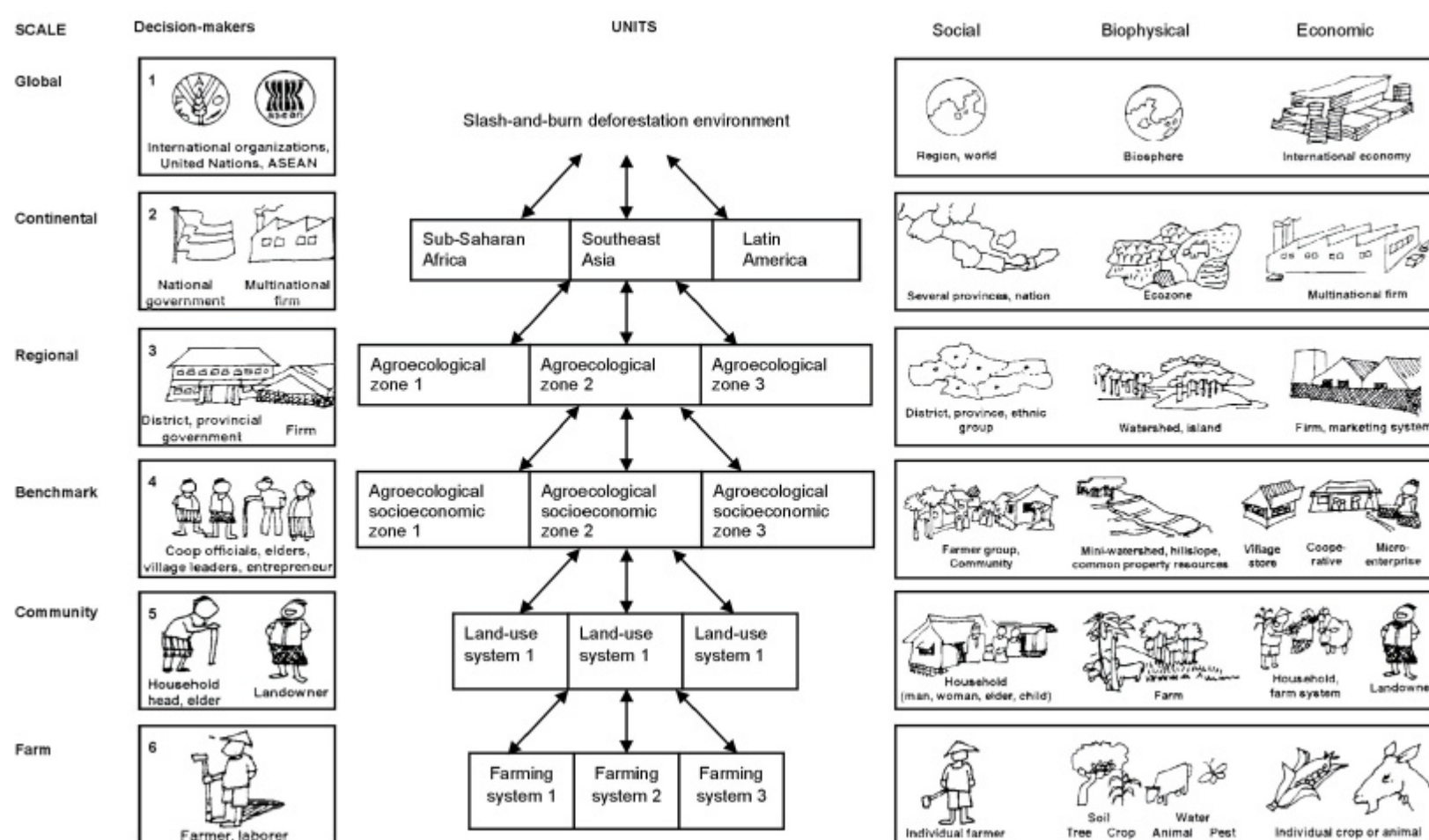


Figure 7. Nested hierarchy of levels of decision making about natural resources, with their social, biophysical and economic aspects; the contents of the boxes are examples, not an exhaustive list. Adapted and modified from FAO and IIRR (1995).



The term ‘**benchmark**’ is often used in this context: it is a unit that is supposed to be representative of a broader domain. It doesn’t have to be internally homogeneous; it should instead reflect a ‘typical’ level of internal heterogeneity. In the end, you can only prove that a ‘benchmark’ is truly representative by doing extensive research in the whole domain – so, the acceptance of certain areas as ‘benchmark’ does have subjective elements. Benchmark areas themselves can be stratified according to various biophysical and socio-economic criteria to cover the variation at the community or village level. Within communities or villages, we’ll need to stratify the households to make sure that we will listen to the perspectives of all groups of importance.

The following section illustrates the concept of scale and nested sampling design as defined by the ASB program:

## 4. The ASB program: from global to farm level

The levels or scales of characterisation are referred to as global, continental, regional, benchmark, community and farm or household levels (see Figure 7). Descriptions of the different levels and the general features that delineate them are outlined in the following paragraphs. These are the scales selected for the ASB program. Scales will differ for other research projects, depending on the scope and questions of that research.

### 4.1 Global level

The global level consists of the humid and sub-humid forests and deforestation fronts of the three continents where slash-and-burn agriculture is practised. It is at this level that data are ultimately integrated for identification of global trends and differences and for extrapolation purposes.

### 4.2 Continental level

For the ASB program, the continental level covers three continents. These are defined in geographic terms and comprise the forest margin zones of Southeast Asia, Latin America and sub-Saharan Africa. For most other research, the continental level only covers one continent. For example, see Table 1. The first thing to note is that the three continents have as many differences as they have things in common – deforestation and forest conversion occur everywhere, but income, population densities, urban employment opportunities, and per capita income differ significantly.

Table 1. Comparative statistics for Brazil, Cameroon, Indonesia and Sumatra as the part of Indonesia chosen for ASB studies

	<b>Brazil</b>	<b>Cameroon</b>	<b>Indonesia</b>	<b>Sumatra</b>
<i>Single indicators</i>				
GNP, mid -1995 (US\$ billions)	688.7	8.7	189.4	35.5
Population, mid-1995 (millions)	159.2	13.3	193.3	40.8
Labor force, 1990 (millions)	65.8	5.1	78.5	18.1
Agricultural GDP, mid-1995 (US\$ billions)	96.3	3.1	33.7	4.7
Agricultural land (millions ha)	238.3	9.0	45.7	16.0
Agricultural labor, 1990 (millions)	15.1	3.5	44.8	8.6
Forest land, 1990 (thousands sq. km.)	5,611.0	204.0	1,095.0	265.0

	Brazil	Cameroon	Indonesia	Sumatra
<b>Key Ratios</b>				
GNP/Capita - US\$ (1995)	3,640	650	980	870
GNP/Capita - US\$ PPP (1995)	5,400	2,110	3,800	--
Poverty : population w/<US\$ 1 PPP/day	28.7%	--	14.5%	--
Income distribution : share of top quintile	67.5%	--	40.7%	--
Agriculture's share of GDP, 1990	11.1%	26.6%	19.0%	12.9% *)
Agriculture's share of labor force, 1990	23.0%	70.0%	57.0%	66.3%
Ag GDP / Ag labor, US\$/person	6,377.5	885.7	752.2	548.8
Ag GDP / Ag land, US\$/ha	404.0	343.3	737.1	294.3
Ag land / Ag labor, 1990, ha/person	15.8	2.6	1.0	1.9
Cropland / Ag land, 1994	78%	96%	93%	97% *)
Permanent pasture / Ag land, 1994	22%	4%	7%	3%
CO2 from industrial sources, MT/capita, 1992	1.4	0.2	1.0	--
<b>Rates of change (per year)</b>				
GDP growth 1990-1995	2.7%	-1.8%	7.6%	7.7%
Agricultural GDP growth, 1990 – 1995	3.7%	2.2%	2.9%	3.3%
Population growth, 1990 – 1995	1.5%	2.9%	1.6%	2.2%
Labor force growth, 1990 – 1995	1.6%	3.1%	2.5%	3.5%
Agricultural labor force growth	2.0%	0.4%	-2.3%	-1.0%
Agricultural land area growth	0.5%	0.0%	-1.1%	1.4%
Forestland area growth, 1980 – 1990	-0.6%	-0.6%	-1.1%	-1.2% **)

*Quoted from Tomich et al., 1998*

*Note: for Sumatra, GNP and GDP refer to Gross Regional Product (GRP)*

*\*) 1995*

*\*\*) 1984 – 1995*

*-- means 'no data available'*

*Sources :*

*World Development Report 1997*

*Statistical Year Book of Indonesia, BPS, 1985, 1990, 1991, 1996*

Table 1 presents comparative statistics for three ASB countries (Brazil, Cameroon, and Indonesia) and, where data are available, for Sumatra. Gross national product (GNP) per inhabitant ('capita') was lowest in Cameroon followed by Indonesia, with Brazil a factor of 5 higher. In Cameroon the majority of the population works in agriculture, in Indonesia it is approaching the 50% mark, and in Brazil it is less than a quarter. In Indonesia only 1 ha of agricultural land is available per agricultural labourer (mostly due to the densely populated island of Java); this rises to 2.6 in Cameroon and 16 in Brazil. Permanent pastures form a substantial part of the total agricultural land base in Brazil (22%) but not in Indonesia or Cameroon.

CO<sub>2</sub> emissions from industrial sources, expressed on a per capita basis, are highest in Brazil and lowest in Cameroon. Indonesia had the highest rate of forest conversion in the 1980 – 1990 time frame, while Cameroon had the strongest population growth. The percentage of households living in poverty is highest in Brazil despite the fact that Brazil has the highest income per capita. In contrast, Indonesia had (at the time these data were collected) the highest GDP growth rate of the three.

Of course these national data can be misleading in judging the situation in the forest margins of each of the countries. For Indonesia, for example, we can see that data for

Sumatra differ from those of the country as a whole. Furthermore, within Sumatra, each province shows differences, and so on.

In terms of the key ratios in Table 1, agriculture's role in the gross regional product of Sumatra – because of its mineral wealth -- was comparable to Brazil and lower than Indonesia as a whole. On the other hand, the share of Sumatra's labor force that depended on agriculture was almost as high as that in Cameroon. Agricultural land of 1.9 ha per worker in Sumatra was almost twice the average for Indonesia, but was less than for Cameroon and only a fraction of the ratio for Brazil.

### 4.3 Regional level

Within each of the continents there may be a few distinct zones or regions, defined in broad agro-ecological terms. For example, the sub-Saharan continental area includes the regions of the humid forests of the Congo Basin in central Africa. Within these regions there are distinct areas where slash-and-burn practices follow different patterns and where the complexity and underlying processes can be studied. The term 'benchmark' is used to distinguish these sites within the region.

### 4.4 Benchmark level

Benchmark areas are zones of most intensive study of the program. They were chosen because they represent, at the regional and global levels, large, active sites of deforestation caused by slash and burn practices. Eight benchmark areas were chosen, representing the spectrum of agro-ecological socio-economic zones where slash-and-burn agriculture is a major land use. These are the areas from where the samples were selected. They are given in the following paragraphs:

**1. Africa.** The benchmark site in Cameroon represents the equatorial Congo basin rainforest of Congo, Gabon, Central African Republic and the Democratic Republic of Congo (former Zaire), where there is low but increasing population density, and largely indigenous slash-and-burn agriculture.

**2. Latin America.** Two areas were selected in the Amazon Basin, which covers large parts of Brazil, Colombia, Ecuador, Peru and Venezuela, representing areas with rapid deforestation resulting from colonisation programs. These are the Brazilian benchmark site and the Peruvian benchmark area. The first one has lower population densities and poor infrastructure, in the second population densities are increasing due to migration from overcrowded urban and Andean areas.

**3. Southeast Asia.** There are three benchmark areas in Southeast Asia, one being in the equatorial rainforest of the Indonesian archipelago, where loggers, indigenous practices, resettlement programs and plantation developers are clearing primary forests. After the forest is gone and the soil depleted, '*alang-alang*' (a type of grass, *Imperata cylindrica*) can take over. The site in the Philippines represents the monsoon forests, where only remnants of forest exist on steep mountain slopes, and degraded *alang-alang* grasslands dominate the landscape. The Thailand site represents the extensive, subtropical hill forest of mainland Southeast Asia, found in Laos, Vietnam and southern China in continental Southeast Asia. In this area, slash-and-burn agriculture by indigenous groups has reduced forest area, while recent investments in infrastructure and development, although providing off-land opportunities, have not been able to stop forest destruction.

## 4.5 Community level

Within the benchmark areas there may be a number of communities, which represent a range of demographic conditions and land-use histories, resulting in different local land use patterns. An example of a community could be a village.

## 4.6 Farm or household level

The farm or household level refers to the unit of study within the community. We must also recognise the heterogeneity at this level (see Figure 8 for example).

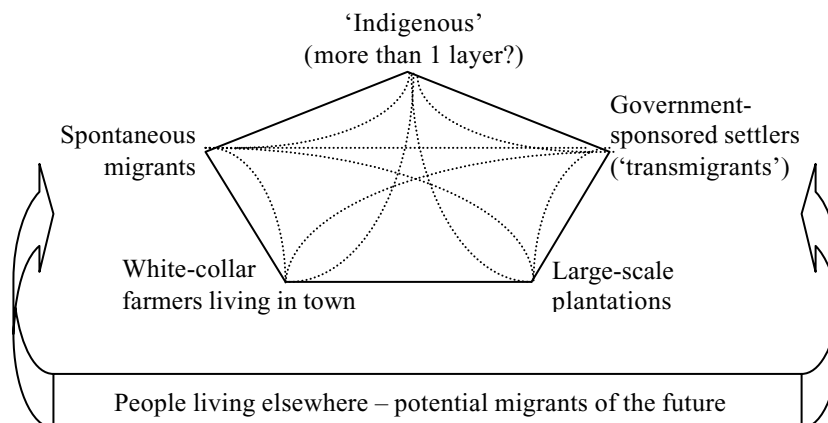


Figure 8. Groups of farmers considered in the design of the ASB Indonesia characterisation process. The potential migrants of the future may be a dominant cause of future land use change, but cannot be investigated in the same way as the groups who are already present.

Examples of the benchmark sites placed at the different scales of characterisation for the ASB program are represented in Figure 8. In addition to the fact that the local – regional – global approach is essential for the purpose of extrapolation, the reverse flow is also necessary to identify the factors impinging on farmers' decision-making, which are related to site-specific resources or constraints, and those related to community or national level policies.

# 5. Characterisation and Diagnosis

## 5.1 Characterisation

Characterisation is a multi-level process. In the broad sense, it involves identification of sites and their classification depending on a range of biophysical and socio-economic parameters. Such classification can be a basis for a 'stratified' sampling approach for subsequent work. Characterisation should also lead to the identification of the stakeholders/decision-makers and/or concerned people at the different scales/levels of the research. Methods of characterisation and diagnosis differ, depending on the purpose and intended use of the data. Characterisation identifies and defines the patterns (agro-ecological-economic zones, land use systems and patterns, and farming systems) and therefore requires gathering of very specific data, detailed in data-survey sheets and questionnaires. Specific types and units of data are necessary to allow for comparison among sites. Methods of characterisation differ somewhat for each level.

The objectives of regional characterisation and global synthesis are to provide a geographically referenced database for identifying the key socio-economic and biophysical determinants of, and processes leading to, slash-and-burn agriculture and deforestation. Data sources here include remotely sensed data, GIS (Geographic Information System) information and maps, climate charts and others. The GIS allows one to make ‘overlays’ and search for replicable patterns and quantify aspects of spatial correlation.

At the regional and the global levels we will often be limited by the databases that already exist. In some cases, detailed data exist at the farm or the community level that only needs to be aggregated for use at higher levels. Examples are the mean monthly rainfall and temperature data obtained from numerous meteorological stations and already existing in GIS databases. In other cases, data exist at higher scales but not in sufficient detail to be of use at lower scales. Examples are soil classification and road network data. When required data are not available, further data collection is necessary. The time spent on this will vary with the nature and intended use of the data. The costs of primary data collection need to be considered relative to the importance and priorities.

Benchmark areas are characterised at the micro scale into agro-ecological-economic zones (see Annex 1 – Parameters for benchmark area characterisation). The objective of benchmark area characterisation is to provide information on the dominant land use systems and the biophysical and social-economic conditions that produce the specific land use systems. It is also at this level that national policy dimensions are incorporated into the characterisation process. Sources of secondary data at this level are maps, weather charts, soil data, vegetation and land use maps from previous research and surveys, among others. The unit of sampling at the benchmark level is the district or its equivalent. At the meso and micro scales, the benchmark areas are characterised in terms of dominant land use systems. The land use systems are identified and characterised according to the criteria explained in Annex 2 (Parameters for community-level characterisation). The land-use systems are then given priority by area represented, their relevance to the whole research project, and their probability of improvement. Within the selected land-use systems, parallel characterisation and diagnosis studies are conducted at the farm level. The criteria for characterisation at the farm or household level are explained in Annex 3.

### ***Box 3: Sampling scheme– site/benchmark area selection.***

The benchmark area/site is selected according to its characteristics and the needs of the research. A sample is an area that is supposedly representative of the general conditions, which the research wants to investigate. In order to select a representative sample for analysis, the site is first characterised to identify its characteristics, such as climate, soil types, vegetation, land use types, land use patterns, agricultural constraints and opportunities and household characteristics. The sample is selected on the basis of this information. Take the ASB site in Indonesia (Sumatra) for example. Sumatra was chosen because of its ecological zones (which extend from the swampy lowlands to the forested mountains) and the demographic trends within these different ecological zones (information obtained through characterisation of the area). It represented the lowland tropical humid forest zones globally. Figure 7 and 9 shows how the area was selected from the ‘general’ to the more focused area. After selection, the site was characterised to identify its biophysical and demographic trends (see Table 2, below).

**Box 3: Sampling scheme– (continued)**

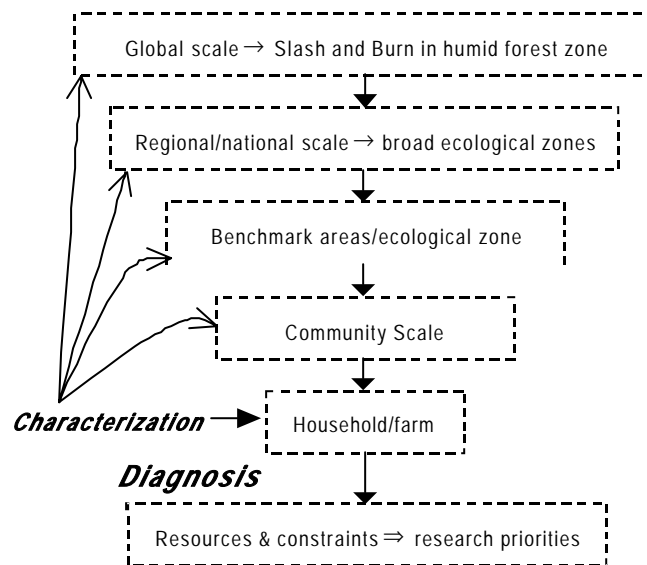


Figure 9. Stepwise choice of research sites and extrapolation domains (Source: ASB-Indonesia Report No. 4, 1995)

Table 2. Site selection for characterisation and diagnosis activities by ASB-Indonesia, based on ecological zone, population density and main group of farmers (Source: ASB-Indonesia Report No. 4, 1995)

Benchmark Area	Ecological Zone	Main Focus in ASB	Population density relative to resources
Air Dingin, W. Sumatra	Mountain	Buffer zone of National Park in highlands	High, emigration
Rantau Pandan, Jambi	Piedmont	Buffer zone of National Park in piedmont, rubber agroforests, and traditional shift. cult.	Intermediate
Sitiung, West Sumatra	Piedmont/peneplain	Transmigration villages interacting with local farmers	Intermediate, recent immigration
Bungo Tebo, Jambi	Peneplain	Forest margin: spont. settlers, transmigrants	Low, immigration
North Lampung	Peneplain	Degraded land rehabilitation as alternative to migration	High, immigration + emigration

If we refer back to the conceptual scheme of Figure 2, characterisation, in close collaboration with the farmer, should identify:

- ⌘ Both the opportunities (resources) and constraints for land use, at biophysical, socio-economic and policy levels. For example:
  - Climate, soil and toposequences from ridges to streams, vegetation, elevation, ecological zonation
  - Local as well as introduced crops, trees, animal resources
  - Pests, diseases and constraints to biological productivity
  - Road or river access for transport, access to markets

- Villages, population density, social stratification
- Rules, regulations, taxes or subsidies for specific activities
- ⌘ The land use practices themselves as used by various groups of farmers in the landscape. For example:
  - Who is practising what type of land use, and where?
  - Since when? What's the local history of innovations?
- ⌘ The impact of these land use practices on resources for future use i.e. does it belong in the 'best bet' category of the right-hand box in Figure 2, or in the 'to be discouraged' category of the left hand box? Is this choice a simple one that involves win-win or loose-loose scenarios on which all stakeholders may agree? Or can we expect 'tradeoffs' and win-loose outcomes that require more careful consideration, negotiations and compromises?
- ⌘ 'So what?' Should outsiders be concerned about the current land cover change? Does the land use practice affect other values and functions?

## 5.2 Diagnosis

After 'Characterisation' comes the 'Diagnosis' stage, where we focus on the 'Why do they do so?' and the 'Could they do it differently?' questions. This is, ideally, done in a participatory setting, so that the 'they' can be replaced by 'we', but this is more easily said than done.

### Example from the ASB project

In the *characterisation* of the jungle rubber agroforestry system in Indonesia, it was observed that farmers slash and burn all their old rubber trees when they replant a jungle rubber garden. In the *diagnosis* phase, we ask, and find answers to, questions such as:

- Why don't farmers sell their felled trees as rubber wood? What is constraining this activity?

The answer we find is that the market price of rubber wood is very low

- Why is the price very low?

Because there are national-and local level policies imposing high taxes and administrative burdens on the sale of rubber wood.

Thus, the diagnosis phase has highlighted a potential policy research issue (see lecture note 12 for more information on policy research).

Diagnosis is an interdisciplinary process, as opposed to characterisation, which is multidisciplinary. Through diagnosis, available resources and the constraints and opportunities at the community and farm/household level are evaluated and quantified. Diagnosis builds functional typologies of the farming systems and consequently requires reliance on participatory appraisal and research methods (see Annex 4 for the initial approach chosen within the ASB program; in Lecture note 8 alternative approaches that are more 'participatory' are discussed).

Diagnosis at the household level develops an understanding of farmers' problems in the context of the agro-ecosystem and farming system within which they farm. As mentioned earlier, this understanding will lead to the quantification of constraints and resources, and to the identification of bottlenecks and leverage points in the system. It is an essential step in the whole research process, where data are collected to generate a full understanding of the functioning of our target land-use and farming systems. It is at this stage that researchers learn how and why farmers make decisions concerning fallows, burning of forest, etc. Researchers gain an understanding of the dynamics of

slash-and-burn systems at this stage. Such understanding is key in the development of appropriate alternatives to slash-and-burn agriculture.

It is worth emphasising here that research is a iterative process, and that characterisation and diagnosis are taking place continuously at different stages within the research process.

Different parameters are used for characterisation at the different scales. The parameters referred to here are the biophysical and socio-economic indicators used to characterise the different scales/levels, and lists of these for the ASB characterisation are provided in Annexes 1, 2 and 3. These lists of parameters are long and detailed, despite the fact that they are considered to be a 'minimum data set'.

The lists of parameters used in the ASB Program show that:

- All the parameters related to land use (e.g. vegetation cover, income per capita) are measured repeatedly at different spatial scales, and using different methods. This is because land use is the principal pattern and process that will be used to aggregate data and connect a particular scale to the one above it in the hierarchy. Consequently, parameters concerning farming systems and farmers' priorities, which can only be measured at the farm or household scale, will be aggregated upwards on the basis of land use or other 'proxies'. For example, the level of integration of farmers in the market mechanism (as measured at the household level) can be indirectly assessed at the community level on the basis of the density of the road infrastructure and market locations.
- The parameters were chosen on the basis of a list of hypotheses concerning the driving forces of deforestation through slash-and-burn practices. For example, it is hypothesised that the biophysical parameters, when combined with specific socio-economic parameters (policies, population pressure), result in specific slash-and-burn practices. The parameters attempt to capture these principal driving forces.

**Exercise:**

1. For your research problem, select the different scales of the research.
2. What parameters will you use for characterisation at the different scales? And for diagnosis? Give reasons.
3. What methods can be used to obtain these parameters?

Several points must be noted concerning the characterisation and diagnosis approach given above:

- In the characterisation guidelines illustrated by the ASB program, the characterisation work may partly deal with issues unique to ASB, but many have wider applicability. The principles can be adapted to suit any research project, depending on the nature of the project and its objectives.
- Not all research efforts are interdisciplinary in nature, but the ASB program is an interdisciplinary one, so interactions among the different disciplines must be assured at each step.
- The issue of scale is one of importance in land use and other related research, as well as in the characterisation and diagnosis exercise. There are different scales of analysis and it is important to know which information is essential to characterize each level and how that information will be used and integrated into the overall research programme. Again, the scales of a research are unique to the nature and objectives of a research project.



## Summary of this lecture note

We started by presenting a number of views and quotes on the issues of tropical forest conversion, the global environment and poverty. Via newspapers and WWW pages it is easy to update such a list, as these issues are high on the current agenda. We asked the question 'why research' on this, if so much is known already, and concluded that the diversity in views and perspectives does lead to a need for challenging one's own basic assumptions. When we look closely, words such as 'forest' and 'deforestation' may lose the clarity that they appeared to have in a black-or-white picture of the world. Multifunctionality can be achieved both via 'segregate' and via 'integrate' pathways, and the choice between the two is not obvious or easy to make. Although deforestation is an issue at global scale that may have global consequences, the direct causes and consequences may differ substantially between the three main tropical continents, and within these. So, a stepwise approach to 'Characterisation' and 'Diagnosis' is needed if one wants to challenge widely held views on what the problems are, and more importantly, how they might be solved or at least reduced. The global Alternatives to Slash and Burn (ASB) program has brought together a large number of international national institutions that are interested in identifying and promoting innovations to reduce poverty and conserve tropical forests. Their approach will be further discussed in the remaining lecture notes of this series.

## III. Reading materials

### Scientific journal articles

- Hofer T. 1998. Do land use changes in the Himalayas affect downstream flooding? Traditional understanding and new evidence. *Memoir Geological Society of India*. No. 41: 119-141.
- Tomich TP, van Noordwijk M, Vosti SA and Witcover J. 1998. Agricultural development with rainforest conservation: Methods for seeking best bet alternatives to slash-and-burn, with applications to Brazil and Indonesia. *Agricultural Economics* 19 (1-2): 159-174.
- Tomich TP and van Noordwijk M. 1996. What drives deforestation in Sumatra? In: Rerkasem B ed. *Proceedings of a conference on "Montane Mainland Southeast Asia in Transition", 13-16 November, 1995, at Chiang Mai, Thailand*. p 120-149.
- Tomich TP, Fagi AM, de Foresta H, Michon G, Murdiyarso D, Stolle F and van Noordwijk M. 1998. Indonesia's fires: smoke as a problem, smoke as a symptom. *Agroforestry Today*, 10 (1): 4 - 7.

### Reports/Proceedings

- Gintings AN. *et al.* 1997. Agroforestry Characterisation in Pakuan Ratu and Tulang Bawang Tengah Subdistricts, North Lampung District, Lampung Province. In M. van Noordwijk *et al.* (eds.) *Alternatives to Slash-and-Burn Research in Indonesia*. Proceedings of a Workshop, Bogor, June 6 -9, 1995: 59 - 69.
- Gintings AN. *et al.* 1997. Characterisation of the Production and Land Use System at the Rantau Pandan Benchmark Area. In M. van Noordwijk *et al.* (eds.) *Alternatives to Slash-and-Burn Research in Indonesia*. Proceedings of a Workshop, Bogor, June 6 - 9, 1995: 83 - 102.
- International Center for Research in Agroforestry (ICRAF). 1998. Report to the Ford Foundation on Policy Analysis of Alternatives to Slash and Burn Agriculture in Mountainous Mainland Southeast Asia. Phase 1 Final Report (July 1, 1995 - June 30, 1998): 2 - 10.
- International Center for Research in Agroforestry (ICRAF). 1999. Characterisation, Diagnosis and Design. Training Exercise Book. ICRAF-S.E. Asia.

- Palm CA, Izac A-M and Vosti S (reprinted 2000). Procedural Guidelines for Characterisation. ICRAF, Nairobi. p 31.
- Rachman A, *et al.* 1997. Soil and Agroclimatic Characterisation for Determining Alternatives to Slash –and –Burn. In M van Noordwijk *et al.* (eds.) *Alternatives to Slash-and-Burn Research in Indonesia*. Proceedings of a Workshop, Bogor, June 6 – 9, 1995: 3 – 20.
- Suyanto S, *et al.* 2000. The Underlying Causes and Impacts of Fires in South-East Asia. Site 1. Sekincau, Lampung Province, Indonesia. CIFOR, ICRAF, USAID, USFSDA.
- Tomich T, *et al.* 1998. Alternatives to Slash-and-Burn in Indonesia. ICRAF- SE Asia. ASB-Indonesia Report No. 8.
- van Noordwijk M, *et al.* 1998. Forest Soils under Alternatives to Slash-and-Burn Agriculture in Sumatra, Indonesia. In: A Shulte and D Ruyihat (eds.) *Soils of Tropical Forest Ecosystems: Characteristics, Ecology and Management*. Springer-Verlag Berlin, Heidelberg, New York: 175 – 185. ISBN 3-540-63607-2.
- van Noordwijk M, *et al.* 2000. Scaling, Lateral Flows, Sustainability and Negotiation Support Models for Natural Resources Management in Landscapes with Trees. In: *Integrated Natural Resource Management (INRM) in the CGIAR. Approaches and Lessons*. INRM Workshop, 21 – 25 August 2000, Penang, Malaysia. INRM, Future Harvest, CGIAR.
- van Noordwijk M, *et al.* (eds.) 1997. Alternatives to Slash-and-Burn Research in Indonesia. Proceedings of a Workshop, Bogor, June 6 – 9, 1995.
- van Noordwijk M, *et al.* (eds.) 1995. Alternatives to Slash-and-Burn in Indonesia, Summary report of 1. ASB-Indonesia Report No. 4.

## Websites

- The Alternatives to Slash and Burn program (including these lecture notes...):  
<http://www.asb.cgiar.org/>
- CIFOR's forest policy expert list POLEX: <http://www.cifor.cgiar.org/polex/>
- Forest Trends: building bridges for sustainable forestry: <http://www.foresttrends.org/>

## Annex 1.

### Parameters for benchmark-area characterisation

Type of data	Output and units (* - frequency of measurement)	Method or source of information	Justification and comments
<b>Vegetation (land use and land cover)</b>	All information in this section is to be geographically referenced. if not available, data must be located on maps.		
Total area of region	The boundaries of the area to be demarcated on maps; total area (ha)	Secondary data; maps	Defines the area of relevance in the region for the Slash-and-Burn programme
Undisturbed forest	Total area (ha) and % of total of forest area found within bench-mark area, divided into major forest types (aseasonal, seasonal), where distinct. Also give average size of forest patches *5-year intervals from 1970	Secondary data; agricultural and forestry census; existing GIS or remote sensing	Determines rates of deforestation and delineate current forest areas
Forest fallow	Area (ha and % of total area) found in forest fallows; does not include degraded scrubland	Same as above but may require ground truth of remotely sensed images (see community level)	Indicates the importance of fallow systems; trends in fallow area indicate relative stability of system
Cropland Annual crops Perennial crops (plantations)	Net area (ha and %) under annual crops; area under perennial crops *5-year intervals	Same as above	Net area does not include multiple cropping; count multiple cropped lands only by the area of the land, not the total area planted during the year
Grassland	Area (ha and %) and stocking rates (animals ha <sup>-1</sup> ) *5-year intervals	Same as above	
Degraded areas	Area (ha and %) of degraded land, define using local definitions of what is considered to be degraded *5-year intervals	Same as above	indicates the information of degraded area and indicates if current practices are unsustainable
Other	Area (ha and %), specifying major land cover not included above 5-year intervals		
Biomass-above and below ground	t ha <sup>-1</sup> dry matter representative of each land-use category	Aggregated from measurements made at community level for each land-use system; also, secondary data of vegetation biomass	For estimating carbon pools and changes with changes in land use; necessary for carbon models

Type of data	Output and units (* - frequency of measurement)	Method or source of information	Justification and comments
<b>Soils</b>			
Soil taxonomy (US system preferred)	Area (ha) of the major soil types of the region, soils classified to the great group level or subgroup if not too heterogeneous	Secondary data; as above	Partially defines the agroecological-economic zones
pH	Area by pH of soils	Same as above	Indicates potential soil-fertility constraints
% soil carbon	Area by %C (0-20 cm), by soil type and land use	Secondary data, but must know soil type and land use from of soil analysed; measurements from community level for different land uses	For calculating changes in carbon stocks with changes in land use; also for use in carbon models
Texture	Area (ha) by surface horizon texture	Secondary data; from pedon data	For estimating potential erosion and for carbon modelling
Slope	Area (ha and %) found in different slope categories: 0-8%, 8-30%, > 30%, 0-30%	Secondary data; existing GIS and land-use maps	Provides information on land use and erosion potential
<b>Climate</b>			
Rainfall	Mean monthly rainfall (mm) from long-term records; if area contains distinct rainfall regimes, reported by % of area in each		
Temperature	Mean and standard deviation of monthly minimum and maximum temperature (*C). As with rainfall, if distinct temperature regimes exist in the region, they should be reported, with % of their area	Same as above	Same as above
<b>Demography</b>			
Population size and distribution	Total population and population densities (people km); population density maps *10-year intervals since 1970	Census data reported on 10-year basis for previous 20 years	Partially defines the agro-ecological-economic zones
Population growth rates and net migratory fluxes	Annual population increases or decreases and % of increase or decrease due to migration *10-year intervals	Secondary data, calculated from above information	Provides information on the demographic driving forces of deforestation
Urban to rural population	% of urban population (people in city or town administrative units divided by entire population) *10-year intervals	Secondary data, aggregated from city or town administrative units and from entire area	Provides information on movement of populations within the benchmark area

Type of data	Output and units (* - frequency of measurement)	Method or source of information	Justification and comments
<b>Infrastructure</b>			
Roads: density and quality	km of roads per area; ratio of paved to unpaved roads *5-year intervals	Secondary data; GIS or ministry of commerce	To determine access to markets, potential impact of increased production, access to forests
Markets	Density of commercial markets; number of markets/area *5-year intervals	Same as above	Same as above
<b>Economic indicators</b>			
Income	Average per capita income in urban and rural areas *annually for last 10 years	Secondary data; census	Provides a rough indication of the economic development of the area
Inflation	Annual rate of inflation, in % *annually for last 10 years	Secondary data; ministry of finance	Indicates stability or instability of the economic environment of the farmers
Food self-sufficiency	Indicate if the area is a net importer or exporter of food *5-year intervals	Ministry of agriculture	Indicates market potential for locally produced food
<b>Policy indicators</b>			
International trade policies 1. Effective rates of protection annual crops, perennial crops wood products animal products	Tariff rate M on each of the major products or by-products *annually for last 10 years	Ministries of agriculture and forestry	Indicates whether national agricultural
International trade policies 2. Export supports for agricultural outputs: (as listed above)	Rate of subsidy M for each of the major agricultural exports *annually for the last 10 years	Same as above	Indicates whether farmers have financial incentives to produce for the export market
Subsidy policies for inputs: Fertilisers Fuel Machinery irrigation	Rate of subsidy for the major inputs; if this information not available, provide national prices of the inputs, in US\$ equivalent *yearly average for the last 10 years	Ministry of agriculture	Indicates whether farmers have a financial incentive to use purchased inputs

Type of data	Output and units (* - frequency of measurement)	Method or source of information	Justification and comments
Price support policies: annual crops perennial crops wood products animal products	Average yearly prices received by farmers for each of the major products; US\$ equivalent and as % of corresponding world prices *yearly average for the last 10 years	Ministry of agriculture	Indicates whether farmers have a financial incentive to produce more of a given product; also indicates stability or instability of the economic environment of the farmers

Note: **Policy indicators** (continued)

**Forest management policies.** Determine whether there exist government policies (legislation, regulations, taxes subsidies) concerning (1) the clearing of forests and watersheds, (2) the burning of forests and (3) reforestation.

If such policies exist, obtain a copy of the law or regulations, and information on the amounts of taxes or subsidies used. Obtain this information for the current policies only; indicate if and how the policies have changed considerably in the last few years. Justification: this is to determine whether the existing legislation provides incentives to deforest or reforest.

**Natural resource management policies.** Determine whether there exist government policies (legislation, regulations, taxes, subsidies) that give farmers incentives or disincentives to better manage or conserve (1) soil, (2) forested areas, (3) wildlife and biodiversity, (4) watersheds, (5) abandoned or degraded areas, and (6) carbon stocks (reduce carbon emissions). If these policies exist, obtain a copy of the law or regulations and information on amounts of taxes and subsidies used. Obtain the information on current policies only.

Justification: this is to determine whether existing legislation provides incentives or disincentives for farmers to conserve natural resources.

## Annex 2.

### Parameters for community-level characterisation

Type of data	Outputs and units (= frequency of measurement)	Method or source of information	Justification and comments
<b>Location</b>	Data need to be presented in a manner that allows georeferencing		
Longitude, latitude, altitude	Boundaries of periphery of community; topography of area	Delineated on highest resolution maps of the area or global position locators	Allows integration into GIS database
<hr/>			
<b>Vegetation (land use or land cover)</b>	Area under each land-use category * 5- to 10-year intervals		
Total area	Area (ha) included within the boundaries Of the community area		Defines the boundaries of the community scale
Forest	Area (ha) and above- and below-ground biomass (t ha <sup>-1</sup> ) and general description of vegetation (forest types and dominant species)	Area by secondary data; existing GIS or remote sensing data; biomass from secondary data or measurements in land-use transects	Provides more precise information on rates of deforestation and loss of carbon
Forest fallow	Area (ha), biomass (t ha <sup>-1</sup> ), in fallow <5 years, 5-10 years, > 10 years; description of fallow 'vegetation	Same as above; will need ground truth information to associate different fallows with remotely sensed images	Provides carbon storage data and indicates decreasing or stable fallow periods
Cropland Annual crops Perennial crops (plantations)	Net area (ha) and biomass in annual crops (by crop) biomass in perennial crops (by crop)	Net area (ha and % of total area) under annual crops and perennial crops * 5-year intervals	Determines if deforested areas are put into crops or if crop area is converted into other uses
Grassland and pasture	Area (ha), biomass, and stocking rate in natural grassland or pasture and in managed Pastures; description of vegetation	Same as for other aerial measurements	Determines if deforested areas are put into pastures or if pastures are converted to other uses
Degraded land	Area and biomass and description of dominant vegetation; local definition of degraded systems	Same as for other aerial measurements	Determines if degraded areas are in creasing or are put into productive uses
Clearing and burning	Area (ha) cleared and burned each year, and from what vegetation type	Secondary data or remote sensing. thematic mapper; aggregate from farm-level surveys	Provides specific information on deforestation and for calculating carbon fluxes

Type of data	Outputs and units (= frequency of measurement)	Method or source of information	Justification and comments
Cropping and fallowing	Number of crops, before abandonment (specify which vegetation was, cleared from land)," Crop area: fallow area ratio, length of fallow now and 5, 10 and 30 years ago	Calculated from area in each category and aggregated data from farm-level survey	Provides information on the current sustainability of shifting agriculture
Average size and range of holdings and cultivated land per holding	Hectares of holding and % under cultivation	Secondary sources or survey data	Rough economic indicator; indicates forest area remaining on farms and possibilities for expansion of cultivated area
Average yields and ranges for annual and perennial crops and animal production	t ha <sup>-1</sup> by crop; live weight gains (kg); general trends (decreasing, increasing or same)	Agricultural census; agricultural extension; previous research; farm surveys and measurements	Indicates if yields are increasing or decreasing and if they are obtaining yield potential
Inputs: Fuel Fertilisers Pesticides Machinery	% of farmers using each input; average quantity used per ha; composition of fertilisers and pesticides, and trends in use of each	Same as above	Indicates level of agricultural intensity and changes with time
Pests: weeds, insects, other pests	List of major pests in the area by crop; trends-increasing or decreasing	Same as above	Reconciles information on pesticide use
Land tenure	Regulations and opportunities (see note at the foot this table)	Secondary data or interview of appropriate community officials	indicates degree of land security and opportunities for development and agricultural investments
<hr/>			
<b>Soils</b>	This information must be presented by the specific land-use types in which the soil parameters are found		
Classification-soil taxonomy to family level	Area of major soil families in the community by land-use type	Soil maps	Provides information on fertility of soils in different land-use categories
Qualities: pH, ECEC, % Al saturation	Area (ha and %), same categories as for benchmark level; for surface horizon (0-20 cm)	Soil maps with detailed pedon information	Indicates area where Al toxicity and limited nutrients are problems
Soil carbon	% C to 20 cm (or deeper) by soil types and land-use category	Secondary data and from measurements taken in land-use transects	Provides information on carbon stocks and changes with changes in land use
Bulk density	g cm <sup>3</sup> for surface horizon	Same as above	Needed to calculate carbon and nutrient stocks



Type of data	Outputs and units ( = frequency of measurement)	Method or source of information	Justification and comments
Texture	For surface horizon, reported by soil type and land-use category	Soil Maps; previous research	Indicates potential for erosion
Slope	Same categories as for benchmark scale, reported according to current land use and topsoil texture; fine-resolution topographical maps	Land-use maps	Indicates potential for erosion
<hr/>			
<b>Climate</b>	There can be distinct climatic zones within the benchmark areas		
Rainfall and temperature	Rainfall-long-term monthly averages and standard deviations Temperature-long-term mean monthly max. and min. temperatures (°C)	Secondary data; from closest meteorological station	Describes local rainfall patterns; necessary for model simulations
Evaporation	Mean monthly evaporation (mm water)	Same as above (give method); measured or estimated potential evapotranspiration	
Radiation	Mean monthly hours of direct sunlight (energy units if available (M m <sup>2</sup> ))	Same as above (give method); or estimated by day length and cloudiness index	Indicates amount of sunlight for plant growth
<hr/>			
<b>Demography</b>			
Age of the community	Age in years of community or date of settlement	Local community officials	Indicates if 'frontier' settlement
Total population	Number and distribution of people within community area *10-year intervals since 1970	Secondary sources; census data	Indicates changes in population pressure
Ethnic composition	% of local population in each ethnic group, including migrants *10-year intervals since 1970	Secondary data; interviews with appropriate community officials	Indicates degree of social homogeneity and may be important for explaining differences in land use
Average household size and range	Number of people per household, average and range	Secondary data or from interviews with community officials and aggregated farm surveys	
Female-headed households	% of households headed by a female	Aggregated from farm surveys	
<hr/>			
<b>Infrastructure</b>	Use of GPS required		
Roads: density and quality	km and distribution of roads, distinguished as paved or unpaved, all-weather or seasonal	Existing maps, ministry of commerce *5-year intervals	Is a prerequisite (constraint) to market integration

Type of data	Outputs and units ( = frequency of measurement)	Method or source of information	Justification and comments
Markets	Location and type of markets (frequency: daily, weekly, monthly); distance to market (type)	Interviews with appropriate community officials; farm survey	Same as above
Transport	Availability, frequency and type (size) of commercial transport from village to market types (times per week)	Interviews with community officials and from farm survey	Same as above
Services			
Cooperatives	Types	Same as above	Indicates potential for receiving services
Extension	Number of offices, agents and distribution	Same as above	Indicates potential and method for transfer of agricultural information
NGOs	Number and kinds	Same as above	Same as above
<b>Economy and policy</b>			
Income per capita	Range of income per capita (upper and lower figures)	Census data, if available; interviews with community officials and groups of farmers	
Off-farm employment sources	% of farmers who have off-farm employment by source of employment	Interviews with community officials; farm survey	Indicates opportunities to move out of agricultural enterprise
Credit	% of farmers who have borrowed money from a bank	Interviews with appropriate community officials	Indicates market integration

**Note: Land tenure indicators**

Information pertaining to the following should be obtained from the appropriate officials in the community:

1. Can people in the community buy land? How?
2. Can people in the community rent land? How?
3. How do people in the community obtain the right to use land?
4. Do people have titles to the land? Do they have the right to sell land?
5. is the right to buy, rent, sell, or use land the same for migrants to the area as for the local people? If it is different, explain how.
6. Are there rights to the use of resources (water, trees, etc) that differ from the use of land? If so explain

### Annex 3. Guideline household-characterisation questionnaire

Name and surname of interviewed farmer:

Location: Village

Locality

District

Province

1. Characterisation of the farmer and family

Name of head of the family:

Place of origin (or of birth) of the farmer:

Number of years spent in the village:

Members of the family living in the same house	Number	Age range	Level of education
Men			
Women			
Male children			
Female children			
Other relatives			

Other remarks and observations:

## 2. Land use (crops, livestock, pasture, fallow)

What is the total area of your farm?

Major types of land use	Total area	Use of final product (sold, consumed locally) and yields (quantity total production)	Did you have to buy this product last year to feed your family? (quantity)
Annual crops (give names)			
Homegardens (name major crops and trees)			
Perennial crops (give names)			
Forest (indicate total area and products obtained from the forest)			
Fallows (length)			
Degraded lands			
Other			

3. Are you **cultivating other fields outside your farm**? If the answer is yes, explain how and why.
4. Do you keep animals? If yes, explain how you manage them. What are the benefits derived from these animals? (cash, meat for local consumption)
5. Are you satisfied with your crop yields? If not, what are the constraints to increased crop yields? How are you trying to overcome them?
6. In the course of a normal year, do you use:

	Yes	No	For what crops
Fertilisers			
Pesticides			
Herbicides			
Hired labour			
Seeds			
Agricultural machinery			
Other (community labour, etc.)			

7. Do you think that you have very different soil types within your farm? if yes, can you explain how you use each type?
8. What do you consider to be the most important products obtained from your farm? Explain why.
9. Where and to whom do you sell your products? Is transportation available to take these products to the market? What are the transportation facilities available? Is the road or track to the market passable all year round or only during certain months?
10. Do you have non-agricultural sources of income? (Are some members of the family employed outside the farm?)
11. What items or goods do you purchase or pay for during a normal year? (food, taxes, medicine, school fees, clothes, etc.)
12. If this happens to be a very good and prosperous year for you and at the end of it you are left with additional money, how will you use this surplus? Explain why.
13. Have you ever obtained a bank loan? If yes, for what purpose? If not, why not? What do you think of the credit facilities provided by the banks?

14. How far (in km or hours) is your house from:

	km or hours
Health centre	
School	
Bank	
Market (urban centre)	

15. What area of land do you slash and burn every year? What type of vegetation do you normally clear and burn? How do you use the wood obtained from the cleared land? What products do you obtain from a non-cleared forest (e.g. wood, fruits, game, shelter, etc.)?
16. Once you have cleared the land, how do you use it in the first year, the second year, the third year, etc.? How many years do you leave your land fallow?
17. Do you think that trees are necessary in your farm? Do you think that even the forest is indispensable in your environment? Why or why not?
18. When did an extension agent visit you last? What was the outcome of the visit?
19. Can you sell your farm? Can you rent it to somebody else? If not, why not?
20. Can you explain how you obtained your land and if your children will be able to inherit your farm?
21. Do you or a member of your family belong to:
- a group or association of farmers
  - a cooperative

If yes, what are the activities that you undertake with that group or association?

22. Do you consider it worthwhile to continue being a farmer? If not, what would you like to do instead? As far as the future is concerned, what would you like your children to do and why?
23. Other comments by the farmer and observations by the enumerators or interviewers.

## **Annex 4. Diagnosis at the household level**

Diagnosis is conducted by a multidisciplinary team of researchers with the participation of the farmers included in the sample. The researchers will need to invest a large part of their time in interactions and discussions with these farmers. This is not adaptive but strategic research, where on-farm experimentation is used as an analytical tool: researchers observe and monitor what farmers do and discuss with them about why they do it.

Using a sample smaller than the household-level characterisation one (e.g.,  $n = 40$ ), stratified to be representative of the general farmer population in the area, diagnosis involves the following principal activities:

1. Identifying (through observation) and monitoring farmers' management practices for pests, water, soil, forests, crops and fallows
2. Supplementing the activities in (1) above with interviews with farmers, to elucidate the reasons for these practices, farmers' perceptions of problems and their decision-making processes
3. Obtaining, through interviews, information on the changes over time of farmers' forest- and fallow-management strategies, as well as understanding the reasons for these changes
4. Setting up trials in farmers' fields and under farmers' management to measure yields of annual and perennial crops and animals, and yield losses due to pest or infestation, low soil fertility, limiting nutrients, etc.
5. Monitoring inputs and costs and benefits of major agricultural activities
6. The specific methods that can be used to carry out these activities will be discussed with the teams at each slash-and-burn site.

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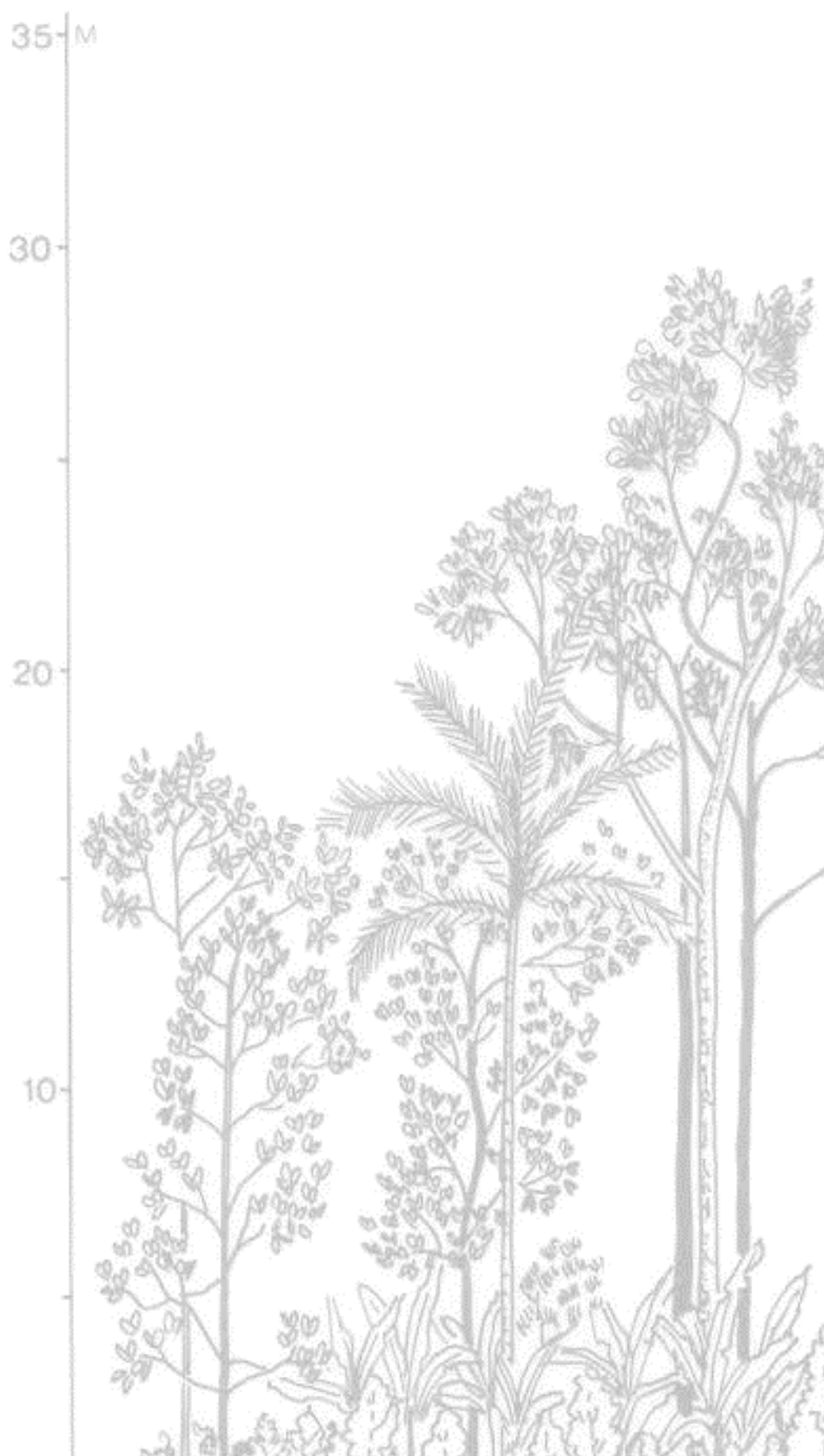
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