Rapid Agrobiodiversity Appraisal (RABA) in the Context of Environmental Service Rewards

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Rapid Agrobiodiversity Appraisal (RABA) in the Context of Environmental Service Rewards:

Protocols for Data Collection and Case Studies in Rubber Agroforests in Bungo District, Jambi, Indonesia and Fragmented Forest in North Thailand

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PREFACE AND ACKNOWLEDGMENTS

While global concern over the loss of forest and global biodiversity is still increasing and the Convention on Biological Diversity (CBD) is expressing aspirations rather than reality, there are essentially two ways to achieve 'conservation' plus 'economic development'. The first approach is based on a spatial segregation of functions and is focused on '*protected areas*' plus '*intensive agriculture*' as ways to achieve both goals on separate parts of the land. The second approach is based on '*integration*' of functions and maintaining substantial biodiversity *within* productive landscapes. A combination of the two approaches is most likely to achieve the joint goals, but includes 'integrated' systems where the 'conservation' and 'economic development' goals compete for the attention of the land manager (farmer or landscape manager). Specific incentives for 'conservation' may be needed to keep the land managers' attention on 'conservation' aspects (and may well do so efficiently) – if only society knew how to do this. Rapid Agrobiodiversity Appraisal (RABA) is an approach to make such reward systems operational, by appraising the location-specific biodiversity of a given agricultural landscape from the local and global perspective. However, the question remains: Can the two perspectives be bridged?

Rapid Agrobiodiversity Appraisal is not a technical biodiversity appraisal. A standardized way to appraise 'diversity' is a *contradictio in terminis* - it is likely to miss out on unique dimensions. It is understood that diversity of place means that every locality is 'unique' in its own way and there is thus no universal 'how to' method that prescribes a rigid appraisal. Rather, this narrative is a suggested approach to use when it is necessary to collect information rapidly about the potential of an agricultural landscape to conserve biodiversity as well as being productive. The method is intended to be an iterative, stepwise approach, suggesting that the user can update new information and modify the approach to suit different localities. If a first screening suggests that there is little opportunity for successful negotiations of 'rewards for biodiversity conservation', the process can stop there. If the first indication is positive, a more detailed assessment can clarify the strength of the case or reveal the pitfalls that have to be avoided.

The RABA approach was developed in the context of the RUPES (Rewarding Upland Poor for Environmental Services they provide) programme, led by the World Agroforestry Centre (ICRAF) with a consortium of international and national partners (see http://www.worldagroforestry.org/Sea/networks/RUPES/). We are grateful for the interest shown by the Roles of Agriculture Project managed by the Agricultural and Development Economics Division, Economic and Social Department of the Food and Agriculture Organization of the United Nations (FAO) and financial support from the Ministry of Agriculture, Forestry and Fisheries of the Government of Japan for the Roles of Agriculture Project (GCP/INT/916/JPN) that allowed the further development of the RABA approach as *'a tool to capture the understanding and knowledge of stakeholders on the benefits of agrobiodiversity'*.

RABA is set up to be the equivalent of the Rapid Hydrological Appraisal (RHA) and the Rapid Carbon Stock Appraisal (RaCSA). For the RHA and RaCSA, a USD 10 000 budget and 6 months time limit were set. For RABA, we hope and expect that the same targets will be feasible, but further comparisons are needed before we can settle on these targets.

We started the RABA process by bringing together a group of representatives from conservation organizations (Conservation International and WWF), research centre (ICRAF), local NGOs (*Komunitas Konservasi Indonesia Forum Komunikasi dan Konservasi* [KKI-WARSI] and *Yayasan Gita Buana*) and the local community in a workshop in Muara Bungo (Jambi, Indonesia) in August 2004. In the middle of the 'rubber agroforest' landscape, we tried to define what questions a RABA will have to answer and how we can find these answers in a timely and cost-effective manner. The result was then presented in an Agriculture Exhibition in Berlin (October 2004) and at the Eco-Agriculture meeting in Nairobi (October 2004). A follow-up discussion was held in Bangkok during the Fourth IUCN World Conservation Conference in November 2004. The appraisal methods that emerged were tested in two sites; Bungo, Jambi, Indonesia and North Thailand. In a second workshop in Muara Bungo in June 2005, the results were synthesized into the current document. We see this as 'work in progress', but hope that by sharing the approach at this stage we can accelerate the learning.

We thank all the participants of the workshops, case studies and discussion sessions (Annex 1) for their inputs and interest. We received constructive comments and support and continuous challenges from colleagues in RUPES (including Ms Fiona Chandler, Ms Beria Leimona, Mr Jim Peters) and ICRAF (Dr Mohammed Bakarr, Dr Brent Swallow). Special thanks are due to the staff of ICRAF Muara Bungo, the RUPES-Bungo Consortium and the RUPES-Bungo team for their cooperation in case studies and workshops, and last but not least to the villagers of Lubuk Beringin in Rantau Pandan Sub-District, Bungo, Jambi and Mae Chaem in North Thailand for their participation in the effort.

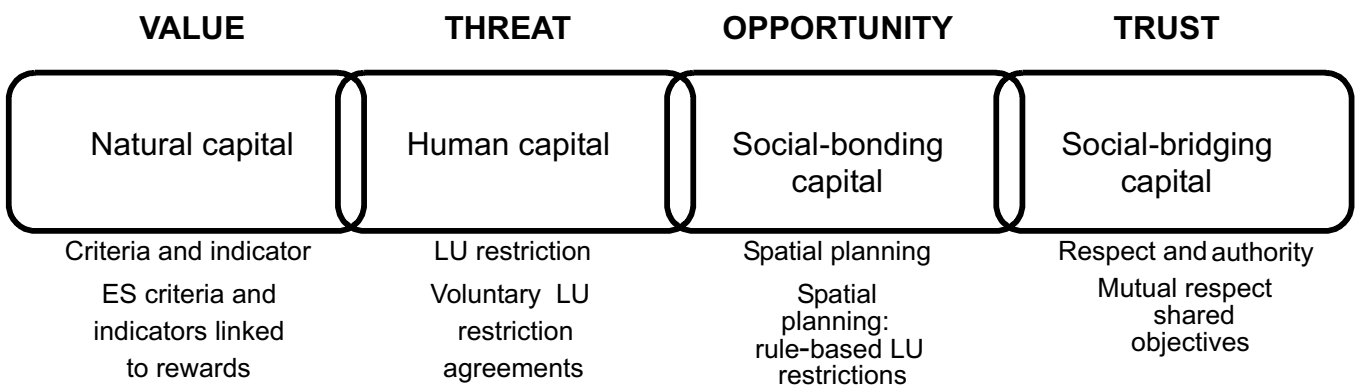
The authors
Bogor, 29 June 2005

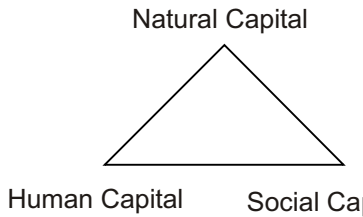
EXECUTIVE SUMMARY

Agriculture usually implies a loss of biodiversity. Yet, seen at larger temporal and spatial scale, many agricultural landscapes still contain substantial parts of the original biodiversity of pre-human vegetation – and allow for the expansion of flora and fauna of more open habitats. In other words, agriculture tends to operate in a 'trade-off' zone, where intensification tends to have financial benefits but ecological costs. Reward mechanisms that help 'internalize' the global benefits at the level of the farmer – decision maker are therefore relevant and necessary. Beyond this general need for rewards, however, we realize that location-specific appraisal is needed to develop reward mechanisms that are effective, efficient and transparent.

Environmental degradation linked to agricultural intensification may occur due to insufficient benefits flowing to the guardians of the land for their efforts in maintaining ecosystems and harbouring agrobiodiversity. Environmental-service reward is a new tool offering new opportunities for conservation. A key difference with past attempts to integrate conservation and development is the concept of 'conditionality' (the reward is linked to performance) and freedom of choice. However, few if any currently known mechanisms in developing countries meet all the criteria to be considered as 'pure' environmental-service rewards, with 'conditionality' as the most difficult one to achieve. Reward for conservation, especially in agroecosystems, is probably located at the bottom of the list, while most of the funds are allocated to 'protected areas'. The higher complexity of multifunctional agroecosystems and associated high transaction costs are limiting factors. A better targeting of situations that have a real chance of success can help both local communities and external conservation stakeholders to use their resources more effectively and thus reduce transaction costs. This primarily depends on improving the flows of information.

Rapid Agrobiodiversity Appraisal (RABA) was developed under the assumption that effective natural resource management, including biodiversity conservation, can only be achieved if there is a synergy between three different types of capital – human, natural and social. While the relationships between the three capitals is shown in the following figure, the combination of all three provides the basis for evaluation of local agrobiodiversity for conservation.





Natural x Human Capital = Land Use
Human x Social Capital = Institution
Human x Natural x Social = Opportunity for biodiversity conservation

(Van Noordwijk, in prep.)

RABA sees reward for environmental service as being conditional on four elements; natural capital, human capital, and social bonding and bridging capitals. In contrast to Wunder (2005), where strict payments for environmental services (PES) is fully based on conditionality and simple criteria and indicators of service delivery, RABA sees reward being situated in a broader domain that combine elements of trust, planning and conditionality based on negotiated and in essence voluntary agreements.

RABA has four stages for sellers and buyers to engage in arranging environmental-service rewards, namely scoping, identifying potential partners, negotiating agreements, and monitoring and evaluating compliance and outcomes. RABA itself is designed to cover the stages of scoping out the domain and identifying partners who will be engaged in the transactions. As an analytical framework, RABA offers guidance on the important things that should be noted in attempts to advocate conservation of agrobiodiversity in the context of environmental-service rewards. It captures the perspectives of seller, buyer and intermediaries. As a tool, RABA is also designed to assist in locating and obtaining initial data necessary for sellers, intermediaries and buyers to explore the potential to develop a reward system.

RABA is neither a stand-alone tool nor a newly prescribed biodiversity assessment technique. Rather it is a tool in which approaches to collect data and appraise the conservation value of an area rapidly are combined, summarized and adapted. Different techniques such as Rapid Rural Appraisal, Stakeholder Analysis and exploration of 'citizen science' (such as Local Ecological Knowledge) are among the methods or approaches that are suggested for use in different phases of RABA.

Collecting information about land uses and natural resources management from local inhabitants can raise confusion if a scientific perspective is used as the focal point. This is because some local taxonomy systems are more complete than the scientific one, giving names to separate 'varieties' which do in fact represent valid species but have yet to be scientifically recognized. Each community and linguistic group will have its own criteria for separating and lumping taxonomic groups. Often morphological and ecological similarities, as well as functional use, are used to define taxonomic groups instead of common evolutionary ancestry. This entails that a direct translation between languages is not possible. Therefore, local taxonomy must be taken into consideration to avoid faulty and misleading conclusion at the end of the analysis.

At the end of a Rapid Agrobiodiversity Appraisal, an 'honest broker' or intermediary will have to advise the local stakeholders of a biodiversity-rich agricultural landscape, as well as the outside stakeholders interested in supporting the conservation of that biodiversity for its global values, whether it is worth pursuing 'negotiations'. If the answer is 'no', both sides can avoid disappointment by focussing on other activities or sites. If the answer is 'yes', further studies will be needed. If the broker isn't 'honest', all parties (including the 'broker') may lose out by wasting time and effort.

The experiences from the application of the tool in Bungo, Indonesia, and North Thailand are that some parts of RABA needed 'local tuning'. In addition, a study of the opportunities for 'bird friendly coffee' from the Sumberjaya (Lampung) area shows that a range of arguments can contribute to the overall conclusion. If the overall conclusion of a RABA is a positive recommendation, it will probably be relevant to proceed with more detailed studies. Two specific methods that may be used are the MLA (Multidisciplinary Landscape Assessment) approach[1] and the RAP (Rapid Assessment Program)[2] method.

[1]MLA is a method to assess local people's perspectives on biodiversity. The method was developed by Centre for International Forestry Research, a Bogor-based research institute.
[2]RAP is a rapid approach to scientifically assess facets of biodiversity (mostly assemblages of species in a certain ecosystem). The method was developed by Conservation International (CI), a Washington-based conservation organization.

1. Introduction

1.1. The end product of RABA
1.2. Agrobiodiversity

1. INTRODUCTION

1.1. The end product of a Rapid Agrobiodiversity Appraisal

It may be best to start at the end (figure 1). At the end of a Rapid Agrobiodiversity Appraisal (RABA), an 'honest broker' or intermediary will have to advise the local stakeholders of a biodiversity-rich agricultural landscape, as well as the outside stakeholders interested in supporting the conservation of that biodiversity, whether it is worth pursuing 'negotiations' towards a system of rewarding biodiversity conservation. If the answer is 'no', both sides can avoid disappointment by focussing on other activities or sites. If the answer is 'yes', further studies will be needed. If the broker isn't 'honest', all parties (including the 'broker') may lose by wasting time and effort.

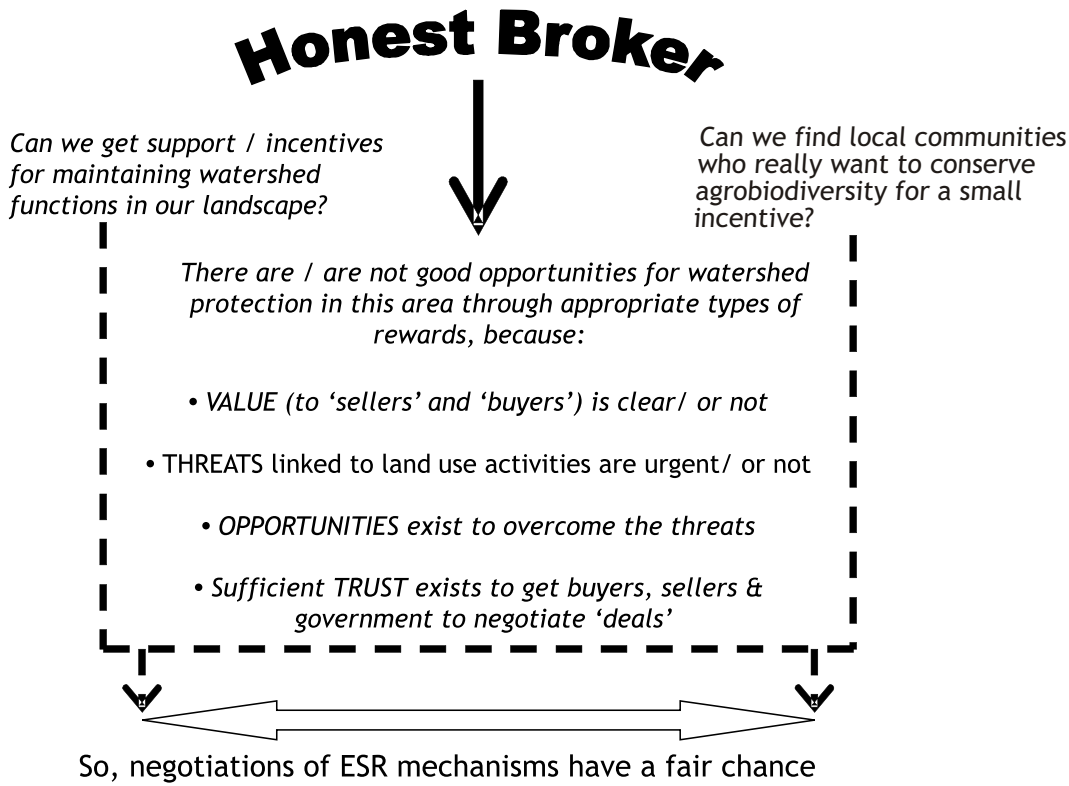


Figure 1: The main conclusion of a Rapid Agrobiodiversity Appraisal is advice, either to pursue more formal negotiations towards environmental-service reward mechanisms, or to look for alternative arrangements as the chances of success are likely to be low.

1.2. Agrobiodiversity

Agriculture refers literally to cultivating fields and normally starts with clearing fields of vegetation, which usually implies a loss of biodiversity. Yet, seen at larger temporal and spatial scale, many agricultural landscapes still contain substantial parts of the original biodiversity of pre-human vegetation – and allow for the expansion of flora and fauna of more open habitats. Many of these additions are considered to be invasive exotics, but many invasive exotics of the past have become valued 'natives', at least from a farmer's perspective. If agriculture is intensified, it tends to utilize a larger fraction of the landscape over a larger fraction of the time (reducing 'fallow' lengths), reduce crop diversity and increase the control over undesirable components of local diversity (labelled 'pests, weeds and diseases'). At some point in this process of intensification, thresholds may be crossed and ecological functions that are relevant for the farmer may be compromised (Swift et al. 2004, Vandermeer et al. 1998). It is likely, however, that this threshold of minimum diversity required for agricultural functions is substantially below the level of conservation that is desirable from a global perspective. In other words, agriculture tends to operate in a 'trade-off' zone, where intensification tends to have financial benefits but ecological costs. Reward mechanisms that help 'internalize' the global benefits at the level of the farmerdecision maker are therefore relevant and necessary. Beyond this general need for rewards, however, we realize that location-specific appraisal is needed to develop reward mechanisms that are effective, efficient and transparent. RABA is meant to be a tool in developing such reward mechanisms, based on an appraisal of the strengths, threats, opportunities and trust between partners.

The interface between conservation and agriculture can be abrupt – as in the 'segregation' of protected areas from surrounding or adjacent intensive agriculture – or gradual in the form of 'integrated' land-use forms (Tomich et al. 1998a, van Noordwijk et al. 2001a, b). In the latter, we often deal with a gradient of land-use intensities – a gradual shift from conservation to production goals. Of specific interest to the current dialogue are the 'integrated' areas that are adjacent to protected areas and those that provide landscape connectivity between protected areas. The conservation value of the 'agrobiodiversity' in such areas probably exceeds the value for the farmers per se and external rewards will be relevant to make the investment in protected areas pay off.

In the continuum of exploitation and modification of forests, a threshold is past when farmers start to actively manage and plant trees and other species of high use value. This form of 'domestication of forests' can still be compatible with natural processes of establishment and growth (succession) of forest species into the 'agroforest' (Michon 2005). Despite the biological and ecological similarities (Schroth et al. 2004)[3], there are historical, sociocultural, institutional and economic, as well as social and political differences between agroforests and forests that are exploited at community scale without tree planting. These agroforests and extensively managed forests perform many of the functions of undisturbed natural forests and can complement forests in protected areas for landscape-scale conservation (Plieninger and Wilbrand 2001, De Clerk and Negregos-Castillo 2000, Williams et al. 2001, Rasnovi and Vincent personal communication). These managed forests and agroforests are considered to be a

[3]Schroth et al. (2004) show how 'artificial' agricultural land use in complex agroforestry systems might not have significantly different vegetation structure from that found in the natural state. Thus, not all agricultural land uses are disadvantageous to the preservation of natural flora and

relatively safe haven for 'agrobiodiversity' (Box 1), or the biodiversity that survives in an agricultural landscape. However, in most cases, the biodiversity present in managed landscapes falls far short of that in habitats that have been less altered by human use (e.g. O'Connor personal observation).

Box 1. Definition of agrobiodiversity

The Convention on Biological Diversity (in Parris 2001 p. 28) defines biodiversity as the variety among living organisms, including diversity within and among species and diversity within and among ecosystems. Agrobiodiversity is essentially the biodiversity present in and supported by agricultural landscapes. It includes the diversity of knowledge and management styles ('culture'). It is the source of many agro-ecosystem benefits and services that are of local value, but it can also represent global values, especially in areas that are connected to 'protected areas'.

Agrobiodiversity can be considered in three levels based on:

- *genetic diversity* ('within species'): the diversity of genes within already domesticated plants and livestock species and their wild relatives;
- *species diversity* ('among species'): the number and population size of wild species (flora and fauna) surviving in agricultural landscapes, including soil biota; acknowledging the effects of non-native species on agriculture and native biodiversity;
- *ecosystem diversity* ('of ecosystems'): the ecosystems formed by biotic and abiotic interactions of species relevant to agriculture or of species and communities partially dependent on agricultural habitats.

In the context of RABA, agrobiodiversity consists of both 'wild' and 'domesticated' components, from which use and non-use values are considered to be potentially important for local decision makers as well as external stakeholders.

The 'agricultural intensification hypothesis' states that more intensive and productive forms of agriculture can help to reduce pressure on remnant forest. However, reviews of the evidence (van Noordwijk et al. 1995, Tomich et al. 1998a, Angelsen and Kaimowitz 2004) suggest that availability of technical options for intensification is at best a conditioning factor for forest conservation, but that only where more labour-intensive forms of agriculture provide higher returns to labour than forest extraction can a direct forest-conserving effect be expected. Agroforestry and other tree-based land-use systems will not in general meet this criterion, and can thus only contribute to conservation goals in combination with rules (or physical landscapes) that restrict access to natural forest. Yet, agroforests and similar tree-based land uses are being advocated as alternatives for maintaining the supply of environmental services, especially where forest is scarce or absent. The main importance of this type of land use is that it offers greater potential as an auxiliary tool for preserving environmental-services provision while as the same time attaining production goals (Schroth et al. 2004). With regard to biodiversity conservation, one of the specific roles of agrobiodiversity is providing habitat and resources for partially forest-dependent species that would not be able to survive in a purely agricultural landscape. This may be done by forming a suitable 'matrix' in which the 'gems' of protected areas are set and by providing corridors of connectivity by offering habitat niches for partially forest-dependent species.

Box 2. Introduction to Bungo, Jambi, Indonesia and North Thailand RABA test sites

Bungo District, Jambi, Indonesia

The area of Muara Bungo District is located between 1°08' and 1°15' latitude and 101°27' and 102°30' longitude. The region is relatively flat, and has an altitude of less than 500 m above sea level. Approximately 50% of the land is covered by rubber-based systems, of which 15% is in the form of old rubber agroforests or 'jungle rubber'.

In comparison with mature natural forest, jungle rubber has relatively low basal area, more open canopy and also lower but considerable diversity of forest understorey species. Michon and de Forestra (1994) found that sampled jungle rubber sites in Bungo-Tebo (now Bungo) District contained 92 tree species, 97 lianas and 28 ephiphytes, compared with 171, 89 and 63 (respectively) in the primary forest of the same sample area. Because of the land-use history, the rubber agroforests are mostly located along riverbanks and adjacent to villages, up to a distance of 1 kilometre. After the switch from river to road transport, parts of these riparian agroforests have been left behind in a road-focussed development strategy and they now form a series patchwork of forest-like habitat along the rivers.

In the Bungo area, deforestation has been high, with almost 60% of the forest having been lost (Ekadinata and Vincent 2004). Additionally, Bungo area is surrounded by three national parks (Kerinci Seblat, Bukit Dua Belas and Bukit Dua Puluh). These parks can be seen as islands of rich biodiversity, which are isolated from each other. The locations where jungle rubber subsists, which are in the proximity of a village and especially along riverbanks, potentially interconnect the three parks. Therefore, apart from the potential to become a refuge area for nearby forest species, jungle rubber could also serve as a buffer zone for local people and a 'stepping stone' or corridor for biological diversity from the national parks.

Mae Chaem District, North Thailand

Mae Chaem District of Chiang Mai Province is in the mountainous northern part of Thailand. The area is a mosaic of forest and agriculture with many examples of both traditional low-intensity shifting cultivation with long fallow periods and modern high-intensity agriculture with permanent fields. However, the newly created protected area in this landscape has triggered a new conflict related to land tenure. The area that has been newly designated for protection is traditionally owned and used by local people, the Karen.

The agricultural area provides a corridor, connecting important habitat. The villages controlling the land forming this corridor where chosen for further investigation. One of the key land uses in this area is 'community-protected forest'. This tends to occur on steep slopes and ridge areas that have relatively low 'use' value and high risk of negative effects after conversion. However, the previous mosaic of fields is changing and there has been a trend towards conversions of crop-fallow systems to become permanently cropped fields. This shift from an 'integrated' towards a 'segregated' pattern probably has impact on the functionality of the area for wildlife conservation.

The agroforests that are compatible with an intermediate stage of land-use intensification and are now recognized to have a function in landscape-level conservation, may be under threat of gradual loss of the 'wild' element for greater productivity or conversion to monocultural production systems.

Environmental degradation linked to this type of intensification may occur because insufficient benefits flow to the guardians of the land for their efforts in maintaining ecosystems and harbouring agrobiodiversity. The attributes of intensively managed production areas, both in terms of inputs and human involvement, be they privately or communally owned, complicate the linkage between maintaining production and ecological functions. Different approaches such as fencing conservation areas or integrating conservation and development have been tested in efforts to persuade or force people to guard biodiversity, but little success has been achieved[4]. These failures suggest the need for a different approach to conserve biodiversity. One such approach being considered is the use of market mechanisms and rewarding managers of productive landscapes that can harbour agrobiodiversity for the environmental services their landscapes provide.

[4]One example of an Integrated Conservation and Development Project (ICDP) in Kerinci Seblat National Park is the case of Organic Spice. People in the buffer zone area of Kerinci have been cultivating cinnamon for many years. However, the low level of trust between institutions and community, as well as weak monitoring have inhibited the organic spice programme from developing as a sustainable livelihood.

2. Rapid Agrobiodiversity Appraisal (RABA)

2.1. Step 1: Locating potential areas and determining conservation values - (V)
2.2. Step 2: Land use identification and classification (V, S_{bo})
2.3. Step 3: Threat and opportunity: Secondary data (V, H, S_{bo} and S_{bi})
2.4. Step 4: Stakeholder analysis (H, S_{bi} and S_{bo})
2.5. Step 5: Future scenario - Taking into account local knowledge (N, H, S_{bo}, S_{bi})
2.6. Step 6: Additional 'first hand' information (V, H, S_{bi} and S_{bo})
2.7. Opportunity assessment - Summarizing the findings

2. RAPID AGROBIODIVERSITY APPRAISAL (RABA)

RABA was developed under the assumption that effective natural-resource management, including biodiversity conservation, can only be achieved if there is a synergy between three different types of capital – human, natural and social. Linkage between human and natural capital would result in good land-use management, while synergy between natural and social capital would produce a solid institution for managing natural resources. The combination of all three provides the basis of evaluation for rewarding local agrobiodiversity conservation.

Very few existing biodiversity conservation mechanisms are, in practice, sufficiently satisfactory to both providers and sellers. Almost all of the existing projects have transaction costs that are prohibitively high. One opportunity to benefit the situation is to improve the flow of information.

RABA sees the success of a reward mechanism for environmental service as being conditional on four elements: natural capital (V=value), human capital (H=human), and social bonding (S_{bo}) and social bridging capitals (S_{bi}) (figure 2). Insufficiency in any of these aspects can be a hindrance to a successful reward mechanism. These four elements can also be used to describe past and current systems for acknowledging environmental services (from integrated conservation and development [ICDP], adaptive co-management of landscapes, to rewards for environmental services).

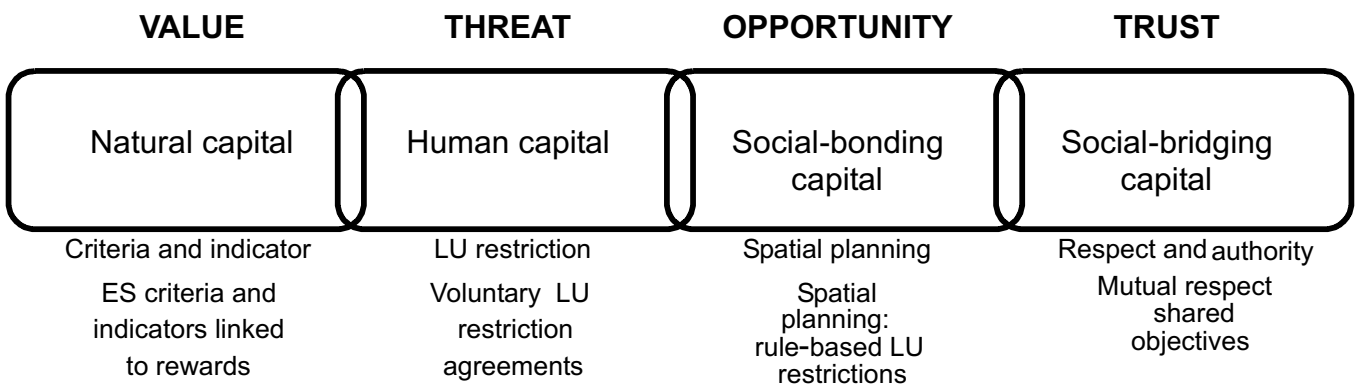


Figure 2. Natural, human and social capitals in environmental-service rewards.

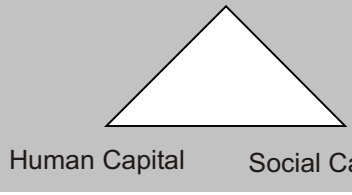
Box 3. Different types of capital

'Natural Capital', often referred to as 'environmental capital', is the natural resource stock from which resources useful for livelihoods are derived. These could include water, land, commodities or services. It refers to a stock (for example, a forest) which produces a flow of goods (such as new trees) and services (for example, carbon sequestration, erosion control or habitat). (http://canadianeconomy.gc.ca/English/economy/natural_capital.html).

'Human Capital' is the collective 'assets' and 'wealth' in terms of talents and capacities of a group of individual human beings when viewed as part of the development process (www.cadi.ph/glossary_of_terms.htm). It also includes the individual or collective knowledge and physical attributes of people that they use in producing goods and services. (http://www.futureharvest.org/about/glossary.shtml).

'Social Capital' is often understood as the types of groups and networks that people can call upon, and the nature and extent of their contributions to other members of those networks. It is measured by respondents' subjective perceptions of the trustworthiness of other people and key institutions that shape their lives, as well as the norms of cooperation and reciprocity that surround attempts to work together to solve problems (Grootaert et al. 2003).

The relationship between these three types of capital and the management and conservation of resources is shown below.



Natural x Human Capital = Land Use
Human x Social Capital = Institution
Human x Natural x Social = Opportunity for biodiversity conservation

The ICDP approach was primarily aimed at establishing, or restoring, trust between the conservation agencies and the inhabitants of landscapes with high conservation value, but it often failed to establish clarity on outcome criteria and conditionality of incentives on continued delivery of the services. Adaptive co-management arrangements tend to focus on land-use zoning and management plans, but again lack 'conditionality'. A strict form of payments for environmental services is fully based on conditionality and simple criteria and indicators of service delivery (Wunder 2005). In between is a broader domain of mechanisms that combine elements of trust, planning and conditionality based on negotiated and in essence voluntary agreements (see van Noordwijk et al. 2004).

The RABA method aims to develop and test a tool for matching a 'bottom-up' sellers' perspective and a 'top-down' buyers' view on strategies that are cost-effective. RABA is seen to have four stages for sellers and buyers to engage in arranging environmental-service rewards (ESR), namely scoping, identifying potential partners, negotiating agreements, and monitoring and evaluating compliance and outcomes (table 1).

Table 1. Stages of RABA and some essential questions for engagement in rewards for environmental services

Stage	**Rapid Agrobiodiversity Appraisal**	*Sellers perspective* Communities that manage or control biodiversity-rich agro-ecosystems	*Buyers perspective* Institutions interested in conserving agrobiodiversity
Scoping		• What do we have that is of interest to outside stakeholders? • What are the downsides to us of efforts to conserve? • What are the positive sides to us of maintaining biodiversity? • What willingness to pay can we expect?	• Where are the areas under threat? Where are conservation activities needed? What species and ecosystems are under threat? • Who can effectively influence conservation uses in these areas? • What willingness to sell can we expect?
Identifying potential partners		• Who should we talk to? • What documentation do we need?	• Who can effectively and equitably represent all the local actors? • Does local government qualify?
Negotiating agreements		• How do we balance restrictions imposed on us with substantive rewards?	• How do we know we can trust the sellers? What guarantees are built in?
Monitoring and evaluating compliance and outcomes		• How can we deal with defectors & free riders in the community? • How do we know the buyer is satisfied?	• How is compliance (at output level) monitored? • How are outcomes monitored?

The RABA itself is designed to cover the stages of scoping out the domain and identifying partners who will be engaged in the transactions. As an analytical framework (figure 3), RABA offers guidance on the important things that should be noted in any attempt to advocate conservation of agrobiodiversity in the context of environmental-service rewards. It captures the perspectives of seller, buyer and intermediaries. As a tool, RABA is also designed to assist in locating and obtaining initial data necessary for sellers, intermediaries and buyers to explore the potential for developing a reward system.

The approach consists of five steps, four of which comprise RABA (figure 4). Locating the area of biodiversity importance, for example, could be seen as an activity that should be conducted by the potential intermediary or as a joint activity with the seller. Limited access to information limits the seller's knowledge about biodiversity hotspots and endangered species. In such a case, it is the intermediaries' role to provide information about the location of biodiversity importance. However, in other cases where there is local knowledge on endangered species, potential sellers could provide initial indicators on the existence of endangered plants or animals. Organizations that might have an interest in conserving endangered species and research organizations are other potential sources of information.

The seller could refer to existing definitions of conservation priorities developed by many conservation organizations. Although done coarsely, the process of locating the area also represents the first filter for indicating situations where there is potential for ESR. Areas of high priority may be indicated by the nature of the species assemblage, its uniqueness and the threats it faces.

Some activities are conducted jointly. For example, inventory of local issues and societies are to be conducted together by intermediaries and potential buyers. The division of work and the context of analysis may be different in each case of ESR engagement, but assessment of the credibility of the potential seller will always be a focus that buyers are very interested in.

RABA is not a stand-alone tool; rather it is a tool in which approaches to rapidly collect data and appraise the conservation value of an area are combined, summarized and adapted. Different techniques such as Rapid Rural Appraisal, Stakeholder Analysis and exploration of 'citizen science' (such as Local Ecological Knowledge) are among the methods or approaches that have been taken into account in the different phases of RABA.

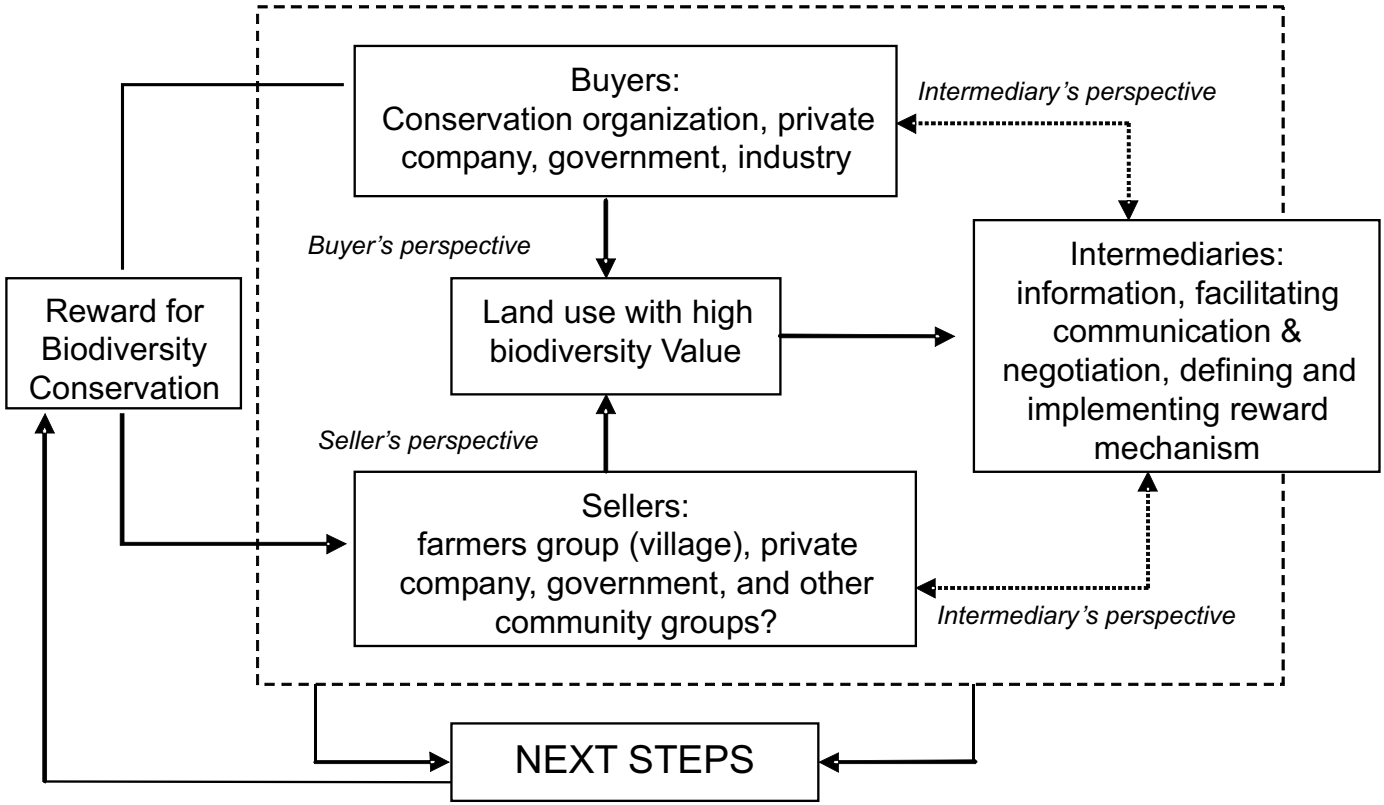


Figure 3. Analytical framework of RABA

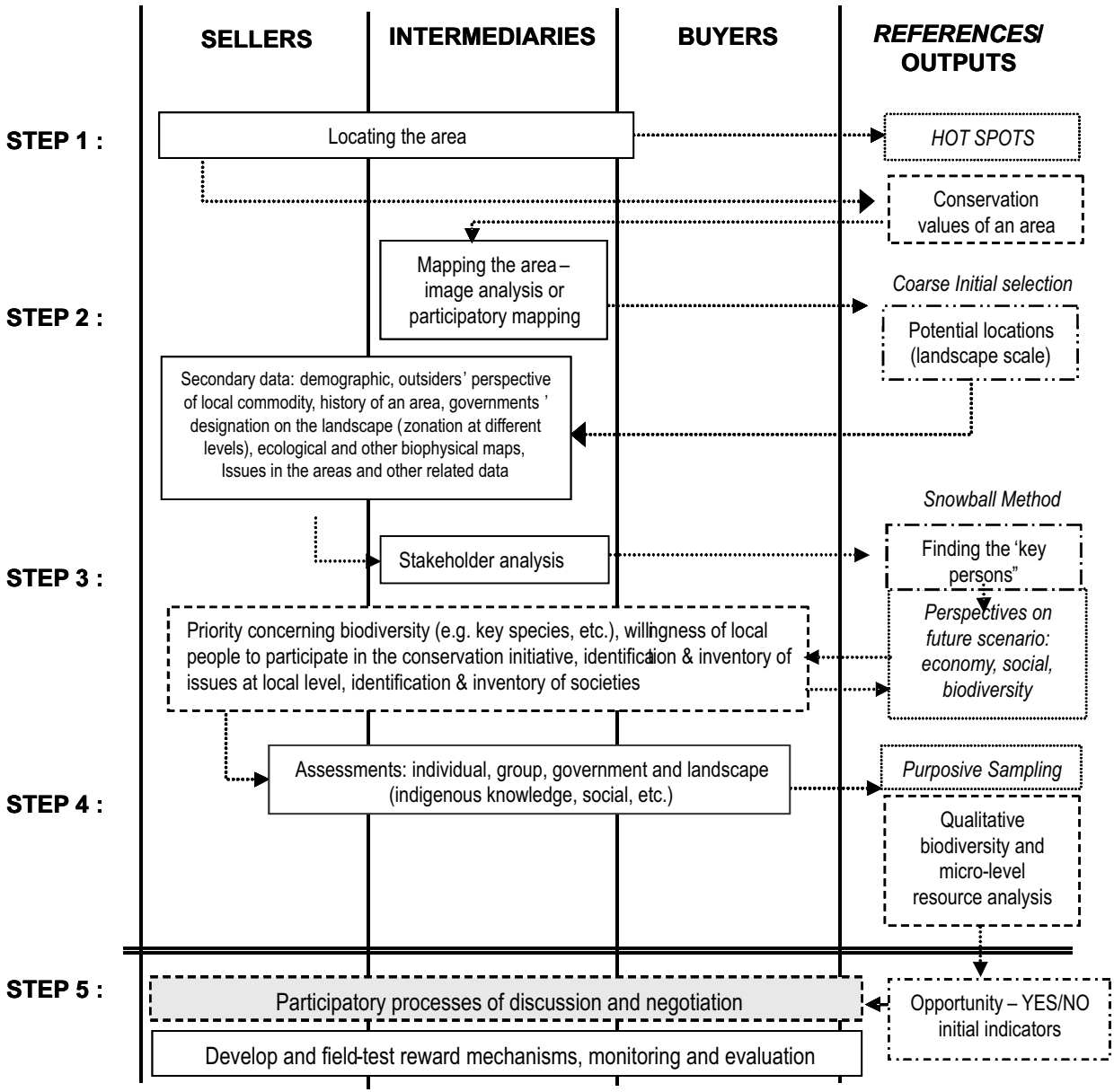


Figure 4. Step-wise approach of RABA tool. The columns represent the parties involved in the process.

Box 4. Locations of biodiversity importance

Large conservation organizations have identified locations of biodiversity importance. WWF (World Wildlife Fund for Nature) uses an ecosystem-based approach, while Conservation International (CI) has combined the uniqueness and rarity of species and rate of resource/habitat degradation approach to determine 'hotspots'. IUCN (the World Conservation Union) and Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) use rarity of species to construct lists of endangered species, while RAMSAR emphasizes the presence of critical habitats, especially wetlands, to determine its focal areas.

Additionally, the condition of areas adjacent to the focus locations may also be important, as they can be supportive to the focal area as corridors to connect the habitat with other patches, providing opportunity for genetic conservation and habitat for a wider range of species that might ultimately benefit the flagship species. These important areas for biodiversity can be seen in the following links:

- Global 200 - WWF
  (http://www.panda.org/about_wwf/where_we_work/ecoregions/about/index.cfm)
- Conservation hotspots - CI
  (http://www.biodiversityhotspots.org/xp/Hotspots?c=14005079)
- The Red List - IUCN
  (http://www.redlist.org/search/search-basic.html)
- RAMSAR's Wetlands Area - RAMSAR
  (http://www.ramsar.org/)
- CITES, list of endangered species - CITES
  http://www.cites.org/eng/disc/species.shtml)
- Focus areas of the Global Environment Facility (GEF)
  (Http://www.gefweb.org)

2.1 Step 1: Locating potential areas and determining conservation values (V)

The initial stage of this tool consists mainly of compiling and analysing secondary data. The question to answer from the first step is whether the area under consideration is located within an area of known biological value. These locations, whether determined by the presence of flagship species, unique habitat, rapid resource or habitat degradation, high species richness or a combination of these features, represent the areas of greatest interest to conservation agencies.

In order to complement the global-level information available from various websites, other web-based information can be collected rapidly. This may include information about protected areas and biodiversity at provincial and national levels, any regional development plan of a potential area and lists of endangered species at national level. These are usually provided on websites of forestry departments, governments' regional planning bodies or research institutes.

2.2. Step 2: Land-use identification and classification (V, S_{bo})

The focus of step 2 is to ascertain what type of land use shows potential for conservation of agrobiodiversity and where this is located. It is important to keep in mind that the effectiveness of a protected or conservation area is related to it having sufficient area or habitat matrices, from which little 'leakage' occurs. Therefore, having located the focal sites, the following step is to determine competing land uses that might become a threat in the future.

2.2.1 Mapping the area of agrobiodiversity importance

Spatial analysis can provide baseline data to be used in the identification of potential biodiversity conservation areas. In the context of RABA, there are two things that should be considered when mapping an area: the size of the area and the level of human population. It is suggested that when dealing with a vast area with a low population, spatial analysis using satellite imagery or aerial photographs is more effective than participatory mapping. On the other hand, participatory mapping would be more effective for smaller areas that are well populated. Despite the time necessary to conduct participatory mapping, the approach is useful to understand local definitions of land-use types and institutions related to land and natural-resource use.

Nevertheless, the two approaches have similar needs for baseline spatial data, which provides basic information on the study site. Examples of maps that are classified as baseline data are: administrative maps (provincial- to village-scale maps), soil and geological maps, road and river networks, and land/forest status maps. These maps can be obtained from local government agencies, forestry departments, or mapping/survey agencies. Most of these maps are usually available in 'hardcopy form', which must be digitized. Some maps that are obtained in digital form may still require editing to ensure their quality.

Spatial analysis - Participatory mapping

Many community development initiatives that on paper seem well designed, turn out, in practice, not to be suitable for the beneficiaries. Consequently, few of the beneficiaries support project implementation. Participatory mapping is a process involving all members of the community. Apart from the objective of obtaining local perspectives about the areas, the process is also useful for increasing the local people's information base and bonding capital, as well as increasing their participation in an activity.

The underlying reason for advocating participatory mapping is that the people who know about an area are those who are living in it. The objective of participatory mapping is to map aspects of the villagers' land and resources that are important to them. There are two groups of people working together: the GIS experts integrate all GIS-based map needs for the area of interest, while local communities assist in mapping their area according to local definitions of land-use types. The method used here involves farmers and local communities in resource mapping, and then transfers data from draft maps to spatial information (see example shown in Annex 5).

GIS-based maps – such as road, river, mountain peak position, village location, land cover, elevations – and local place names are important for marking boundaries and transforming data into GIS format. Participatory mapping benefits

from participation by local communities explaining local resource utilization and change in the area. Outsiders will then be able to understand the context of their land use and see the potential of the area for conservation more clearly. An example technique for conducting participatory mapping is given in Annex 6.

Spatial analysis - Remote-sensing-based mapping

There are two additional types of data that are needed to conduct an image analysis to delineate potential areas for agrobiodiversity conservation – elevation and land-cover data. The former are of importance in landscape analysis and also to help in field exploration, while the latter are of importance for obtaining information related to existing land uses in the area identified as having potential for conservation activities.

Additional to the collection of maps and other baseline information, an image analysis needs two further steps – processing and analysis, and delineation of potential areas for biodiversity conservation. The processing and analysis is mainly used to classify the existing land cover using aerial photographs or satellite images. Identifying locations for biodiversity conservation involves developing criteria and indicators for the specific areas, combining data and maps (baseline and other information) and contrasting the criteria and data to define potential conservation areas. The details of the suggested approach for spatial analysis are presented in Annex 5.

One type of information that can be derived from the analysis is the history of land conversion. This information reflects the rate of habitat and biodiversity loss, and provides an indication of the likelihood of land-use change in the near future. Therefore, level of threat can also be derived from the analysis.

2.3. Step 3: Threat and opportunity: Secondary data (V, H, S_{bo} and S_{bi})

The main objective of step 3 is to coarsely identify threats to the biodiversity of the area and opportunities to counter those threats. For conservation investments to be efficient, an agrobiodiversity conservation initiative should not aim to intervene in an area with too high or too low a level of threat or too little an opportunity to address those threats. The 'optimal level of threat' for intervention is hard to determine, and probably differs between conservation agencies, but in the absence of threat the opportunity costs for 'no intervention' are negligible and if the threat is not matched by opportunities to counteract it, outside efforts will appear to be a waste of time and resources.

Secondary data is essential to accelerate the pace of the appraisal process as well as to identify what additional primary data collection should be made. This background information could be in the form of maps or metadata. The importance of the locally observed agrobiodiversity within the national context can be evaluated from the representativeness of existing conservation areas. Some types of agrobiodiversity may be more valuable as being complementary to already protected areas than as a core habitat per se.

Some of the relevant types of information are: demographic, economic activities (especially the importance of local commodities, including plants and animals), area history, government policy for conservation and natural resources, as well as zonation plans and other ecological and biophysical data. Policy from different levels of government on the use of natural resources can also be unfavourable to biodiversity initiatives; thus, a thorough policy analysis is recommended.

2.4. Step 4: Stakeholder analysis (H, S_{bi} and S_{bo})

Stakeholder analysis is done to identify people or institutions that have vested interests in resource management in the selected area. Stakeholders are defined as people, groups or institutions that are likely to be affected, either positively or negatively, by a proposed intervention, or those who can affect the outcome of the intervention. Conducting a stakeholder analysis would allow users to design future activities, especially in respect to what and who should be taken into account in agrobiodiversity conservation initiatives.

Given time limitations and the wide variety of people and institutions to be dealt with, the best way to conduct stakeholder analysis is by combining secondary data with appropriate forms of participation by informal (customary) institutions and key stakeholder groups. This may include other interest groups (such as universities, research centres), as well as other development-related agencies that serve as sources of secondary information. Additionally, reflection upon and exploration of the knowledge and perspectives of stakeholders about the potential area, as well as their direct interests are to be solicited during the analysis.

There are many ways to conduct a stakeholder analysis, but one of the most practical was developed by Rietberger-McCracken and Narayan (1998). They summarized stakeholder analysis as a four-step process; *identifying* key stakeholders, assessing stakeholders' *interests* and *potential impact*, assessing *influence and importance*, and outlining a *strategy for stakeholder participation*. Further elaboration of stakeholder analysis is given in Annex 7.

2.4.1 Mapping the stakeholders

When tackling issues of poverty and environmental degradation, power relations and conflicting interests must be addressed. A stakeholder analysis provides a starting point, by establishing which groups to work with and setting out the appropriate approach. In order to obtain indications on the potential issues, once the initial stage of stakeholder analysis is completed, the interests of and interactions among the different stakeholder groups can be explored. The interactions among stakeholders – past, present and, most importantly, the future – with respect to natural-resource management and development of agrobiodiversity conservation are explored and summarized in terms of conflict, trade-offs and correspondence. Understanding these conditions will help to encourage stakeholders to see the value of agrobiodiversity conservation and to better manage the process. The outcome of this process is important for assessing the need for additional data collection (research), whether it is biodiversity-related data, socioeconomic data, local ecological knowledge or institution and policy related.

2.5. Step 5: Future scenario - Taking into account local knowledge (N, H, S_{bo}, S_{bi})

Following the stakeholder analysis is the step of obtaining perspectives of the identified stakeholders on their future expectations of economic, social and biodiversity conditions. This is done by conducting an assessment of society, both as individuals and as groups, and of government, with regard to landscape and land uses.

RABA is not a purely 'scientific' appraisal tool, it makes extensive use of 'citizen science' and local people's knowledge. This is on the basis of local knowledge of biodiversity having considerable advantages over scientific field techniques. These advantages include its time effectiveness, ease of use, flexibility for combination with other 'scientific' approaches, and it can foster development of relationships between researchers and the local community.

Several disadvantages of the methodology limit its appropriateness to certain research objectives. These include language barriers between cultures and between villages; variation in knowledge between key informants, which contributes to a lack of comparability; and a lack of trust between stakeholders or personal objectives of stakeholders that can affect accuracy and comprehensiveness of results. Nevertheless, in RABA it is essential to consider and document scientific and local taxonomic systems (see Box 5). The local system reflects local values including 'use' and 'service' functions and is important to understand for local communication. The scientific taxonomic system allows the work to be communicated internationally. The main risk is that a 'hybrid' system is used: local names are collected and 'translations' are made without the necessary checks. The same local name may be used for several biological species, varieties within biological species or completely different species depending on the place, individual and ethnic group involved. In reporting survey results, the source of taxonomic information has to be clearly specified.

Box 5. Local taxonomy - Getting it right

The local taxonomic system of plants and animals will rarely match exactly with the internationally recognized scientific taxonomic systems. Sometimes, the local system recognizes finer detail than that defined by biologists as a 'species', for example, different varieties with recognizable properties and possibly use value, but not necessarily reproductive isolation. This may be due to visual differences between 'species' members or other defining characteristics that make the phenotype more suited to a specific use by local communities. Similarly, members of scientifically recognized species may be lumped into the same nomenclature unit by local people due to similar characteristics. In addition, local systems may lack an understanding of life cycles and not recognize developmental stages as belonging to the same species as the adult counterpart, such as caterpillars and butterflies.

Some local systems are more complete than the scientific one, giving names to separate 'varieties' which do in fact represent valid species but have yet to be scientifically recognized. Each community and linguistic group will have its own criteria as the defining characteristics to separate and lump taxonomic groups. Often morphological and ecological similarities, as well as functional use, are used to define taxonomic groups instead of common evolutionary ancestry. Thus, direct translation between languages is not possible. If these differences in taxonomic systems are not taken into consideration, data collected will be faulty and misleading. So, please be clear on the methods used for taxonomic identification, whether using 'scientific' or 'local' taxonomy.

2.5.1 Exploring 'local perspectives'

Assessment of local perceptions or perceived value of agrobiodiversity usually indicates the relative importance of certain facets of biodiversity, which are non-quantitative, utility-focused and infrequently documented. Therefore, the existing methods of acquiring information usually use an ad-hoc approach. Some of the most commonly found issues related to resources management at the local level are shown in table 2.

Table 2. Exploring the perspectives of local actors on agrobiodiversity conservation

Aspects to explore in the assessment	Examples of ideas for exploration
Tenure and rights on land	Forms of rights, ownership and access, terms and definition of land uses, acknowledgement of rights; establishment of claims and resolution of conflicts and multiple claims
Local knowledge on agrobiodiversity	Use and non-use values of plants and animals, management of utilization, knowledge about function of agrobiodiversity, forests and other land uses (products and services)
Livelihood importance	Alternative livelihood options, dependency on forest agrobiodiversity, and other land uses
Institutions	Existing regulations, agreements with other organizations (government, private sector or other villages), collective actions, customary rules and regulations
Threats and environmental services-related issues	Behaviour in natural-resource extraction, level of satisfaction from current land use, preference in regards to land-use types, policy from different administrative levels
Potential opportunities	Bundling the environmental services, existing networks, unforeseen opportunities

In order to explore these aspects, a set of questionnaires has been prepared (see Annexes 8-14). Although the questionnaires are specifically tailored for Indonesian and Thai contexts, they are designed to be adequately generic to be used in other tropical contexts.

Social strata in a village

Key persons are selected on the basis of representativeness of the existing 'social strata'. Despite the fact that social strata are established informally, issues are often perceived differently by these different social groups. For example, it is often suggested that wealthier individuals may be less dependent on different aspects of agrobiodiversity, while at the same time they may have higher control over the resources and options to overexploit them. In addition, poorer

individuals might appreciate a community-based ownership of agrobiodiversity, as (due to existing rules) they possess access security. Based on these facts, some ideas to consider in selecting 'social strata' at village level are:

- Gender – institutional arrangements for division of responsibilities in daily living; women's representation and decision making, etc.
- Economic assets and land ownership (land owner, tenants, intermediaries)
- Representation of institutions (customary, administrative)
- Professions/occupations (manager, hunter, fisherman, etc.)

To ensure rapid capture of issues (or problems) regarding land uses and biodiversity perceived by different 'strata', the number of people to be interviewed at this stage is projected not to exceed 10. Additionally, in order to avoid bias in the information acquired from individuals, two group discussions are also to be conducted in every village assessment, one male and one female group.

2.6. Step 6: Additional 'first hand' information (V, H, S_{bi} and S_{bo})

Buyers need to be assured that the landscape and agrobiodiversity land use can deliver the environmental services in the quality and quantity for which they have paid. Prior to commencing the society assessment processes, three activities need to be done to obtain relevant information for buyers and intermediaries of biodiversity conservation services. These activities are:

- Defining the society to work with
- Identification and clarification of definition of threats, perceived as positive or negative, and potential impacts of actual land use/landscape
- Biodiversity and agrobiodiversity assessment.

As emphasized earlier, RABA does not constitute a technical biodiversity appraisal method. Therefore, it is suggested that users refer to the existing rapid biodiversity assessment techniques that are available.

2.6.1 Biodiversity assessment

A rapid assessment of biodiversity would doubtfully be acceptable for scientific purposes, because of the modest quality of data collected and the complex attributes of biodiversity. However, having specified the purpose of the assessment – that is, solely to obtain indicators for richness, uniqueness and other functional attributes–, it is believed that a combination of 'citizen science' and semi-qualitative data would be adequately acceptable for potential donors.

Participatory processes in juxtaposition with individual interviews with the extractors of natural resources (such as hunters, bird catchers and fisherman), group discussion, a simple semi-qualitative survey and observational walks, are simple and quick, but at the same time quite successful for gathering information (Celestreme personal communication 2005). However, language and idiomatic expressions are indeed a challenge in following such an approach.

Other rapid assessment techniques for plant assemblages are also available and ready to use (Gillison 2001).

2.6.2 Social aspects

In the chain of elements important for biodiversity conservation (figure 2), two of the four components comprise social capital. Social capital is used to determine the 'performance' and 'social quality' of society towards the development of self-regulatory mechanisms. The exploration of this quality is done under the assumption that societies with better social capital perform more effectively and efficiently in managing their natural resources (both individually and community owned) by using their institutions, thus reducing the number of free riders. The quality is determined by the involvement of individuals in different collective actions and other organizations occurring in the society in which they reside.

Narayan (cited in Grootaert et al. 2003) suggests that there are two types of social capital that should be considered in attempts to measure network access and forms of participation: 'bonding' social capital, i.e. ties to people who are similar in terms of their demographic characteristics, such as family members, neighbours, close friends and work colleagues; and 'bridging' social capital, i.e. ties to people who do not share many of these characteristics.

Interviews with individuals or households are done purposively by selecting respondents who own or manage (cultivate, reside on, extract resources from) certain types of land that have potential for biodiversity conservation. The number of households to be interviewed depends on the population size.

The objective of exploring social aspects of a society is to find indicators on the identity of its constituents, how they perceive their landscape and any interactions between institutions and societies. These indicators, for example, could be a positive perspective towards having rich-biodiversity land use, although this system does not provide competitive financial benefit. People who have such a perspective could be used initially to identify future beneficiaries of reward for biodiversity conservation. Additionally, base information to measure 'social capital' includes knowledge of existing collective actions and informal organizations, as well as involvement of individuals in those collective actions and organizations (e.g. rules, membership, acknowledgement and involvement in the collective actions and organization).

Data related to social aspects are mostly constructed from qualitative analysis of the condition of the village or society being assessed. Other measures are derived using a simple tabulation to obtain information regarding the quality of social capital. The level of social capital in a society is indicated by elements of collective actions and involvement of individuals/members of households in the existing collective actions and other organizations. The extent to which social capital is developed may be evaluated by quantifying the number of people involved in organizations (such as number of and level of participation). High levels of participation are taken to imply high development of social capital.

2.6.3 Economy and livelihood assessment

The degree of dependency of farmers on their agrobiodiversity is a crucial indicator to express the likelihood of farmers maintaining the biodiversity-friendly land use.

Livelihood importance is assessed using the 'game' elaborated in Annex 15. Nevertheless, the method is not designed to assess in detail the importance of a certain type of land use with regard to local people's livelihood. Therefore, a simple and quick approach is of particular use for obtaining an indication of the importance of land uses and determining whether to conduct further analysis of this.

In addition, this importance of local land uses may also reflect perceived opportunity costs. This may be found by contrasting the findings of local knowledge[5] and practices with villagers' expectations for the future. For presenting the trade-offs, simple diagrams, where profitability is put on one axis (as depicted by return to land) and biodiversity is put on the other (figure 5), may be shown to farmers to explain their opportunity costs.

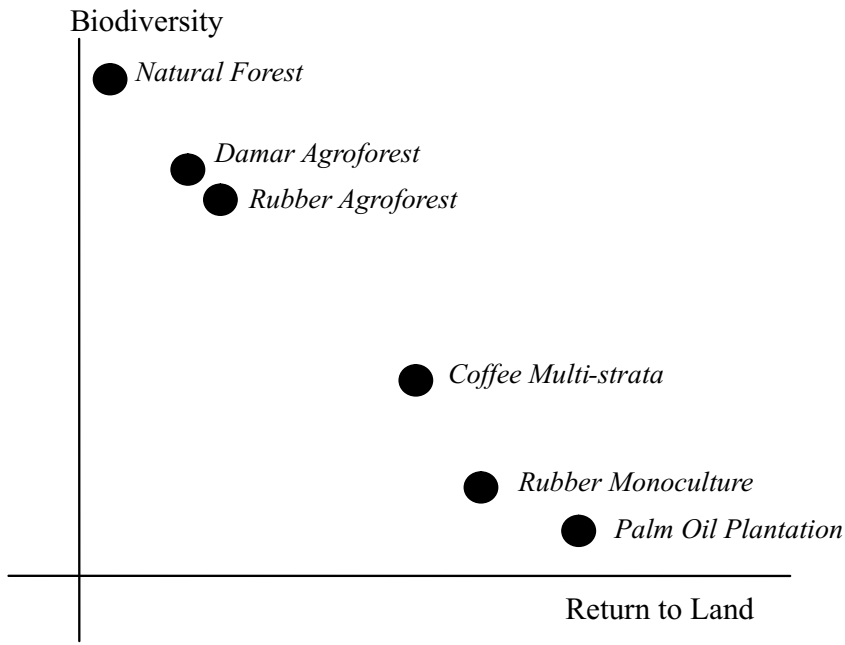


Figure 5. Simple trade-off between biodiversity and profitability (return to land). (*after* Tomich et al. 1998b)

[5]These may encompass utility and non-utility values of products and services from the targeted land use; including the religious importance of biodiversity, institutions, local knowledge and other added values.

2.7. Oppurtunity assessment - Summarizing the findings

Following the completion of data collection, there must be a decision on whether to commence an agrobiodiversity conservation initiative without ESR or to engage in rewards for environmental services. All the indicators (human, natural and social capitals) are needed to assist buyers and seller(s) to negotiate whether reward is necessary and together come up with a common consensus to initiate an ESR. During the RABA workshop in Jambi, all the sites' representatives (Bungo and North Thailand) were asked to come up with 10 justifications for a decision regarding the potential for each site, and an overall recommendation to potential sellers and buyers.

In order to provide a logical sequence, it may perhaps be useful to categorize the scoping questions along the lines of a SWOT (Strengths - Weaknesses - Opportunities - Threats) analysis. The logical sequence is essential for grouping the questions from the seller's and buyer's perspectives. The role of the brokers (intermediaries) would be to link the results of the two SWOTs.

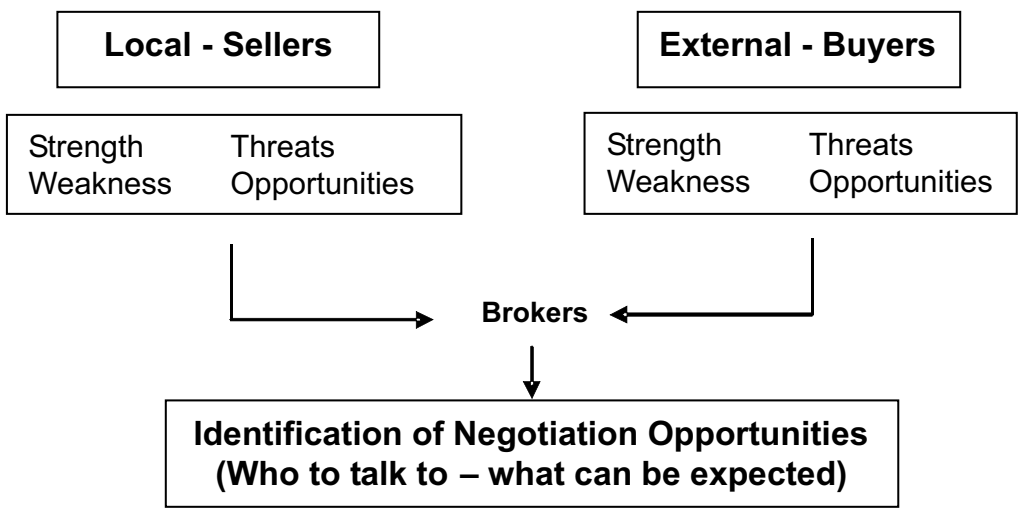


Figure 6. Scoping SWOT for agrobiodiversity conservation/enhancement.

Using the SWOT as a basis for prioritization, the following equations can be used:

Strengths - Weaknesses	= functional value
Threats x (Strengths - Weaknesses)	= urgency of action required
(Threats x (Strengths - Weaknesses))x Opportunities	= relevance of taking next steps: important threats that can be overcome.

If the sellers believe that the positive value of the system is higher than the threats, but the buyers do not, then there is insufficient external demand for the environmental service. In this case, the sellers would be keeping the system for their own benefit and not that of the external buyers. If, on the other hand, the positive value were greater for the external stakeholders they would be willing to pay for the environmental service being generated.

In other words:

(S - W) local > (S - W) external → if the local value (strengths minus weaknesses) exceeds the external value, there is limited need for intervention beyond helping to realize local incentives

(S - W) local < (S - W) external → if, however, the external perception of value exceeds the local one, we deal With a true 'externality' requiring incentives to overcome opportunity costs.

3. Case Study 1: Rubber agroforests in Bungo (Jambi, Indonesia)

3.1. Bungo and its biodiversity importance
3.2. Land-use classification and identification in Bungo District
3.3. Issues at local scale and stakeholder analysis
3.4. Assessing the societies and the landscapes
3.5. Conclusion

3. CASE STUDY 1: RUBBER AGROFORESTS IN BUNGO (JAMBI, INDONESIA)[6]

3.1 Bungo and its biodiversity importance

Indonesia is one of the Mega Biodiversity Countries – currently the third richest. The island of Sumatra is of great importance for biodiversity. Using WWF's Ecoregion definition, which uses habitat type as main indicator, the Bungo area falls within the upland Sumatra Forest.

VALUE: Bungo is in a biodiversity hotspot and there are numbers of flagship species in forest areas in Bungo

Conservation International's hotspots classification (Conservation International 2006) includes the island of Sumatra in the Sundaland territory. The hotspots are regions that harbour a great diversity of endemic species and, at the same time, have been significantly impacted upon and altered by human activities. Conservation International thus highlights 25 of the richest and most threatened reservoirs of plants and animals. On the basis of this classification, the whole of Indonesia (Sundaland and Wallaceae) – except for Papua – is considered to fall within hotspots, while Papua is considered 'Wilderness area'. Additionally, Bungo is also a potential focus site for the Global Environment Facility (GEF), as it falls in the buffer zone of Kerinci Seblat National Park. Other, non-geographical priority lists – such as IUCN's Red List (Baillie et al. 2004, IUCN 1994, 2006) and CITES (Inskipp and Gillet 2005) – show that some of the most threatened or endangered species dwell on the island of Sumatra.

[6] *Case Study Jambi* written by Susilo Ady Kuncoro, Endri Martini, Jasnari, Damsir Chaniago, Eri Malalo, Meine van Noordwijk, Laxman Joshi and Mikkel Kallesoe.

[7] Additional indicators for defining ecoregion are species richness, endemism, higher taxonomic uniqueness (e.g. unique genera or families, relict species or communities, primitive lineages), extraordinary ecological or evolutionary phenomena (e.g. extraordinary adaptive radiations, intact large vertebrate assemblages, presence of migrations of large vertebrates) and global rarity of the major habitat type.

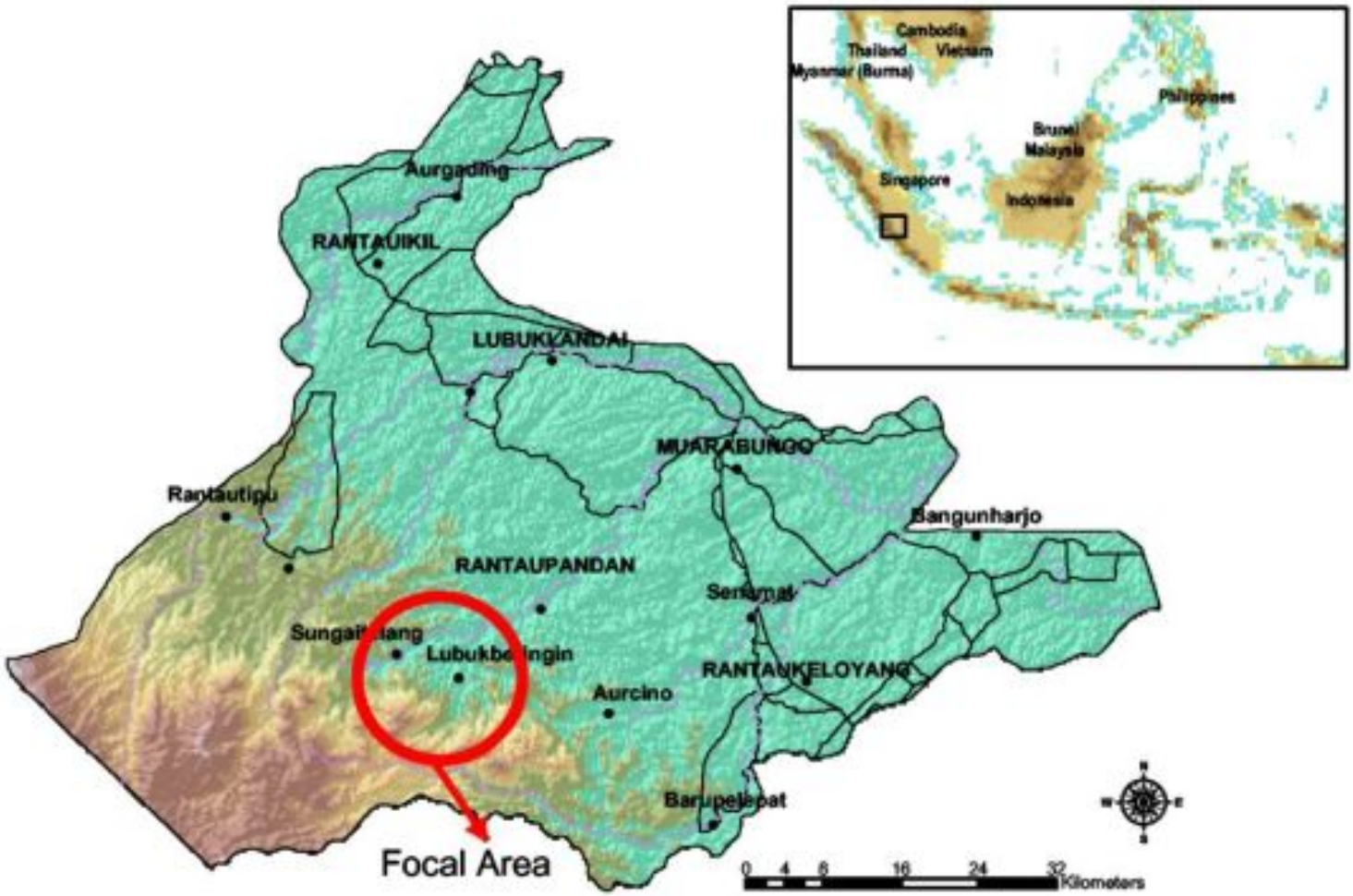


Figure 7. Location of Bungo District, Jambi Province, Indonesia.

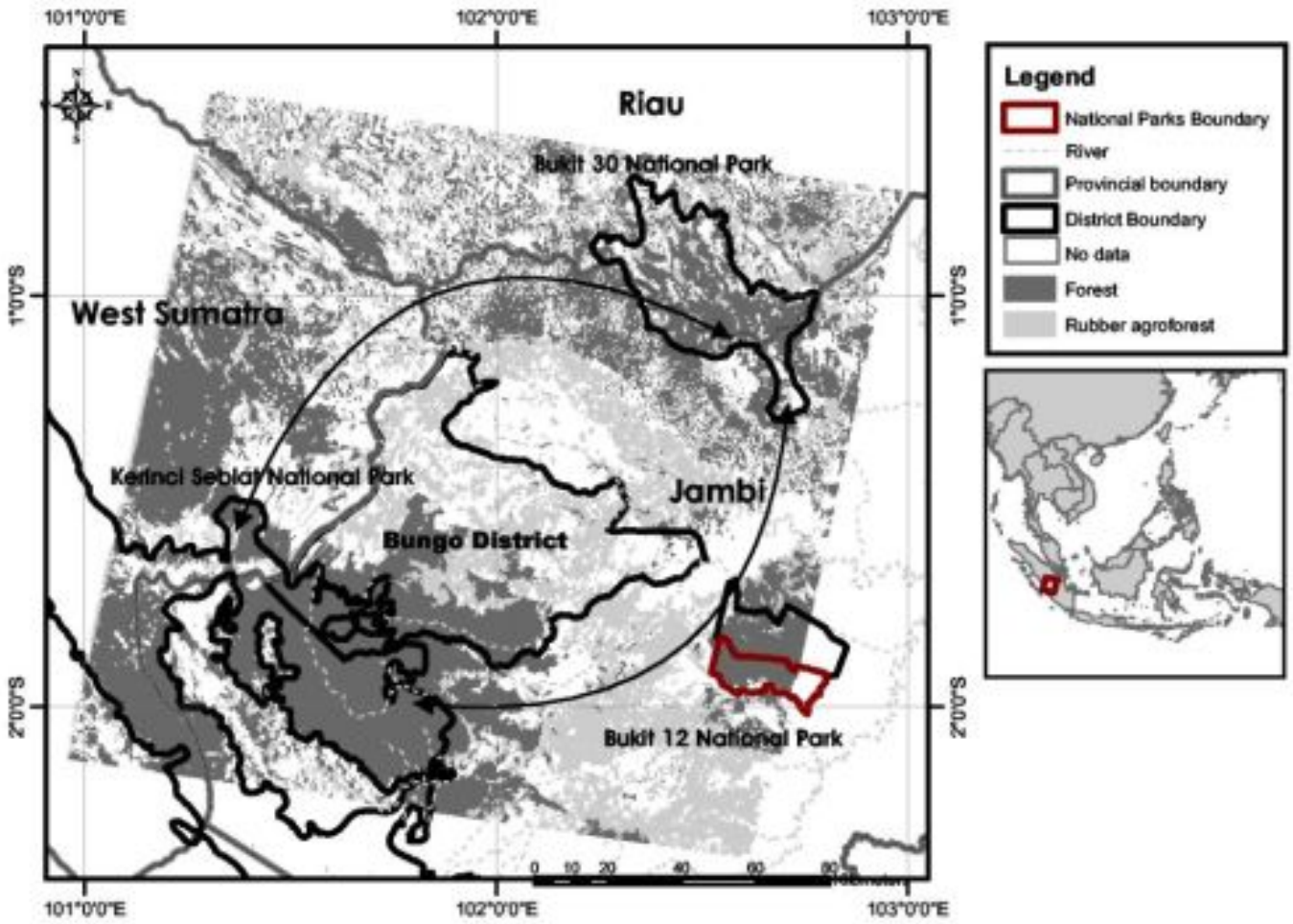


Figure 8. Potential of rubber agroforest as corridor to link three national parks.

VALUE: Bungo is in a local biodiversity hotspot (3 protected areas in its surroundings)

Bungo District in Jambi Area is situated on the south-west of Sumatra between 1°08' and 1°15' latitude and 101°27' and 102°30' longitude (figure 7). Most of the area (more than 75%) is relatively flat, and below 500 metres above sea level. The area is the headwaters of the Bungo River catchment area, one of the contributing watersheds to the Batanghari River, the longest river in Sumatra.

The focal area that is being promoted for biodiversity conservation is Bungo District. Apart from the global classification, the ecological importance of Bungo District can be seen from its relative proximity to the existing government-designed natural reserves. Although the location is not wholly covered by pristine forest, Bungo District is adjacent to Kerinci Seblat National Park (1.4 million hectares) and, a bit further north, near to Bukit Tiga Puluh National Park (144 000 hectares) and, to the south, near the Bukit Duabelas National Reserve (60 500 hectares). In this area, endangered species such as the Sumatran tiger (*Panthera tigris sumatrae*) and the worlds' biggest flower, the rafflesia (*Raflesia arnoldi*), persist. Therefore, the area has potential to inter-connect the existing natural reserves (figure 8).

THREATS: Rapid deforestation and ineffective protection of forests

Bungo Area has undergone incredibly rapid forest degradation - about 60% of the forest cover has disappeared in 35 years (ICRAF data). The remaining forest is considered to be rich in species and has other characteristics typical of lowland tropical forest, such as leafy tree creepers and big-buttress-rooted trees. The loss means that the previously dominant lowland tropical forest in which abundant biodiversity persisted has been replaced by intensive land-use types. For some specialist plants and animals, forests are the only habitats in which they can continue to survive, whereas for generalists, their adaptability to new environments has made them the least affected by forest degradation.

This indicates that remnant forests and protected areas in Bungo are not conserved adequately. Habitat for large animals such as Sumatran tigers is limited to 'islands' such as in Bukit Tiga Puluh National Park. Corridors that enable tigers to roam and inhabit areas outside the national park are threatened by deforestation and land conversion. Therefore, rubber agroforestry with its high plant assemblage diversity and dense canopy cover exhibits potential as a 'steeping stone' providing temporary habitat for endangered species to move between protected areas.

3.1.1 Conservation values of Bungo and rubber agroforests

The type of agroecosystem being promoted as likely to play a role in biodiversity conservation is the rubber agroforest system known as jungle rubber. In simple terms, jungle rubber is a type of agroforest in which rubber trees (*Hevea brasiliensis*) are planted together with fruit trees and timber trees. The site of Bungo District is important for biodiversity because the jungle rubber plots in the area are able to provide refuges for species from nearby forest.

Research in comparing forest, rubber agroforest and intensive monocultural plantations in Muara Bungo shows that in comparison with mature forest, jungle rubber has relatively low basal area, a more open canopy and also

VALUE: Rubber agroforest as a refuge for forest plant species and potential as corridor for ground-dwelling animals

considerable diversity of forest understorey species (albeit with less diversity than mature forest). Michon and de Forestra (1994) found that sampled jungle rubber sites contained 92 tree species, 97 lianas and 28 ephiphytes compared with 171, 89 and 63 (respectively) in the primary forest.

In addition to playing essential roles in harbouring flora and fauna elements of biodiversity from the adjacent forest areas, rubber agroforest also serves as 'stepping stones' for terrestrial animals. Several attributes of rubber agroforestry systems, make the land-cover type the likely 'best bet' both for replicating the function of forests as corridors and as alternatives for sustainable livelihood options. These characteristics include their location within two kilometres of villages and along riverbanks, extensive cover at landscape levels, ability to harbour 80% of forest plant diversity and at the same time high importance for local people's livelihoods.

Nonetheless, there is as yet insufficient research to confidently pronounce that rubber agroforest is essentially comparable to forest for biodiversity, and thus suitable for providing temporary habitat as corridors. Comparative studies using environmental indicators of landscape-level vegetation and dung beetles are being carried out. Further research on assemblages of bats and primates, to compare ecological functions of rubber agroforest and forests, is also being carried out. These surveys are being done to explore the potential of rubber agroforest as a habitat provider for those animals.

Even though there is a strong tendency toward a dynamic land-use change, with deforestation being a common pattern in Bungo, rubber agroforest has had relatively stable occupation. Land use in Bungo in 2002 (determined/interpreted from Landsat 7 images) is shown in figure 9.

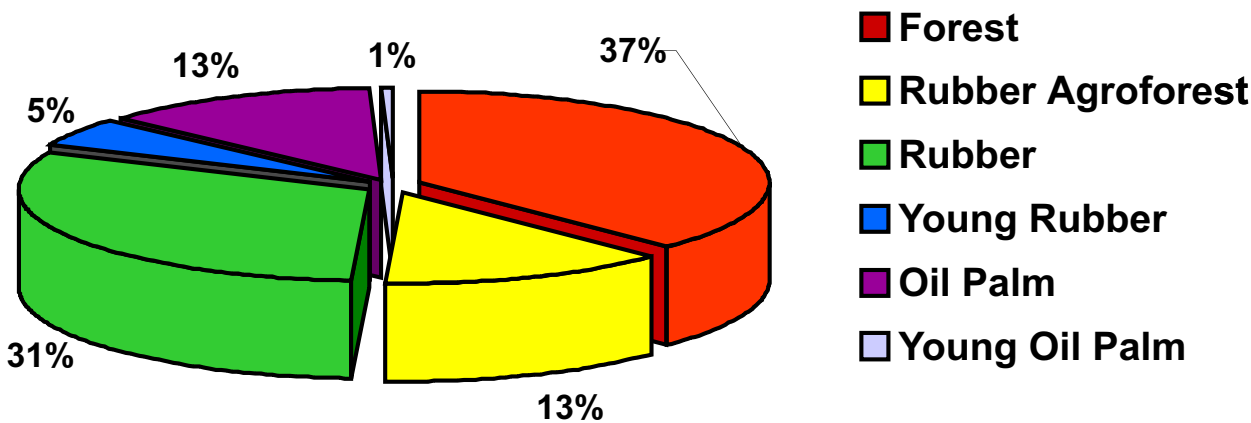


Figure 9. Land use in Bungo 2002. (Landsat 7 image interpretation, ICRAF)

THREAT: Rapid deforestation and conversion, especially close to roads. Financial benefit as the main motivator in conversion

As deforestation continues, the jungle rubber agroforests are becoming increasingly important as reservoirs of forest diversity. These agroforests now provide some of the forest 'services' valued in natural forests. However, these agroforests are also under pressure for conversion to monoculture plantations. There is often a lack of immediate benefit flowing from biodiversity conservation and other environmental services. This makes immediate private benefits in terms of financial gains from a land-use management a more pressing consideration than those of environmental services. Consequently, more monoculture plantations are being developed in Bungo District.

Therefore, a new approach of providing rewards for environmental service of (agro-)biodiversity conservation in rubber agroforest systems can be seen being an alternative means by which the opportunity costs from alternative land uses can be offset.

THREAT: Rubber agroforest is not a competitively efficient system

In comparison, in one tapping day one person taps about 300 trees. In an old rubber agroforest (RAF) there are 100200 tappable trees per hectare, so a farmer needs 2-3 ha. In a rubber plantation, there are about 500 trees per hectare, thus there are more than enough trees for a person to tap in a single hectare. Additionally, the yields per hectare could be 3 times higher (Wibawa personal communication) or if expressed in net present value, the system is about two times more profitable than old RAF (Budidarsono et al. 2001). Oil palm plantation offers better profitability but higher establishment cost.

Box 6. The economy of rubber agroforest

Jambi is the third largest rubber-producing province in Indonesia, after North Sumatra and South Sumatra. In Jambi, around 97% of natural rubber comes from smallholder farmers tapping rubber gardens (called *kebun karet*) smaller than 5 ha. Economically, Gouyon (1999) notes that the jungle rubber system contributes up to 80% of its farmers' livelihoods, while the remaining 20% comes from other sources of income. Similarly, Wibawa et al. (2000) state that rubber farmers in the province of Jambi receive on average 70% of their household income from rubber.

The economics of rubber agroforestry depend on land scarcity and land price. Per day of labour, the returns are comparable with more intensive plantations, per hectare of land yields are low. Economic analysis by Budidarsono et al. (2001) indicates negative values for returns to land (approximately Rp 340 000 $^{ha-1}$ or similar to USD 350 $^{ha-1}$), although at social prices there are indications that the systems are potentially profitable. The calculated internal rate of return (IRR) indicates that traditional rubber systems are not profitable, with annual discount rates over 16%. This reflects the unfavourable condition of these systems for smallholder rubber farmers, as the productivity of rubber agroforest is very low, at only one-third to half of production in clonal plantations.

3.2. Land-use classification and identification in Bungo District

Within the breadth of variety of rubber agroforest types, only some are considered to be havens for biodiversity. Therefore, in order to narrow the scope for targeting areas for conservation incentives, a set of criteria is needed. These criteria are based solely on spatial analysis (GIS), in which satellite images are processed and analysed. The output of the process is a current land-use map.

Prior study on using a multicriteria analysis suggested that selecting villages in Bungo District for biodiversity conservation could be done by combining the perspectives of different stakeholders. These perspectives were obtained by asking the representatives to give weights to indicators (ecological, economic and social) that were synthesized from prior exploration. A study conducted by Kuncoro (2004) highlighted that the village of Rantau Pandan is the prominent village candidate for biodiversity conservation, because of its ecological attributes of intact forest and relatively vast rubber agroforest in the area.

In conjunction with information on spatial arrangement (*Tata Ruang*) made by the District Government's planning body (Bappeda) and soil and agroclimatic data, the previous work on land-use change in Bungo District has indicated that the following criteria can be used to coarsely identify rubber agroforest with high conservation value:

1. The rubber agroforest is more than 30 years old.
2. It is located relatively close to remnant forest, or within 'corridor' or 'stepping stone' paths of forest species.
3. The ownership status is private (or known as *Areal Penggunaan Lain*[8] in the Indonesian mapping system).

In order to avoid future conflicting interests between RUPES-Bungo and local government, a map of the future spatial plan of Bungo District (*Peta Rencana Tata Ruang*) and an overlaid map of different government sectors (*Peta Padu Serasi*) was also used as an additional filter to select the potential sites.

[8]APL or *Areal Penggunaan Lain* is a term used by the Indonesian Government to describe land upon which no Government right or ownership is reserved. In other words, it is the terminology for privately-owned land.

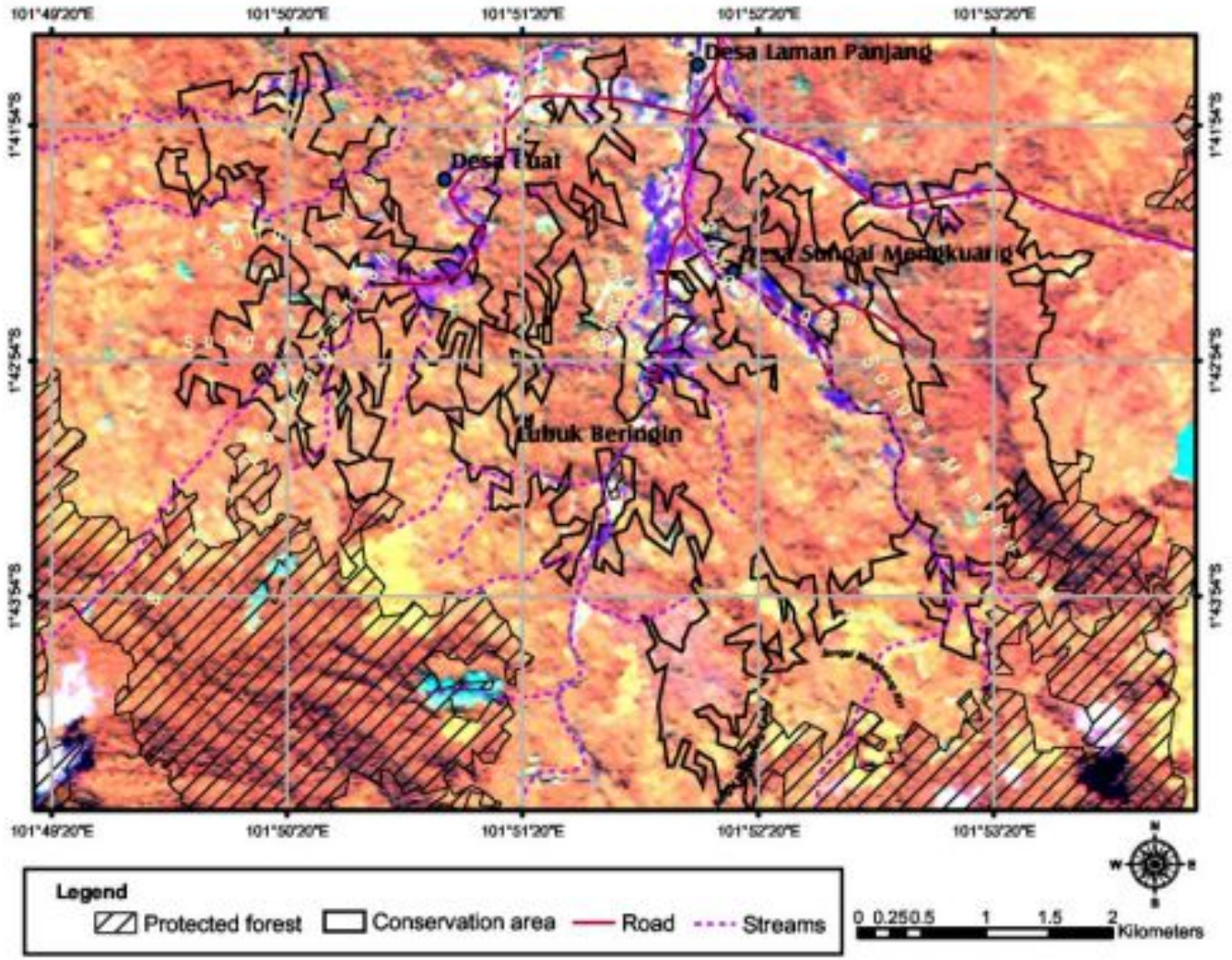


Figure 10A. Selected clusters for agrobiodiversity conservation objective: Cluster Lubuk Beringin

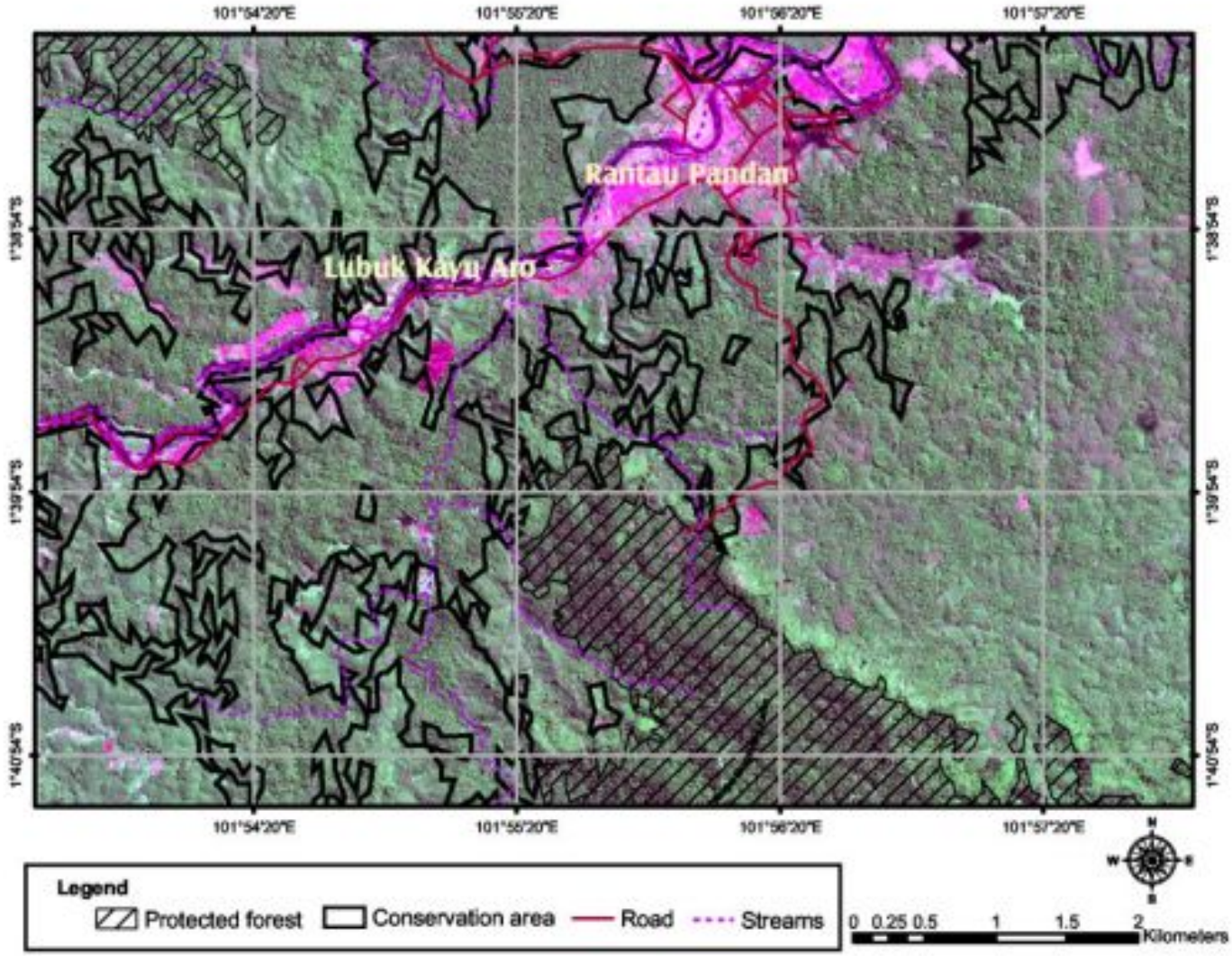


Figure 10B. Selected clusters for agrobiodiversity conservation objective: Cluster Rantau Pandan.

Considering that the unit of analysis was rubber agroforest, administrative units were not used in the selection process. Therefore, villages were not considered as a unit, but rather a cluster of rubber agroforests was considered as a unit. The finer filter to select potential sites took into account aspects other than biodiversity – information on population and other demographic information, institutions (their roles and existing regulations on land management and tenure), land-ownership structure (management systems and the history of land-use change).

Using this process, two clusters were identified to have sufficient potential to provide the environmental service of agrobiodiversity conservation, especially in regard to habitat preservation and corridor function. Figure 10 highlights the selected clusters. Cluster Lubuk Beringin is located in the south of Bungo District. The total area of old RAF in this cluster is 2345.6 ha in nine parcels (patches). The closest rubber agroforest from the remnant forest is between 100 m and 400 m. Administratively, the cluster is located within areas of three villages – Lubuk Beringin, Buat and Laman Panjang.

Cluster Rantau Pandan is located on the south side of Bungo District. The total area of this Cluster is about 1000 hectares and the cluster is comprised of three parcels (patches). The closest rubber agroforest from the remnant forest is between 0 and 600 m. Administratively, the cluster is located within the area of Rantau Pandan village.

The former cluster is adjacent to the Kerinci Seblat National Park and is thus considered as a buffer zone area for the national park. The latter cluster is spatially of importance as it is located in a strategic place to connect the remnant forests and, at a bigger scale, the national parks.

3.3. Issues at local scale and stakeholder analysis

3.3.1. Issues at local scale

As mentioned above, rubber agroforests are the most important source of livelihood for farmers in Bungo District. Therefore, the main issues at local level are centred upon increasing productivity, land-use design and market improvement for the products from rubber agroforests.

THREAT: Policy at District and Sub-district levels does not support conservation and continuation of rubber agroforest

For improving productivity of rubber agroforest, the main issues are damage from pest animals (pigs and various primates, especially the locally endemic leaf monkey) and low productivity. Additionally, there is relatively strong support for oil palm and monoculture rubber plantations. In contrast, for rubber agroforests there is a lack of support from Government officials (extension agents) in respect to new technology to improve quality and quantity of rubber production, as well as little (or no) recognition and support from local government for farmers' effort related to watershed protection.

Policy at district level

Centralized land-use designation, which has neglected local people's perspectives in the process, has led to conflicts over land ownership, most of which have not yet been resolved. Also, in Bungo,

there was a conflict between villages and timber-concession holders in one of the selected sites. However, as the concession holder has moved out and no justifiable holder has been appointed to manage the remnant forest, encroachment, illegal logging and other extraction of forest products are becoming more intensive. Despite some apparent dissatisfaction with the process, a participatory approach in designing land use in Bungo, led by BAPPEDA, is ongoing.

Another issue is related to infrastructure and market opportunity. The remoteness of some villages and other natural barriers has constrained village development. The most important threats are from oil palm plantations and the extraction of recently discovered coal in the area. Apart from offering high incomes in a relatively short period, these two options are strongly supported by local government. These lands have potential to contribute to District Governments' revenue; as a consequence of decentralization, local governments must now find their own means to finance their activities.

In order to accelerate economic development, local government has also allocated areas for transmigration. Labour from the new immigrants, land from local people and initial investment from private sector is a perfect concoction for local economic development. In Rantau Pandan village, a transmigration project has recently been initiated. Local government is also planning to extend the area to neighbouring locations, including Lubuk Beringin village.

OPPORTUNITY: Villagers are reluctant to participate in transmigration programme

Although transmigration seems to be an ideal approach and is supported by village elite and Sub-district Government, the rest of the local community is not in favour of it. However, they have little 'voice' in regard to decision making, despite the fact that most of the land used for transmigration comes from secondary forest, old RAF and fallow, some of which belong to the community. Additionally, some villagers are reluctant to give their lands to newcomers under transmigration schemes, because of relationship reasons and economic consequences. In one of the established transmigration sites (Sungai Telang), there is a case where original inhabitants ended up as labourers to newcomers (personal observation).

Local policy to speed up local 'development' is also reflected in the policy to encourage coal mining. The most likely site for a coalmine is Rantau Pandan. Success from current mining has triggered local government to allocate another 2800 hectares for mining in 2006.

3.3.2. Stakeholder analysis at district and village levels

The framework of stakeholder analysis developed by the World Bank (Rietberger-McCracken and Narayan 1998) is adopted to define the existing stakeholders in the area. The final objective of the analysis is to understand the positions of associated individuals and institutions with respect to development of rewards for environmental services. The positions may take the form of conflict, trade-offs or even endorsement.

Initial stakeholder analysis has been conducted to understand the parties and their interests, including potential future interests, in the locations and the initiative. Two levels of analysis – one at district and the other at village level – have been conducted following the completion of the site-selection process. Since ICRAF and WARSI have been working in Jambi for a number of years, their staff already have some information on local stakeholders. For RABA,

however, relevant stakeholders are identified through consultation with two groups of persons who are thought to be knowledgeable about specific issues, areas and people of different origins.

One initial finding is that at district level there are three important groups of stakeholders. These groups are government offices and officials, private companies, and non-governmental organizations (NGOs). At this scale and in this context, private companies have a moderately negative influence towards the development of rewards for environmental services. With policy support from local government, these threats from the private sector may become highly influential, potentially even too great to be offset by the reward mechanism. In contrast, government officials and NGOs are the most important stakeholders that seem to have a significant role in the ESR initiative. The most important government offices with respect to developing mechanisms for ESR are the District Representative of Forest and Estate Corp (Dishutbun), District Planning Body (BAPPEDA) and District Representative of Agriculture (Distan). Even without the ESR initiative, the former two institutions have the same missions, which are supportive towards the development of rewards for environmental services. *Dinas Pertanian*, on the other hand, takes a more neutral position with respect to developing rewards for environmental services.

Other important stakeholders are universities and NGOs. Both are important sources of information. Fortunately, a number of initiatives are being carried out in Bungo District, facilitated by local NGOs and international research centres, including these related to natural-resource management (community-based forest management, CBFM) and community empowerment (adaptive co-management, ACM) – these two initiatives are beneficial with regard to knowledge sharing and network development.

At village level, there are at least five groups that have been identified with potential to influence the success of ESR development. These are farmers, including landlords and landless farmers (tenants or share tappers); government officers, which comprise administrative government and extension agents from Dinas Pertanian; customary institutions, also known as *lembaga adat*; NGO (facilitator in the process); and the private sector, which includes intermediaries in the rubber market and estate-crop developers.

The identified stakeholders have a significant to very strong influence over the development of ESR and vice versa. Some activities under the ESR development may threaten stakeholders' aim to improve the productivity of rubber agroforests.

Having identified the most important stakeholders in the area, the next step in a stakeholder analysis is to assign the involvement of the stakeholders in different stages of initiatives' activities.

1. Identification and preparation. Collaboration in determining location in the preparation stage was conducted by ICRAF and local NGOs that have been involved in different initiatives in Bungo District. Initial selection was then presented to Dishutbun and Bappeda to consult on the status of the locations and to compare the locations with existing land-use designation.
2. In the appraisal stage, farmers, government offices, customary institutions, NGOs and the private sector will be involved in determining the appropriateness of the location for ESR development. Activities related to information sharing, consultation and collaboration are to be conducted with the related stakeholders.

3. In the implementation stage, collaboration with local NGOs as implementing partner of RUPES-Bungo initiative. Consultation and information sharing are done with government offices.
4. The monitoring and evaluation process will be conducted by farmers, customary institutions and village government representatives, in collaboration and consultation with implementing bodies of the RUPES-Bungo initiative.

3.4. Assessing the societies and the landscapes

3.4.1. Plant diversity in rubber agroforest

In addition to the local knowledge and Rapid Rural Appraisal approaches suggested in the protocol, to obtain comprehensive conservation values, a site-specific tailored approach was also used in determining conservation value in Bungo. A rapid plant assemblage analysis is being conducted in the rubber agroforests. Calculation of the value itself is underlain by several assumptions, namely:

a. Based on ICRAF's previous study, the extent of biodiversity richness (both plants and animals) of rubber agroforest correlates positively with basal area.
b. Factors that influence the extent of biodiversity in a plot of rubber agroforest include management intensity and distance from the plot to forest. Assemblages of biodiversity depend on the number of non-rubber species growing in a plot. Additionally, plots adjacent to forest tend to have more plant diversity than do those further away.
c. A plot in which many fruit trees are grown would be preferred, as it may be used as a feeding ground by various animals.

Data of quantitative plant diversity was obtained by creating sampling plots, in which two or three linear transects were made in every hectare. The method of assessing plant diversity rapidly used in this research was developed by Sheil et al. (2003) and uses a 60-metre line made in the 'representative'[9] location. Basal area and tree density are indicators to assess the level of RAF biodiversity.

Six vegetation transects using Sheil et al.'s (2003) method have been taken in Lubuk Beringin cluster. These transects were made in Sub-Cluster Laman Panjang (LAED and LYED - see table 3 for definitions of codes), and in Sub-Cluster Lubuk Beringin (LMED, LDED, LSED and LRED). Transect-site selection was done purposively, of which two transects were made in agroforest with good biodiversity (using understorey flora as indicator, LMED and LDED), two transects in agroforest with many fruit trees (LAED and LRED), and the other two transects in productive rubber, in which rubber domination is more than 60% (LSED and LYED).

The result of plant assessment is provided in table 3. Basal area (BA) ratio refers to the ratio of BA rubber divided by BA total, while the density ratio is the ratio of rubber density divided by total density. There is quite a strong tendency that Total BA correlates with the estimated level of plant diversity. Nonetheless, the very limited number of transects

[9]For the case of Bungo, 'representative' potential area for biodiversity conservation is selected among rubber agroforests that are more than 25 years old, where observation indicates relatively high plant (fruit) diversity.

could not support such conclusion statistically. From a previous study (Rasnovi personal communication), the average BA for RAF is around 24 m^2 ha^{-1}, while secondary forest is 34 m^2 ha^{-1}. The highest value of BA in rubber agroforest in Lubuk Beringin (41.60 m^2 ha^{-1}) is higher than the average of secondary forest.

Table 3. Vegetation structure in Cluster Lubuk Beringin; BA = basal area; Plot

CodePlot*	Total BA† (m^2 ha^{-1})	Estimated Total Density (ha^{-1})	Rubber BA (m^2 ha^{-1})	Estimated Rubber Density (ha^{-1})	BA Ratio	Density Ratio	Estimate Age (years)	Estimated Level of Plant Diversity
LSED	7.28	166.24	6.14	143.76	0.84	0.86	50	low
LYED	15.63	224.88	7.38	134.90	0.47	0.60	40	low
LRED	20.07	365.35	0.57	4.55	0.03	0.01	50	moderate
LAED	22.16	358.22	2.27	55.89	0.10	0.16	80	moderate
LMED	30.74	466.70	0.56	15.77	0.02	0.03	90	high
LDED	41.60	535.51	15.21	135.34	0.37	0.25	90	high

* First letter refers to location (name of village); second letter refers to first name of the land owner; third and fourth letters refer to data collector. For example, LSED means the plot is in Lubuk Beringin village, it's owned by Sanusi, and the data was collected by Endri dan Dasrul
† BA = Basel Area

Information on basal area and density in combination with plant inventory[10] data as a reference are used as indicators of biodiversity level of rubber agroforests. Other information derived from the data is the result of similarity analysis, which is done to observe the percentage of forest-dependent species that can be harboured in rubber agroforests, by measuring aspects of distance to forest and management intensity. The result is compared with the species assemblages from different plots.

Further analysis is possible by plotting the basal area data to GIS to see any relationship with digital patch value. Additionally, diversity indices of Simpson[11] and Fisher-Alpha[12] will be derived from calculating the plot-based qualitative data.

[10]ICRAF and IRD have conducted plant inventory in forest and rubber agroforest in Bungo area since 2001.
[11]Simpson index (http://www.geog.ubc.ca/courses/klink/methods/lq/) indicates dominance and it is derived from assemblages of commonest species.
[12]Fisher-Alpha index indicates relative plant species richness and it is used despite its lack of sensitivity to sample size.

3.4.2. Animals in rubber agroforest

Lists of animals seen or heard during observational walks and interview with key persons are combined with data from other secondary sources. The list was then contrasted with IUCN's Red List species (Baillie et al. 2004, IUCN 1994) to clarify whether or not flagship or endangered species were present in the area. This list (Annex 16A) would provide information on existing species with high conservation value in the land-use system.

Most species found during the direct observation were mostly categorized as LR/nt[13] (*Lower Risk/near threatened*). Most of the mammal species here were also found in Kerinci Seblat National Park (list produced by Bureau of Kerinci Seblat National), i.e. all except white-handed gibbon. It was reported in May 2005 that a rubber tapper from the sub-village of Sangi (one of RUPES action-research sites) was attacked by a sun bear while tapping rubber. Sumatran tiger is also reported to be present the area. Although farmers could not recall the last sighting of Sumatran tiger in rubber agroforest, they did mention that the best time to look for tiger is during the big durian fruiting season.

Based on the BirdLife International threatened bird list (BirdLife International 1992, Collar et al. 1994), all the bird species that were seen or observed directly in the field were neither threatened nor endemic (Annex 16A). A potentially important bird for conservation is greater coucal *(Centropus sinensis)*: the Bureau of Kerinci Seblat National Park states that the species also lives in Kerinci Seblat.

Although possible, it is quite difficult to see the relationship between the proportion of fruit trees (mature to produce fruit) in rubber agroforest with animal assemblage and diversity. Inappropriate method and insufficient time to conduct animal study have limited scientific justification of the relationship. Some of the plant species found during the observational walks and probably interesting for the RUPES-Bungo are listed in Annex 16B.

[13]Low risk or near threatened means that this taxon does not qualify as Conservation Dependent, but is likely to be qualified as Vulnerable (when it is facing a high risk of extinction in the wild in the medium term).

3.4.3. Rubber agroforest and forest in local perspectives

OPPORTUNITY: Farmers see rubber agroforest not only from a financial point of view but also from an ecological one

Farmers see rubber agroforest not only as a source of livelihood, but also as a provider of environmental service of watershed protection. There is a strong indication that water or river protection is perceived more important than biodiversity conservation and there is no essential difference between forest and rubber agroforest in regard to protecting constant water/river flows. Figures 11 and 12 capture the importance of rubber agroforest and forest for the environment.

The main differences in the perspectives are that because of the locations in hilly areas, forests could control erosion or sediment flow to the river. An additional function of forest acknowledged by villagers was micro-climate control. This function was not thought to be related to rubber agroforest; however, rubber agroforest is seen as provider of **mainly** fruit, while forests are seen as the provider of timber and as better habitat for animals.

Another interesting perspective is about the relationship between forests and pests, especially animal pests. Villagers seem to have a clear idea that with the more forests in an area, the less pest disturbance occurs to agriculture.

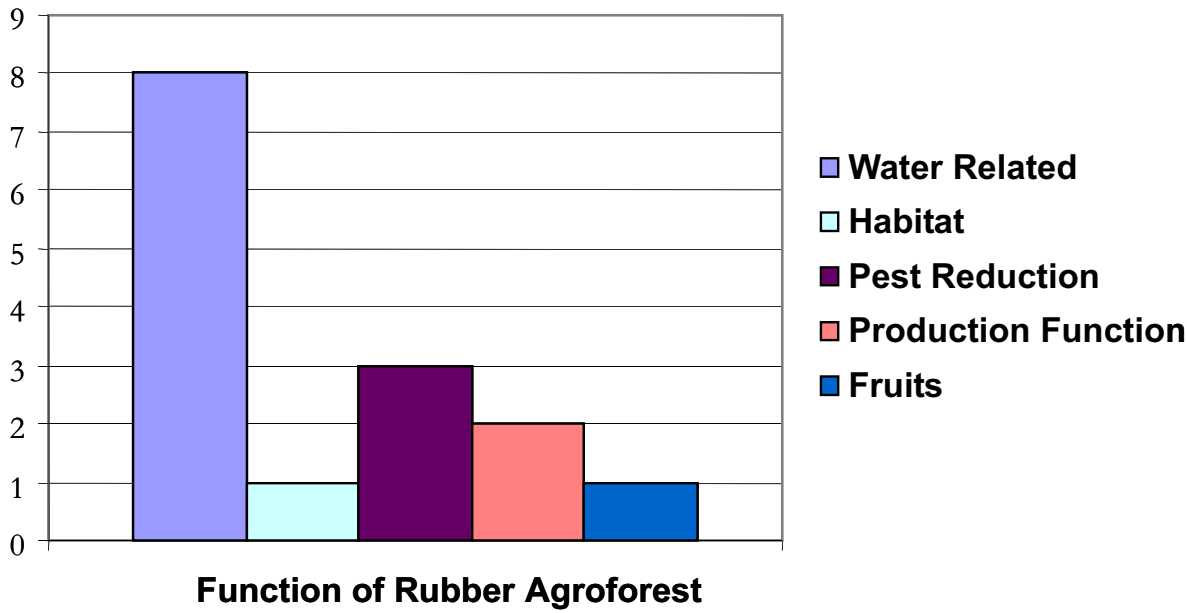


Figure 11. Function of rubber agroforest from farmers' perspective.

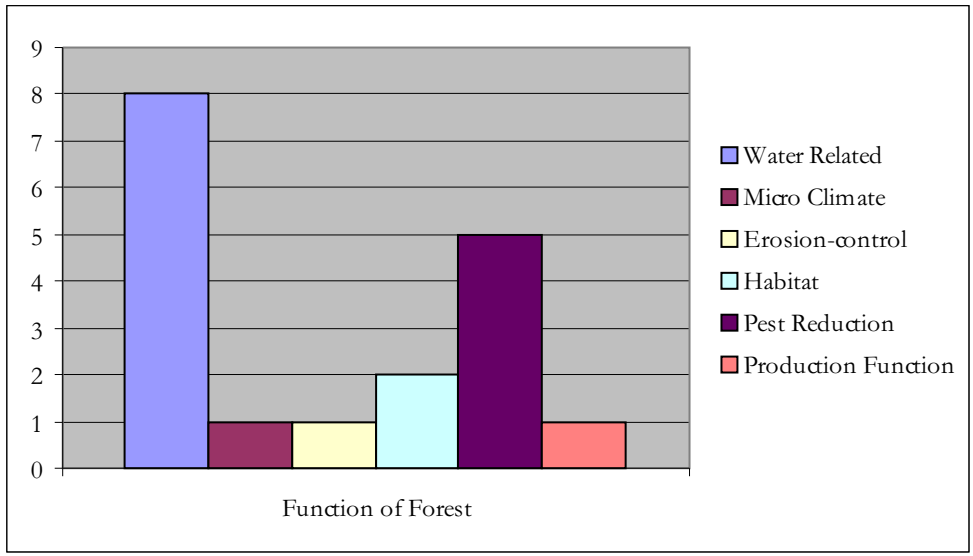


Figure 12. Function of forests in farmers' perspective.

In locals' perspective, forest area is almost publicly owned. Although it is legally owned by the state, weak monitoring and lack of acknowledgement from villagers have made forests operate as an open-access resource.

3.4.4. Rapid livelihoods assessment

Rapid livelihood assessment is done for the managers of agricultural land with conservation value. In Bungo, as suggested in the RABA protocol, a group-discussion-based assessment was conducted in Lubuk Beringin village (by M. Kallesoe, IUCN).

More than half (56%) of the income of villagers in Lubuk Beringin came from rubber and non-timber products (figure 13). The total amount is accounted (at current prices) at USD 860 per household per year.

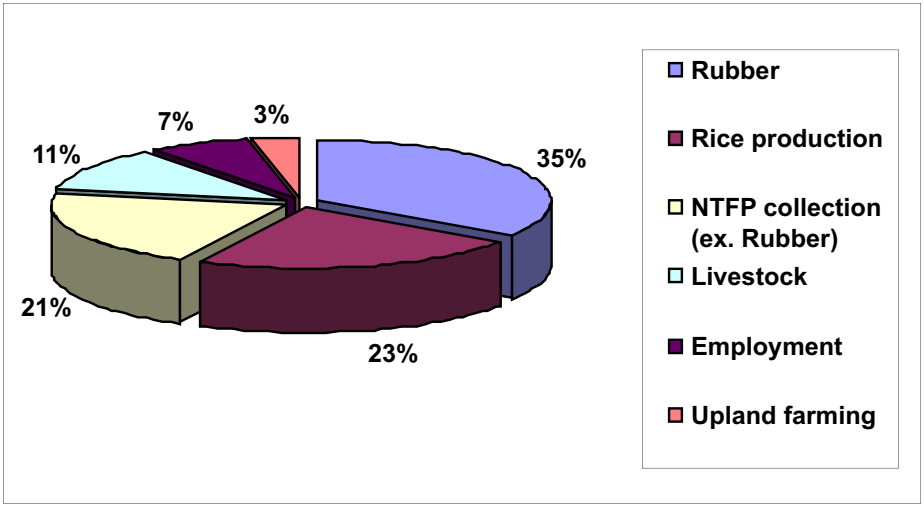


Figure 13. Sources of livelihood of people in Lubuk Beringin.

Despite the fact that the outcome is only indicative of the effect on livelihood, a similar approach will be adopted in other villages in the area. However, in other villages in the region the assessment will be conducted using two groups, men and women, to obtain the information about their livelihoods.

3.5. Conclusion

On the basis of the rapid appraisal, the location of Bungo and the existing system of rubber agroforest have potential for agrobiodiversity conservation. The agroforests have potential as havens for plant diversity, to act as a buffer zone for adjacent forest and as a corridor connecting national parks inside and outside of Bungo.

However, further research is needed to confirm that the land use and area could actually fulfil these functions. At this stage, intermediaries are required who can find interested parties (buyers) to make an initial investment as part of developing a reward for environmental service. Figure 14 summarizes the rubber agroforest case.

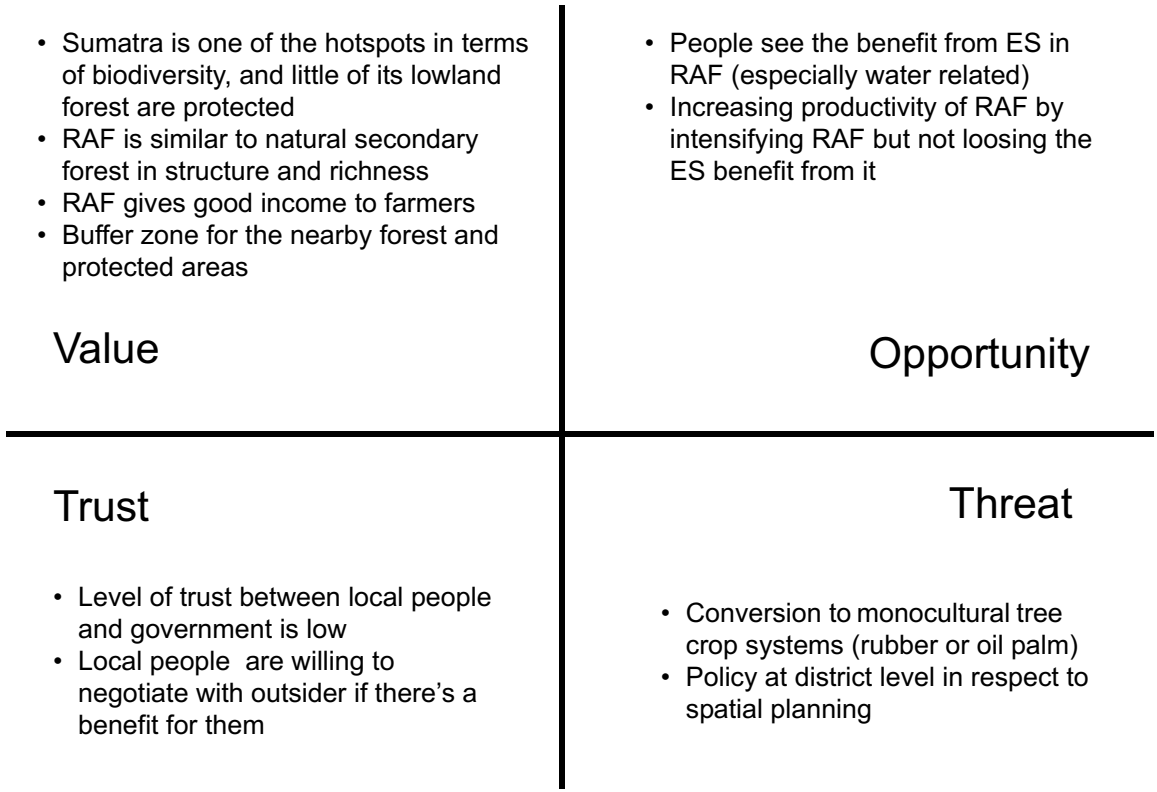


Figure 14. Summary of rubber agroforest and its attribute for biodiversity conservation.

4. Case Study 2: Forest agriculture mosaic in Mae Chaem (Thailand)

4.1. Biodiversity importance of North Thailand
4.2. Land-use types and site selection
4.3. Issues at local scale and stakeholder analysis
4.4. Assessment on the society and the landscapes
4.5. Conclusion

4. Case Study 2: Forest agriculture mosaic in Mae Chaem (Thailand)[14]

4.1. Biodiversity importance of North Thailand

VALUE: Hotspot area and potential to discover flagship mammal species under threat

According to Conservation Internationals' hotspot definition (Conservation International 2006), the Thai–Malay Peninsula area is the transition area to the Sundaland hotspot, and the boundary between the ThaiMalay and Sundaland hotspots is represented by the Kangar-Pattani Line. Nevertheless, the northern part of Thailand is of importance in respect to zoogeographical transition between the Sundaland and Indo-Burma biotas, which may lie just to the north of the Isthmus of Kra. Apart from the transition from Sundaland and Indo-Burma, the northern part of Thailand is also important for the Mekong River. WWF has put serious effort into conserving freshwater biodiversity in the Mekong.

THREAT: Potential ethnic conflict and low level of social-bridging capital

However, a newly created protected area has triggered a new conflict related to land tenure. The designated protection area is traditionally owned by local people, including the Karen. Thus, there is a big difference in land-tenure setting between Bungo and Chiang Mai. In Bungo, the RABA test site is under private ownership, whereas in Chiang Mai the land ownership is at issue.

Thailand has been undergoing vast deforestation since the 1970s. Lakanavichian (2000) notes that during the period 1961-2000, forest cover decreased by about 60%. The rapid deforestation is a major threat to biodiversity conservation. Olson et al. (2001) state that this country is an important site for mammal conservation, but only a small proportion of the country is under protected area (less than 10% covered or about 409 000 km^2).

Mae Chaem District of Chiang Mai Province is in the mountainous north of Thailand. The area is a mosaic of forest and agriculture with many examples of both traditional low-intensity shifting cultivation with long fallow periods and modern high-intensity agriculture with permanent fields.

[14] *Case Study Mae Chaem* written by Veronika Areskoug, Pornwilai Saipothong and Susilo Ady Kuncoro.

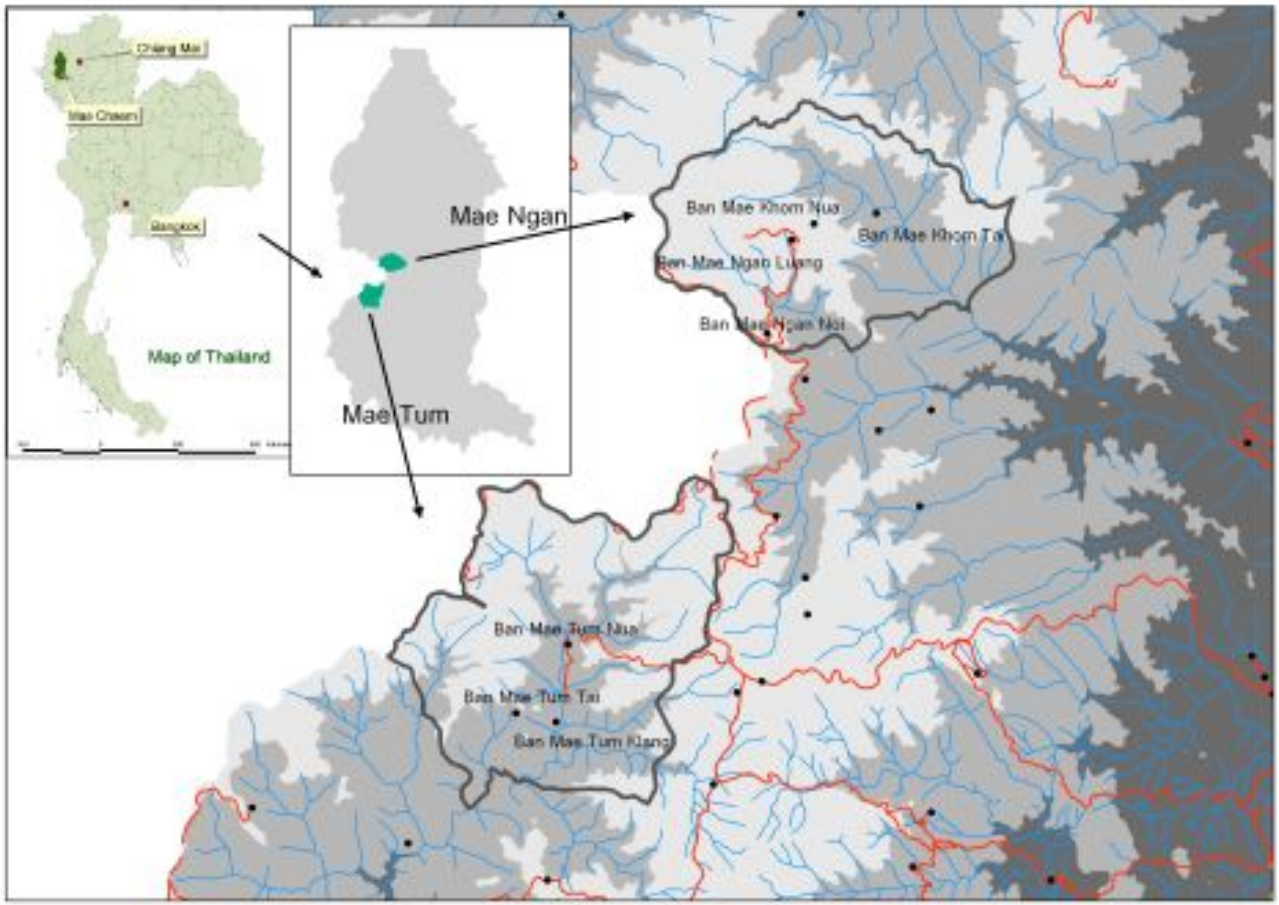


Figure 15. Location of North Thailand site

4.2. Land-use types and site selection

THREAT: Recognition of village inside National Park

In respect to the objective of agrobiodiversity conservation, initial GIS evaluation of the area allowed us to identify the following criteria to be used in the site-selection process.

- Area within and outside National Park
- Species connectivity potential
- Shifting cultivation area
- Have a large proportion of land use deemed of potential high conservation value, in this case community-protected forest area
- Has not yet undergone same degree of land-use conversion as the surrounding villages.

Digitalized land-use maps showing land use known to provide habitat for targeted mammal species was used to identify villages of greater conservation value.

Analysis of the maps revealed a structural habitat corridor connecting important habitat. The villages controlling the land forming this potentially functional corridor were chosen for further investigation. Community-protected forest was one of the key land uses that made up the corridor. This land use tended to occur on steep slopes and ridge areas. A high percentage of recent conversions to permanent crop fields have occurred in similar situations. Using the criteria and digitized map, two of the best potential locations for application of RABA were identified. These areas are located in the same sub-district (Pang Hin Fon), which means the same TAO (Tambon Administration Organization[15]). These areas consist of four and three settlements comprising two administrative villages:

1. Ban Mae Ngan Luang, Ban Mae Ngan Noi, Ban Mae Kan Nua and Ban Mae Kan Tai make up village no. 1 (Ban Mae Ngan) of Pang Hin Fon Sub-district outside the National Park.
2. Ban Mae Tum Nua, Ban Mae Tum Klang and Ban Mae Tum Tai are in village no. 4 (Ban Mae Tum) of Pang Hin Fon Sub-district, located inside Mae Tho National Park.

[15]Tambon Administration Organization (TAO) is an administrative unit below sub-district, but larger than village.

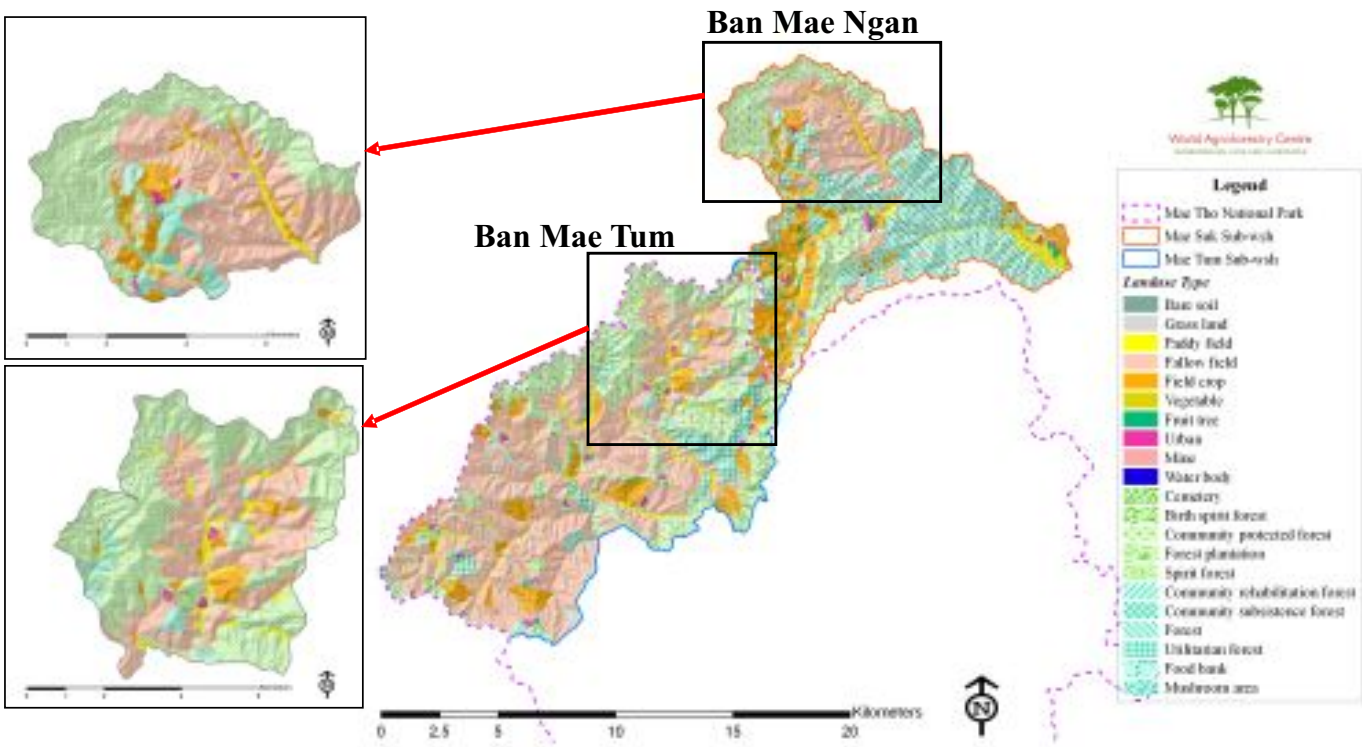
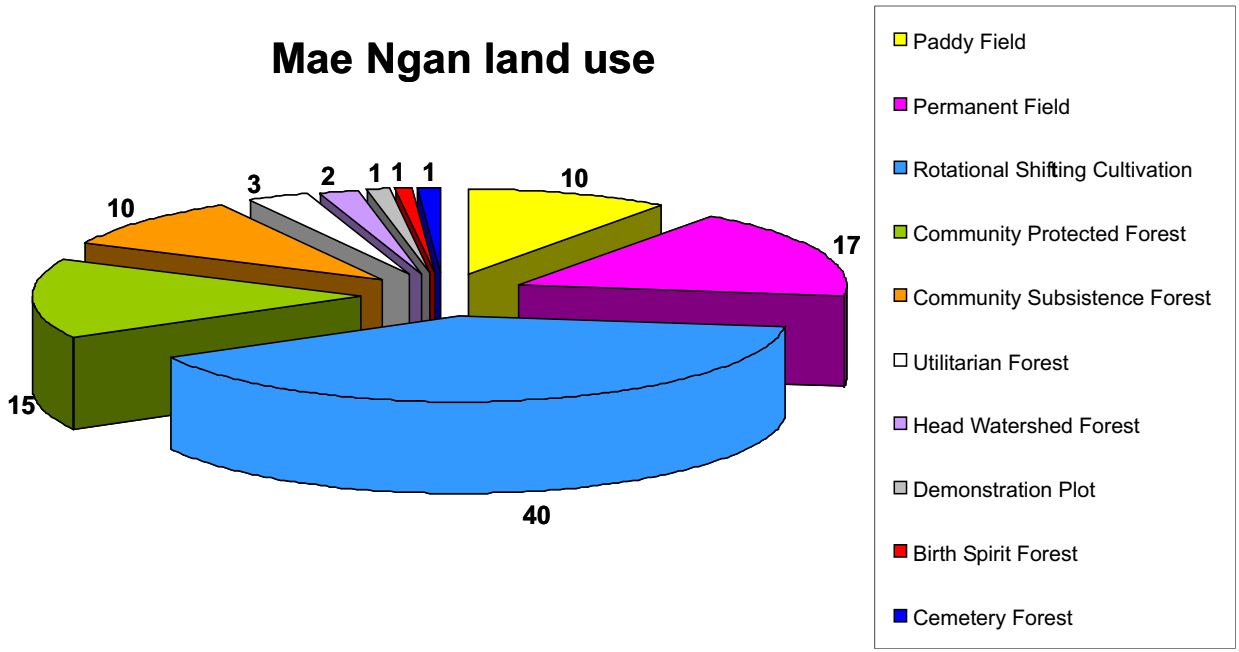


Figure 16. Ban Mae Ngan and Ban Mae Tum, focus villages for RABA trial.

Initial results from GIS analysis indicate that there are more permanent fields in Ban Mae Ngan and that there are more areas of shifting cultivation in Ban Mae Tum. Figures 17 and 18 depict current land uses in the villages.



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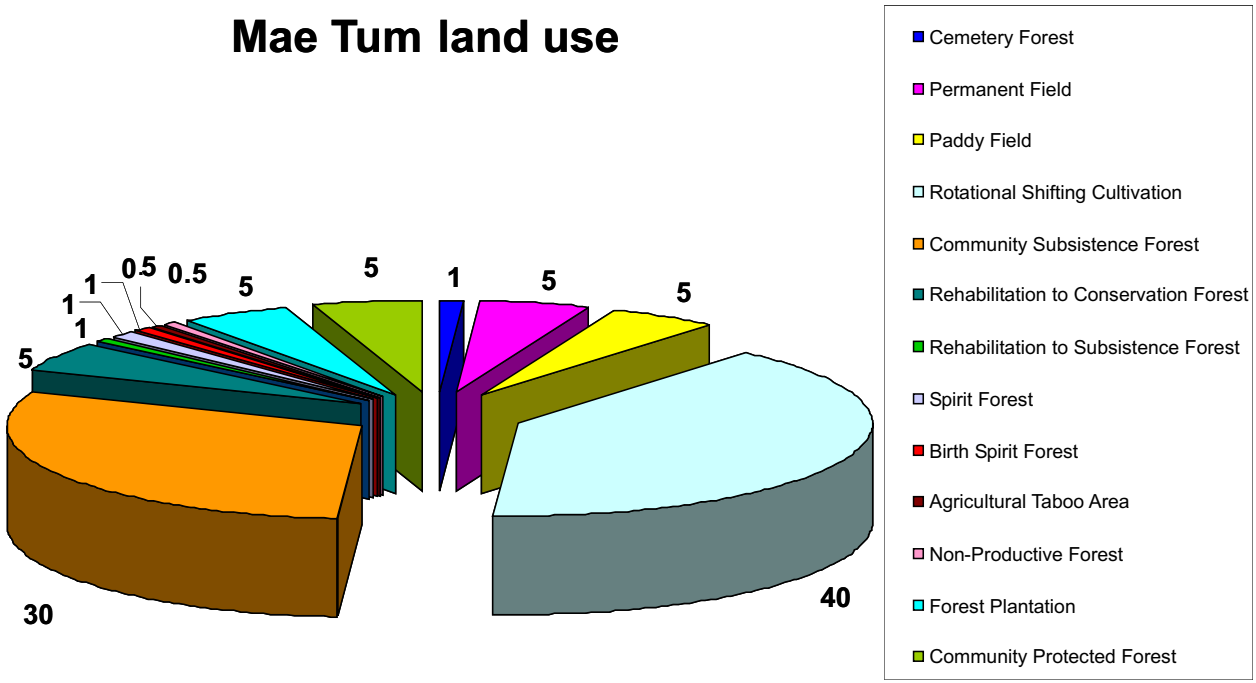


Figure 17. Land use in Ban Mae Ngan Village. (ICRAF internal data, 2002)

Despite the differences, both villages use almost the same definitions about forest. Villagers in Ban Mae Tum see or define forest in more ways than do villagers in Ban Mae Ngan. However, this diversity of views and definitions does not indicate greater awareness with respect to biodiversity conservation.

4.3. Issues at local scale and stakeholder analysis

4.3.1. Defining issues at local scale

OPPORTUNITY: Options for alternative livelihoods are available

The ethnic Northern Thai live in lowland areas and use a wet rice cultivation system, supplemented with vegetable and soya bean crops in irrigated areas. They also engage in field-crop cultivation in upland areas. Thai farmers have also tried to expand their cultivation activities into the forest. Where this expansion has been into forest fallow of the Karen people, this has led to conflict between the Karen and the Northern Thai farmers. Such conflicts have been most intense in relation to the corporate contract farming of potato and maize for seed production above the Mae Chaem valley.

Box 7. The Karen and other immigrant peoples in Mae Chaem

The Karen entered the district in the mid-1800s from Burma. They have settled primarily in the middle-altitude zone area (600-1000 m.a.s.l.) and practise their traditional rotational shifting cultivation system (10-15 years forest fallow). This traditional system was geared to meeting only their subsistence needs. The Karen exchanged forest goods with the lowland Thai to supplement their agricultural production. With expansion of upland field crops and government natural-resource management policies, they have had to change from their traditional system to a system based on permanent field crops and cash cropping. The Karen are the most populous group in Mae Chaem, numbering more than 40 000 people (over 60% of the area's total population).

The Hmong migrated from Mae Hong Son province (west of Mae Chaem) after World War II. They live in the highland zone of the watershed. They used to grow opium in their pioneer shifting cultivation system. Under the nationally mandated opium-substitution programme, they now cultivate commercial highland cash crops of cabbage, tropical fruit trees, etc.

A secondary group of Hmong people migrated from Hot district, south of Mae Chaem, as part of a government resettlement programme and are now located in the lowland area. They also produce commercial cash crops of different vegetables. The lowland of Mae Chaem now hosts the wholesale market of cabbage and other vegetables transported from Mae Chaem to Bangkok.

Having previously engaged in different biodiversity related activities in the same area, ICRAF identified the following local issues related to developing ESR:

- New National Park
- Land-use conflict with the Forestry and National Park Officers and other groups
- Water use, especially in dry season
- Expansion of cash-crop area
- Indigenous people (the Karen) and their livelihood dependence.

4.3.2. Stakeholder analysis in North Thailand

OPPORTUNITY: Existing watershed network

From stakeholder analysis, there are three groups that have significant stake in the management of resources at the potential sites: administrative offices, consisting of TAO (Tambon Administration Organization), village headman, heads of district and sub-district; environmental groups, consisting of forester, watershed network committee (Upper and Lower watersheds) and NGOs (conservation-related); and the management of National Park.

Further stakeholder analysis on interest, what is at stake, as well as the standings of individuals or institutions are planned. This is crucial, as developing a reward mechanism for environmental services would be best achieved by participatory process, in which not only those who have significant stake and influence as well as impact are taken into account, but also those who have less at stake.

4.4. Assessment of the society and the landscapes

4.4.1. Socio-economic survey

OPPORTUNITY: Institution on land exists, indicating high awareness

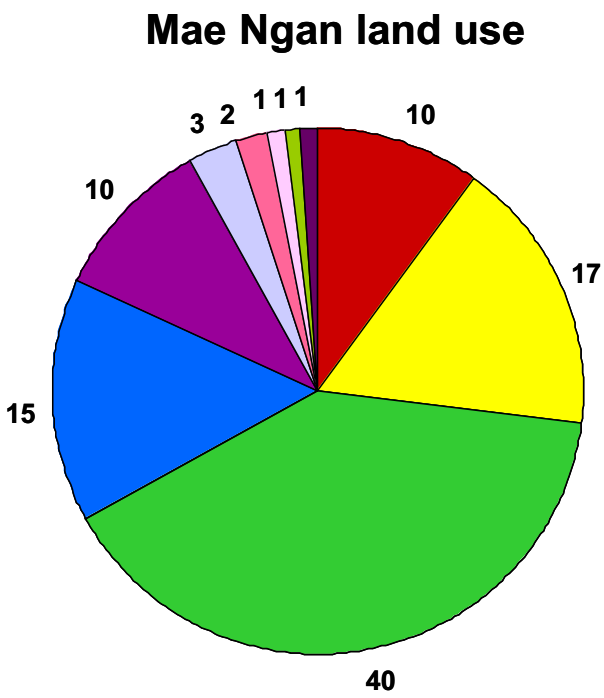
Both group and individual interviews were carried out in a survey of the socio-economic circumstances of the area. Part of the survey is related to existing institutions (rules and regulations) related to natural-resource management. Hunting is prohibited in the community-protected forest and village wildlife sanctuary area. In addition, outsiders are not allowed to hunt within village boundary by some villages. If they do, they have to pay 500-5000 baht per head of prey. Other types of institutions and local knowledge are potentially beneficial for the development of rewards, designing appropriate reward mechanisms as well as monitoring Aspect of the rewards.

Access to Different Land Uses

Since villagers in both villages assign their lands and forest to many different uses, it is important to know who can access which lands and what kinds of activity are allowed on those lands.

Generally, there are four types of group that have access to certain kinds of land: government; people from the same family or the same lineage; society or communally based; and all the inhabitants of a village. Access to different land uses in the focus villages are shown in Figure 19A and 19B.

Although there is a strong institution administering who can access the land and when, there is no strongly acknowledged rule in regard to administering hunting. Therefore, in the two villages, hunting activities have been one of the major threats to biodiversity. Nevertheless, there is a strong indication that abundance of animals and extinction rates in the areas are quite different.



Lineage-based / Family-based	Paddy Field Permanent Field Rotational Shifting Cultivation
Society Communally-based /State	Community Protected Forest Community Subsistence Forest Utilitarian Forest Head Watershed Forest
State	Demonstration Plot Birth Spirit Forest
Village-based, Society /Communally-based	Cemetery Forest

Figure 19A. Access to land in the focus villages: Mae Ngan.

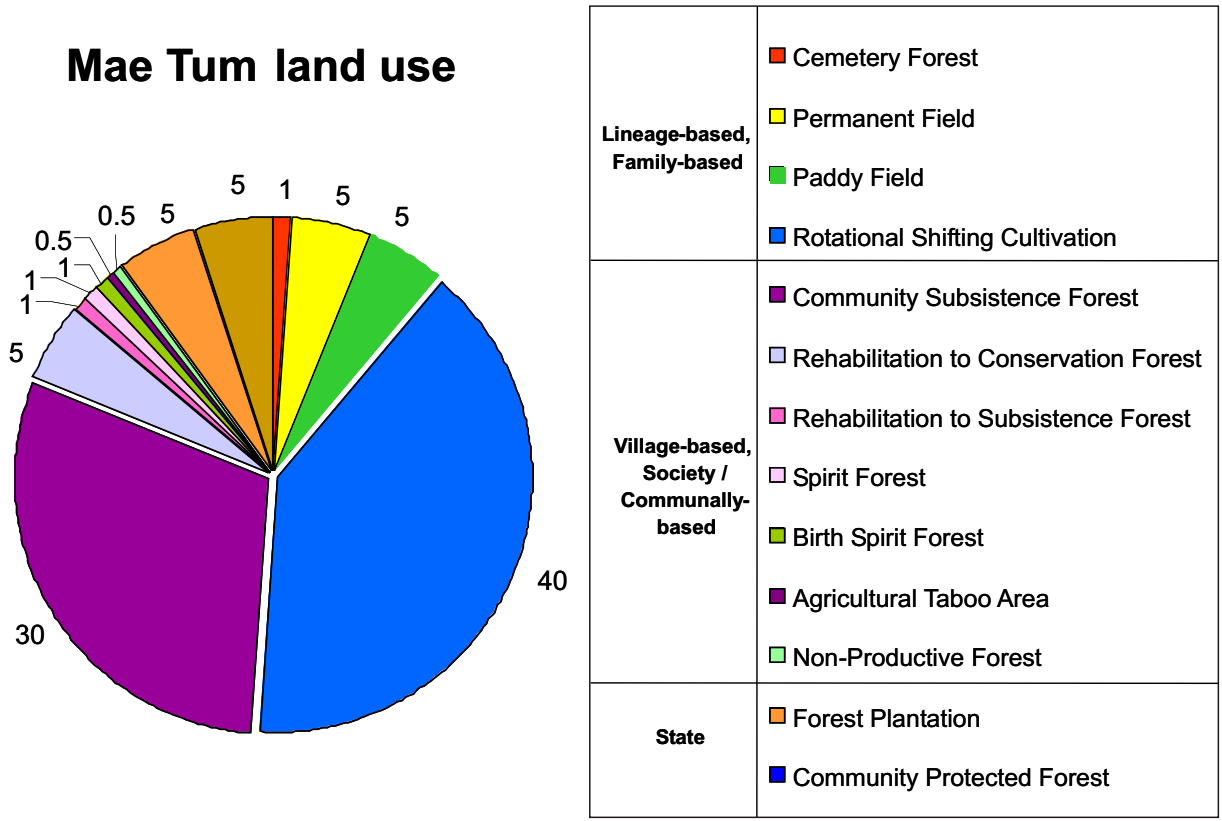


Figure 19B. Access to land in the focus villages: Mae Tum

Limited land available for agricultural expansion has lately forced farmers to move onto Karen fallow areas. This move was also triggered by new economic pressures with increased outside influence. If ethnic conflict (especially for hunting and land-use rights) escalates, it seems likely that the agricultural expansion will cause the locals to neglect their biodiversity-related values (e.g. they will hunt locally in protected areas). This is as a result of government approval being given to agricultural practices that do not take into consideration local values, knowledge (including conservation knowledge), techniques and preferences.

4.4.2. Identification of species richness present and population abundance and trends

Local Ecological Knowledge is an exploratory tool in identifying key habitat and wildlife landscape resources. Multiple ethnic groups were included in this survey work in order to capture both broader and more specialized ecological knowledge.

Interview technique

A key informant was chosen by his village peers as an expert on the local fauna. Often this status as an individual with specialized expert knowledge on wildlife correlated to him being a hunter or an ex-hunter. In all cases, those recognized by the community as wildlife experts were male.

Using local names, the key informant was asked to list every animal which, to his knowledge, occurs or has occurred in his lifetime within the village boundaries. We asked about each taxonomic group of mammals separately to maximize the comprehensiveness. By allowing him to recall the animals instead of simply asking about a prepared list, we ensured that the lists are truthful and accurate and it allows us to discover species which are not recorded in the literature as occurring in the area. The expert informant was then questioned about any species known or suspected to have a North Thailand distribution which he had not already discussed. To verify the identity of each species, the informant was asked to give a description of it. Lastly, he was asked to verify the species from a set of photos. The completed list of species present, local extinctions and species distribution was verified by the same key informant at a follow-up interview at a later date.

Migration route and key landscape wildlife resource mapping

Standard PRA methodology was extended to include aspects of wildlife use of the landscape. The work was carried out with one to three key informants.

Using a large sheet of blank paper and coloured marker pens, the villages created a standard land-use village map, identifying the major physical and land-use features of the village land. The key informants were then asked to draw the habitat of target species. Extra paper was added to allow physical features outside of the village-owned land to be included. The informants were asked detailed questions on times of day and year that specific resources in the landscape are used by the animals. Informants were then asked about the routes that animals use for passage. The character of target-species movement was described and added to the map. These included discreet passages and broad defuse habitat that animals move through. Types of knowledge gathered reflect seasonal movement following water resources particularly for large herbivores, and daily foraging and refuge patterns particularly for deer. Our results indicate that the village land of Ban Mae Ngan (our study site located outside of the National Park boundaries) and that of Ban Mae Tum (whose lands connect forest patches inside of Park boundaries) do indeed contribute to mammal species habitat, dispersal and connectivity for populations of Park mammals. However, all seven settlements studied (on both sides of the park boundary) have suffered high rates of species extinction according to key informants, indicating that human activity does have a strong impact on the Park mammal populations.

Village wildlife interaction and consumption behaviour

Daily journals were kept by six villagers from six villages (36 journal keepers) on their use of wild animals, on observations made of mammals and mammal signs in various landscape elements, and on the activities and time they spent in various habitat types. The mammal observation data was correlated with the amount of time spent by each journal keeper in various activities and landscape elements. The journal keepers where selected to represent an equal number of male and female participants and from each of three age classes (young, middle-aged and elderly).

Mammal sightings were rare and we found that the method was insufficient to provide data that could be of use for compiling species lists or as indicators of species abundance. It was, however, extremely useful for species of local economical importance and for quantifying the frequency and amount used.

Village wildlife valuation and conservation concerns

Following the completion of the species-present interview, open-ended interviews were used to obtain the communities' concerns and attitudes towards particular species and population trends. They were asked to rank the species considered most valuable and most offensive.

In combination with subjects of discussion on species richness, villager–animal interaction and conservation concern, the result of species presence and distribution as well as local extinction are depicted in figure 20. Despite being located outside of the Park boundaries, all four settlements located in the administrative village of Ban Mae Ngan maintain considerably higher species richness than the three settlements of Ban Mae Tum. However, both areas support roughly 90% of the original fauna and about 20% more species than surrounding villages with higher rates of land conversion.

THREAT:
High extinction rate

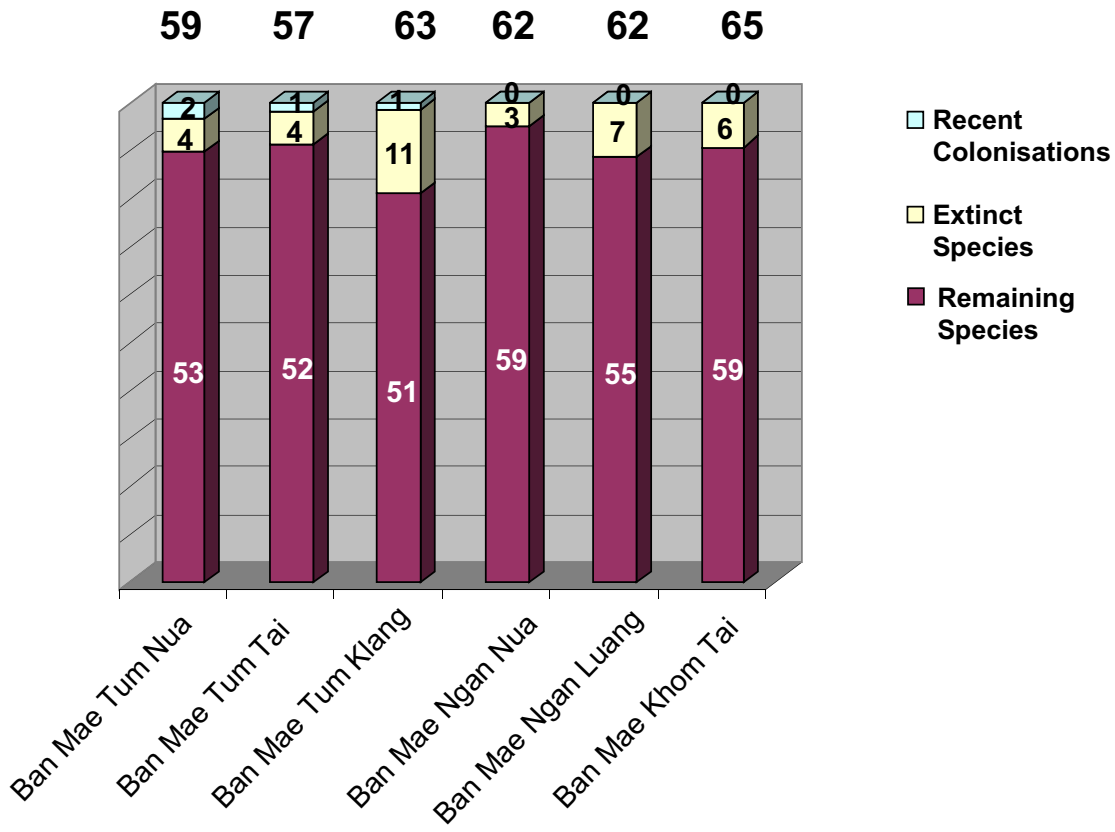


Figure 20. Species richness and extinction rate in the North Thailand case study area.

4.5. Conclusion

From the rapid appraisal, the location of North Thailand has potential for an agrobiodiversity conservation initiative. The service to be advocated is the potential role as corridors to connect national parks.

However, further research is needed to confirm that the land use and area could actually fulfil the function. There are also some concerns about future challenges to engage in developing rewards for biodiversity conservation, namely, that trust is a bottleneck, traditional hunting, ethnic conflict, hunting laws and private land control for shifting cultivation.

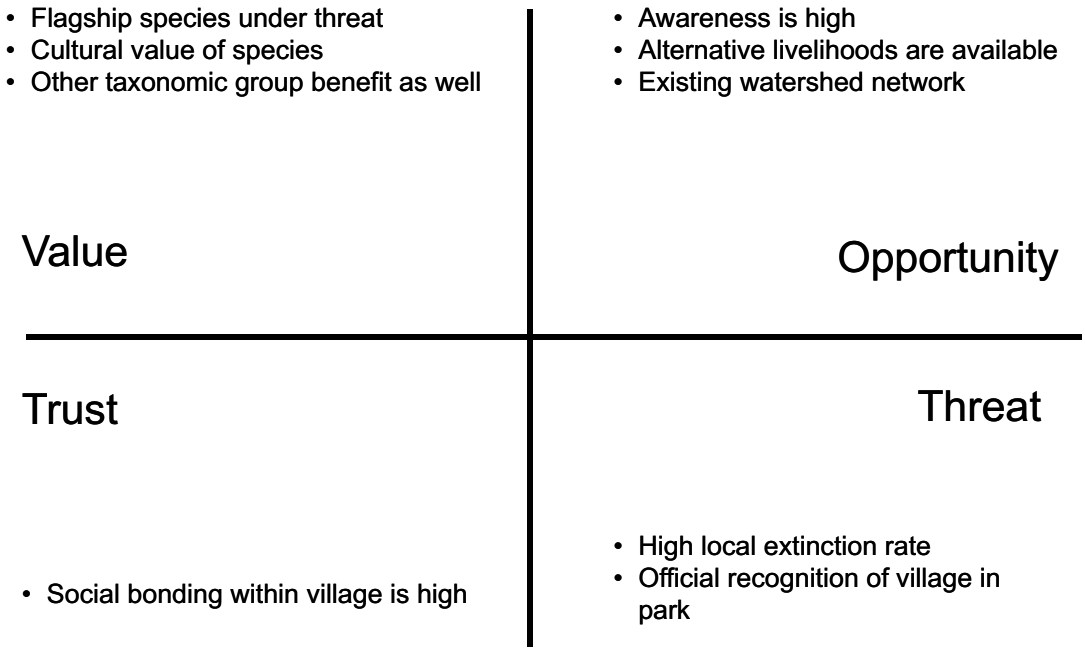


Figure 21. Summary of SWOT analysis of North Thailand case study.

5. Concluding remarks

5. CONCLUDING REMARKS

The protocol elaborated in this narrative is not a rigid 'how-to-do-it' prescription, but a guideline to identify significant questions that need to be answered in developing a buyerseller relationship in environmental-service provision. There are many techniques to assess the biological aspects of biodiversity, which can be used with little adjustment to assess agrobiodiversity. Site characteristics – physical, social, as well as institutional – determine the most suitable tools to use to obtain data necessary for indicating appropriateness of a location for biodiversity conservation. The important part is to 'start at the end' and focus on the information that is really needed to 'make a case'. A summary of the two case studies plus a study of the opportunities for 'bird-friendly coffee' from the Sumberjaya (Lampung; Gillison et al. 2004) area shows that a range of arguments can contribute to the overall conclusion (table 4; Trudy O'Connor doctoral thesis). The development and application of this tool in the Bungo area in Jambi has been an iterative process, with new studies initiated on the basis of emerging evidence. An analysis was made of how these various statements were derived from previous or ongoing studies and from the specific RABA protocols (Annex 16C).

If the overall conclusion of a RABA is a positive recommendation, it will probably be relevant to proceed with more detailed studies. Two specific methods that may be used are the MLA (Multidisciplinary Landscape Assessment) approach developed at CIFOR and the RAP (Rapid Assessment Program) method of Conservation International (undated).

The Rapid Assessment Program (RAP) was created in 1990 to provide biological information (mostly assemblages of species in a certain ecosystem) needed to catalyse conservation action and improve biodiversity protection (Conservation International undated). RAP uses the approach that small RAP teams of expert international and host-country tropical field biologists conduct rapid first-cut assessments of the biological value of selected areas over a short time period. More specific biological expertise is needed if the initial appraisal suggests that there are likely to be conservation values involved.

Multidisciplinary Landscape Assessment (MLA) is an approach to explore and understand local people's perspectives on their surrounding landscape. This is done by collecting the most decisive information, which is collected in a manner that is multidisciplinary and collaborative, and with special regard to local perspectives on environmental impact (Sheil et al. 2002).

The methods used in MLA are similar to RABA and have formed part of its inspiration. There is extensive use of participatory (or collaborative) 'biodiversity' survey that combines local knowledge and definition with scientific taxonomy. Both methods also explore the potential of traditional practices of natural-resource management, especially based on value and preferences of local people in the context of biodiversity and its utilization. In RABA and MLA, local definitions of land use, landscape and their elements, which are based on their relative utility values, are not seen as an incompatible comparison to scientific approaches. The knowledge enriches and helps in communicating the definitions and knowledge to a scientific audience. However, both tools are created not to isolate biodiversity for their sole existence and option values, but to explore them primarily for their use value. The main difference between RABA and MLA is the focus on affordable budget and limited time frame that was part of the RABA design. Recent MLA applications, however, are moving in the same direction (Sheil personal communication)

Table 4. Summary of the key arguments supporting a RABA conclusion in three cases

Primary criterion	*Bungo* Rubber agroforest (RAF)	*Sumberjaya** Bird -friendly coffee gardens (Trudy OConnor, PhD thesis in preparation)	*Mae Tho* New national park in forest agriculture mosaic
VALUE (to sellers and buyers) is clear	• Sumatra is biodiversity hotspot; lowland forest not effectively protected; RAF is main remaining refugium • RAF is equivalent to secondary natural forest in tree richness • RAF gives good income per day of work for the farmers • RAF is good buffer-zone habitat & still forms stepping stones	• Sumatra is a biodiversity hotspot; Lampung is largely deforested; whatever is left is therefore of value; restoration is important • Multistrata coffee is better bird habitat than monoculture coffee, but substantially less than forest; landscape-level role exists	• The area is part of recognized region with high mammal diversity under threat • Flagship mammal species under threat exist in Mae Tho Cultural valuing of species in local systems is high • Other taxonomic groups also benefit from habitat protection
THREATS linked to land-use activities are urgent	• Conversion to monoculture seems to be more profitable, but leads to loss of agrobiodiversity • Policy threat from existing government plans: transmigration, oil palm, mining, etc.	• Forest conversion in the area has been rapid • High-canopy trees compete with coffee: farmers perceive clear trade-off • Coffee gardens dont meet all ecolabel criteria	• High local extinction rate linked to habitat change and overhunting • Inter-village self-regulation of hunting is not sufficient
OPPORTUNITIES exist to overcome the THREATS	• People still like RAF for the local environmental service it provides (especially water supply) • There are technical opportunities for increasing the competitiveness of RAF relative to other options	• Farmers like birds they dont cause problems to them • Coffee quality is low; it will be difficult to find a buyer interested in addition values Farmer groups exist and have accountability	• Awareness is high • Social bonding high within village • Alternative livelihoods are available • Potential for development of a Royal project
Sufficient *TRUST* exists to get buyers, sellers & government to negotiate deals	• Level of trust between local community and government plans and projects is not high • Local people are willing to negotiate with outsiders if the benefits are clear	• HKM (*hutan kemasyarakatan*, a community forestry) programme provided tenure incentive, conflict was replaced by negotiations	• Existing watershed network works well • Official recognition of villages in the Park
Overall RECOMMENDATION to potential SELLERS and BUYERS	*Yes, there are good opportunities for biodiversity conservation in rubber agroforest landscapes through rewards for targeted areas*	*Bird -friendly coffee markets will be difficult to reach; integration of conservation concerns into HKM is feasible*	*Yes, there are good opportunities for biodiversity conservation in the forest agriculture mosaic through rewards and adjustments to the new national park*

* The Sumberjaya bird-friendly coffee study was done before RABA protocols were defined.

RAP, on the other hand, is different from MLA and RABA. Although it is an exploratory tool, RAP focuses on obtaining scientific biodiversity information using primarily taxonomic indicators. Sole emphasis on biodiversity thus makes the possible approaches for rapid assessment limited, either using remote-sensing methods or using the services of highly qualified experts on biodiversity. RAP uses the latter.

MLA is focused on obtaining more in-depth information or perspectives of local people about certain aspects related to local land uses. Agricultural areas are seen as an explanatory part in MLA, whereas in RABA agricultural areas (agrobiodiversity) are the 'centre' of analysis. In MLA, the main objective of collecting the local perspectives is that the land that is owned by local people should be respected and understood by other institutions, especially the government. In the past, land designation (zonation) was done in the absence of consultation with local people, let alone in a participatory process.

In RABA, local perspectives on agricultural area are used to define threats, value with regards to biodiversity, and potential development of rewards for environmental service of agrobiodiversity conservation. RABA uses secondary data to rapidly assess facets of biodiversity, and rapid rural appraisal and semi-structured interviews to obtain local perspectives.

In terms of time necessary to finish a case study, conducting an MLA would take six months to one year. Rather complex data analysis and the need for a certain degree of computer expertise lengthen the analysis time. RAP is very quick, once the local experts have been trained. A case study on RAP application in Papua, Indonesia (RAP, Richard and Suryadi 2002) was finished in one month. In comparison, for RABA, the time is highly dependent on the availability of secondary data and additional 'first-hand' information to be collected.

A final discussion point is the comparison with the rapid appraisal methods that are evolving for watershed functions (Rapid Hydrological Appraisal, RHA; Jeanes et al. 2006) and carbon stocks (Rapid Carbin Stock Appraisal, RaCSA; Lusiana et al. 2005). They are all based on a similar triangulation of local, policy makers'/public and scientific/modeller's knowledge, and they all lead to the appraisal of value, threat, opportunity and trust (figure 22).

The Government of Thailand is already interested in conserving the area. An upcoming Royal Project could be directed towards solving the problem of trust between the government and the communities.

In the further development of these toolboxes, a further specification of the common approaches and data requirements can probably contribute to greater cost efficiency compared to isolated studies, adding to the likelihood of 'bundling' of services at acceptable transaction costs.

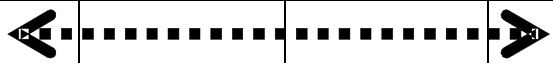
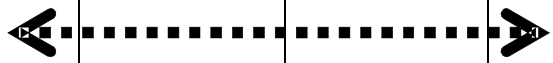
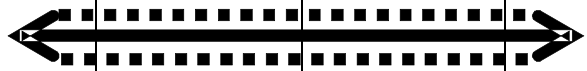
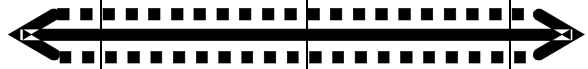
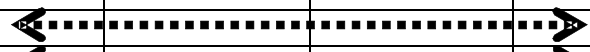
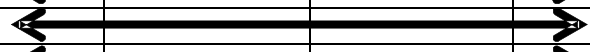
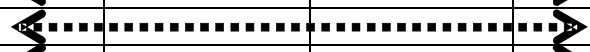
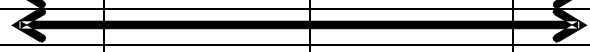
Scoping stage: is there a service worth rewarding, who should talk to whom?				
Environmental Service Knowledge domain	Rapid Hydrological Appraisal (RHA)	Rapid Agro-biodiversity Appraisal (RABA)	Rapid Carbon Stock Appraisal (RaCSA)	Ecotourism Appraisal* ..??...
1. LEK: Local ecological knowledge & preferences				
2. PEK: External (public, policy) ecological knowledge & preferences				
3. MEK: Scientific (Modellers) spatial analysis & bio-economic models				
4. Participatory scenario development: plausible futures				
Synthesis				
VALUES				
THREATS				
OPPORTUNITIES				
TRUST				
Proceed	Yes/No	Yes/No	Yes/No	Yes/No
Full negotiation stage	Ten-step watershed function assessment and NSS†	Multi-stakeholder Landscape Assessment (MLA)	CDM project document preparation	..??..

Figure 22: Emerging toolboxes to help in the 'scoping' and 'negotiation' stages for four 'environmental services' (⟷ indicates substantial similarity of data requirements, ⟷ indicates partial synergy is possible)
***** Ecotourism appraisal has yet to be conducted.
† NSS = negotiation support system.

Abbreviations and Acronyms

References

Annexes

ABBREVIATIONS AND ACRONYMS

ACM	adaptive co-management
APL	*Areal Penggunaan Lain*
BA	Basal Area
BAPPEDA	*Badan Perencanaan Pembangunan Daerah* - District Government's planning body
BGBD	below-ground biological diversity
CBD	Convention on Biological Diversity
CBFM	community-based forest management
CDM	Clean Development Mechanisms
CFC	Common Fund for Commodities
CI	Conservation International
CIFOR	Center for International Forestry Research
CIRAD	French Agricultural Research Centre for International Development
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
Dishutbun	District Representative of Forest and Estate Corp
Distan	District Representative of Agriculture
DEM	digital elevation model
ES	environmental service(s)
ESR	environmental-service reward
FAO	Food and Agriculture Organization
GEF	Global Environment Facility
GIS	geographical information system
GMS	Greater Mekong Subregion
HKM	*hutan kemasyarakatan* - a community forestry
IAMM	*Institut Agronomique Méditerranéen de Montpellier*
ICDP	Integrated Conservation and Development Project
ICRAF	International Centre for Research in Agroforestry (legal name of World Agroforestry Centre)
ICRAF-SEA	ICRAF Southeast Asia
IFAD	International Fund for Agricultural Development
IRR	internal rate of return
IUCN	International Union for the Conservation of Nature
KKI-WARSI	*Komunitas Konservasi Indonesia – Forum Komunikasi dan Konservasi*
LEK	local ecological knowledge
LU	land use
m.a.s.l.	metres above (mean) sea level
MEK	modellers' ecological knowledge
MLA	Multidisciplinary Landscape Assessment
NGO	non-governmental organizations
NSS	Negotiation Support System
PAM	policy analysis matrix

PEK	public and policy maker ecological knowledge
PES	payments for environmental services
PhD	Doctor of Philosophy (doctoral degree)
RABA	Rapid Agrobiodiversity Appraisal
RaCSA	Rapid Carbon Stock Appraisal
Ramsar	Ramsar Convention on Wetlands of International Importance
RAF	rubber agroforestry
RAP	Rapid Assessment Program
RHA	Rapid Hydrological Appraisal
ROA	Roles of Agriculture Project
RRA	Rapid Rural Appraisal
RS	remote sensing; remotely sensed
RUPES	Rewarding Upland Poor for the Environmental Services they provide (ICRAF project)
SEA	Southeast Asia
SRTM	Satellite Radar Topographic Mission
SWOT	Strengths – Weaknesses – Opportunities – Threats
TAO	Tambon Administration Organization
US	United States (of America)
USAID	United States Agency for International Development
USD	US dollars
WWF	World Wide Fund for Nature
YGB	*Yayasan Gita Buana*

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www.redlist.org

ANNEXES

Annex 1. Participants in the various venues

Participants	Workshop August 04	Round table Nov 2004	Case studies	Writeshop June 2005
Bambang Heriyadi****			■	■
Damsir Chaniago***	■		■	■
Deddy Irawan**	■			
Endri Martini*	■		■	■
Ery Malalo***	■		■	■
Fiona Chandler*	■			
Grace Wong*****	■			
Gustavo Schwartz*****			■	■
Hendra Hendarto****			■	■
Hesti Lestari****	■		■	■
Ibnu Maryanto**	■			
Janudianto*			■	
Jasnari*			■	■
Jim Peters*****	■	■		
Laxman Joshi*	■	■	■	■
Mahendra Taher**	■			
Marie Celestreme****	■			
Meine van Noordwijk*	■	■	■	■
Mikkel Kallesoe*****		■		
Mohammed Bakkar*	■			
Nur Haryanto****			■	■
Pandam Nugroho****			■	■
Parmadi****	■			
Perry Ong****	■			
Pornwilai Saipothong*			■	■
Ratna Akiefnawati*	■		■	
Susilo Ady Kuncoro*	■	■	■	■
Sutono***	■			
Suyitno*			■	■
Takumi Sakuyama*****		■		
Trudy OConnor****			■	■
Veronika Areskoug*			■	■
Xavier Rossi****	■			

* : ICRAF

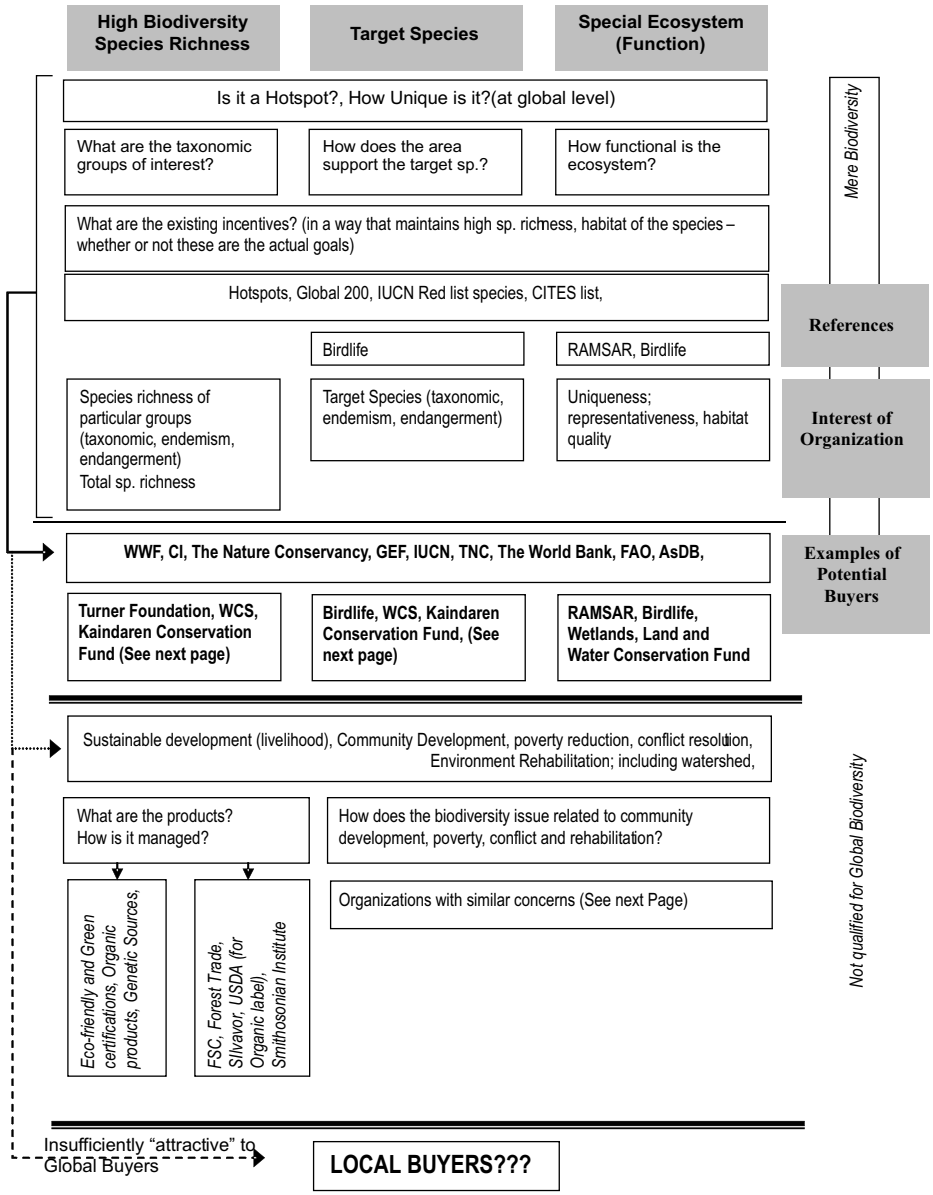
** : Government officials (Forestry, Planning Body, LIPI [Indonesian Research Institute])

*** : Local NGO (Gita Buana,WARSI)

**** : Students/University (Univ. of Montpellier, Univ. of Utrecht, Univ. Of Jambi. UP Philippines,Univ. Of Hawaii,Univ. Negeri Jakarta, and Univ. of Adelaide)

***** : International participants (Conservation International, FAO, IUCN, EMBARPA-Brazil).

Annex 2. Finding buyer for environmental services of biodiversity conservation



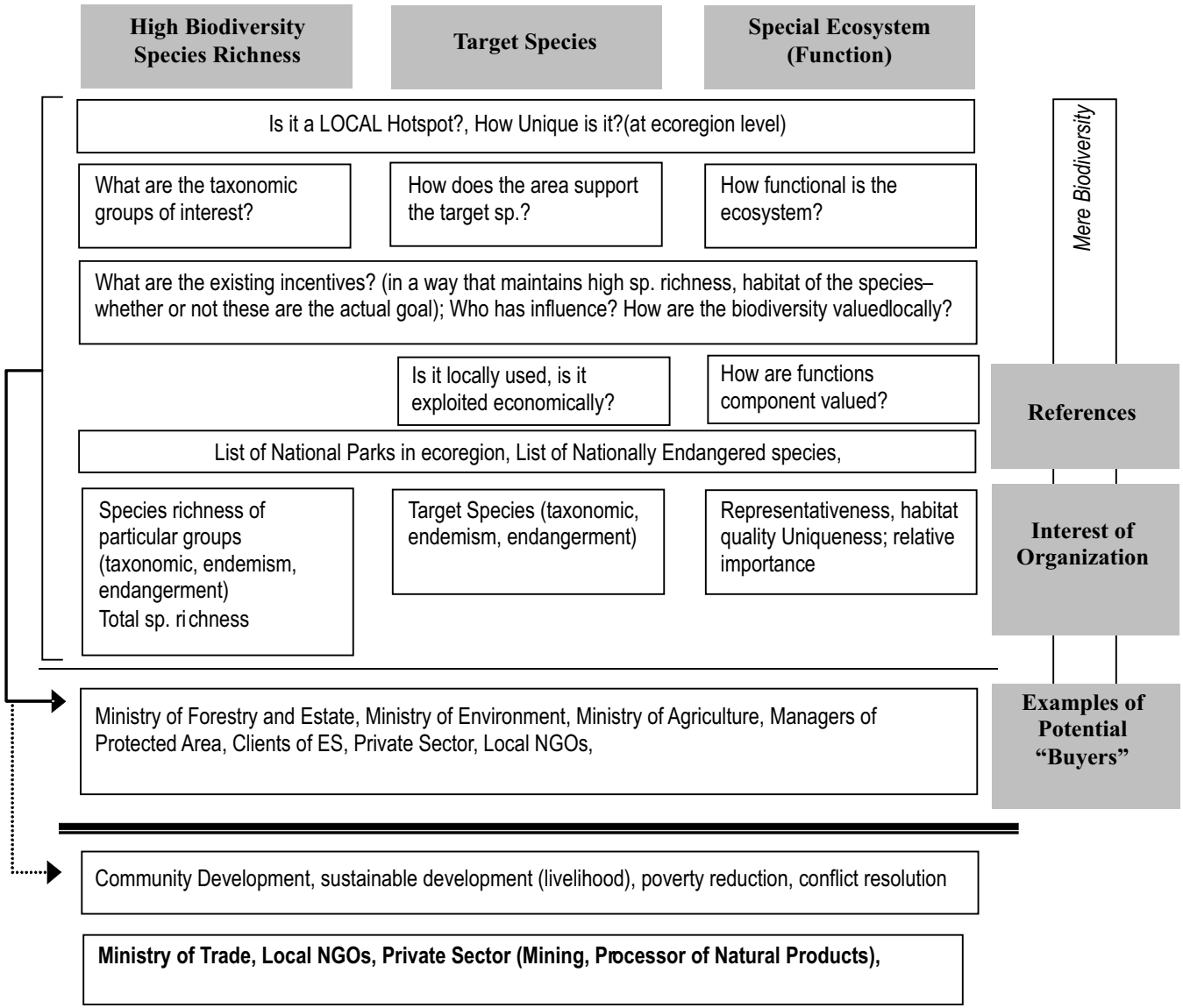
Annex 3. List of Potential Organization for Funding, Information, Certifier and Additional Fund/Assistantship For Research

	Information	Research	Certifier	Buyer		
Center for Plant conservation	■	■			www.centerforplantconservation.org/	
European Center for Conservation		■		■	www.ecnc.nl	
Habitat Conservation Trust Fund				■	http://www.hctf.ca/	For individual and small project less than 10.000 $
Silvavor			■		http://www.silvafor.org/programs/ecocert/	
Fairtrade			■		http://www.fairtradefederation.com/	
Oxfam - Fairtrade			■		www.oxfam.org	
Organic Trade Association			■		http://www.ota.com/index.html	Criteria and Standard for development of organic trade
					http://www.ota.com/links/resources.html	link to organizations that potential to provide assistantship
Rainforest Conservation Fund				■	http://www.rainforestconservation.org/	Focuses on South America but could be of good source of information about
Forest Stewadshi Council (FSC)			■		www.fsc.org	
Envirolink	■				http://www.envirolink.org/	
Global Conservation Fund (From CI)	■	■		■	http://www.conservation.org/xp/gcf/apply/types.xml	
Conservation Fund for Birds				■	http://www.pathwaystonature.com/	Non-protected area, focuses in North America
Wildlife Conservation Fund	■			■	http://www.arazpa.org.au/Conservation_WCF.htm	Focuses in Australasia, and has a program on Sumatran Tiger Conservation
Knowledge Center on Eco-friendly label	■				http://www.eco-labels.org/good_ecolabel.cfm?mode=text	
Disneys' World Conservation Fund				■	http://disney.go.com/disneyhand/environmentality/dwcf/	
Shade grown Coffee (Bird-Friendly Coffee)			■		http://nationalzoo.si.edu/ConservationandScience/MigratoryBirds/Coffee/	
Kaindaren Conservation Fund				■	http://www.keidanren.or.jp/kncf/eng_index.html	Potential souce for Conservation related activities, including energy etc.
GTZ (German Technology Aid)	■	■		■	http://www.gtz.de/en/index.htm	Interested in development issues and environment, though not primarily biodiversity
Tropenbos	■	■			http://www.tropenbos.nl/index.html	
Gibbon Foundation	■	■		■	http://www.gibbon.or.id/	
Global Environment Facility	■			■	www.gefweb.org	
The David Shepherd Wildlife Foundation		■		■	http://www.davidshepherd.org/core_pages/!_index.shtml	
BP Conservation Program				■	http://conservation.bp.com/projects/results.asp	
Flora-Fauna International	■	■		■	http://www.fauna-flora.org/	Funding for in-depth biodiversity research and has experience in designingn a Mesoamerica corridor
Asian Nature Conservation Foundation	■			■	http://www.asiannature.org/	
Rufford Small Grants for Nature Conservation				■	http://www.rufford.org/rsg/index.html	Small grant, aimed at financing small conservation program or pilot projects
Rainforest Alliance	■		■		http://www.rainforest-alliance.org/	Certifier agent of wood products to coffee.
CRS Fair Trade	■		■		http://www.crsfairtrade.org/coffee_project/sealdeal.htm#four	
Conservation International	■			■	www.ci.org	

List of Potential Organization for Funding, Information, Certifier and Additional Fund/Assistantship for research (Continued)

	Information	Research	Certifier	Buyer		
Smithsonian Bird Institute	■		■		http://nationalzoo.si.edu/ConservationandScience/MigratoryBirds/Coffee/default.cfm	
World Wildlife Found			■		www.panda.org	
The Nature Conservancy	■			■	www.nature.org	
World Conservation Society	■			■	www.wcs.org	
Asian Development Bank		■		■	www.adb.org	
IUCN	■			■	www.iucn.org	
World Bank	■	■		■	www.worldbank.org	
Food and Agriculture Organization	■	■		■	www.fao.org	
CIFOR	■	■			www.cifor.org	
Land and Water Conservation Fund				■		
UN for Environmental Protection				■	http://www.unep.org/	Promote the development of policies, economic instruments, management practices and tools that ensure an environmentally sound approach to activities , develop partnerships with the private sector and corresponding outreach activities,
DFID				■	http://www.dfid.gov.uk/	global poverty and hunger to protecting the environment, improving health and sanitation and tackling illiteracy and discrimination against women
Turner Foundation				■		
Birdlife	■	■		■	www.birdlife.net	
Wetland	■	■		■	www.wetlands.org	

Annex 4. Finding local 'buyers'



Annex 5. Example of spatial prioritization for conservation[16]

Issuance Date: 14 June 2005; Closing Date: 15 July 2005
Subject: Request for Applications (RFA) Number 486-05-004 Regional Biodiversity Conservation Program

"The United States Agency for International Development (USAID), through its Regional Development Mission/Asia, is seeking applications from non-governmental organizations (NGOs) to implement activities to support programs under its Regional Biodiversity Conservation Program."

"THE GREATER MEKONG SUBREGION PROGRAM AND ITS BIODIVERSITY CONSERVATION CORRIDORS INITIATIVE"

The Greater Mekong Subregion (GMS) Program was initiated through ADB support in 1992 to facilitate sustainable economic growth and to improve the living standards of the people of the GMS. The GMS consists of Cambodia, Lao PDR, Burma, Thailand, Vietnam, and Yunnan Province of the People's Republic of China. The GMS Program's Environment Working Group recently established the Biodiversity Conservation Corridors Initiative, with the aim to establish sustainable management regimes to restore habitat connectivity as well as provide benefits of natural resource (forest, water, soil, air) goods and services that contribute to improving livelihoods of peoples living in and around the biodiversity corridors. The Initiative also protects the physical infrastructure investments deemed central to economic integration and sustainable development in the subregion. The components of the Initiative are: poverty reduction, land use, ecosystem restoration, capacity building and environmental financing.

Its primary focus is to establish biodiversity conservation landscapes and corridors to maintain or increase biodiversity and forest cover. These corridors are continuous strips of land or stepping stones of suitable habitat that provide physical linkages between core protected areas permitting species migration between areas. There are nine priority biodiversity corridors identified through the Initiative: 1) Western Forest Complex; 2) Tonle Sap Inundation Zone; 3) Cardamom and Elephant Mountains; 4) Northern Plains Dry Forest; 5) Eastern Plains Dry Forest; 6) Tri-border Forests; 7) Central Annamites; 8) Northern Annamites; and 9) Mekong Headwaters (Figure 1)

The Mekong Region's habitats support diverse, abundant, and rare wildlife. Recently, six new large mammal species the saola, large-antlered muntjac, Roosevelt's muntjac, Annamite muntjac, and the Annamite striped rabbit have been described in the Greater Annamites ecoregion. The Forests of the Lower Mekong are also home to other mammal species of international conservation significance. These include the kouprey, Javan rhino, tiger, Asian elephant, and douc and Francois' langurs. The region also contains important bird species, such as Edward's pheasant, Sarus crane, giant ibis, and the white-shouldered ibis as well as myriad species of reptiles (such as the Siamese crocodile the rarest crocodile in the world), amphibians, fish, invertebrates and plants. The aquatic biodiversity of the region, though not well studied, is already proving to be one of the most diverse in any tropical river system in the world. The forests and associated ecosystems also have significant watershed value. The Mekong River is also home to 1,300 fish species, the highly endangered giant catfish and Irrawaddy dolphins."

[16]For updated information on the GMS project, see http://www.adb.org/projects/gms-biodiversity/

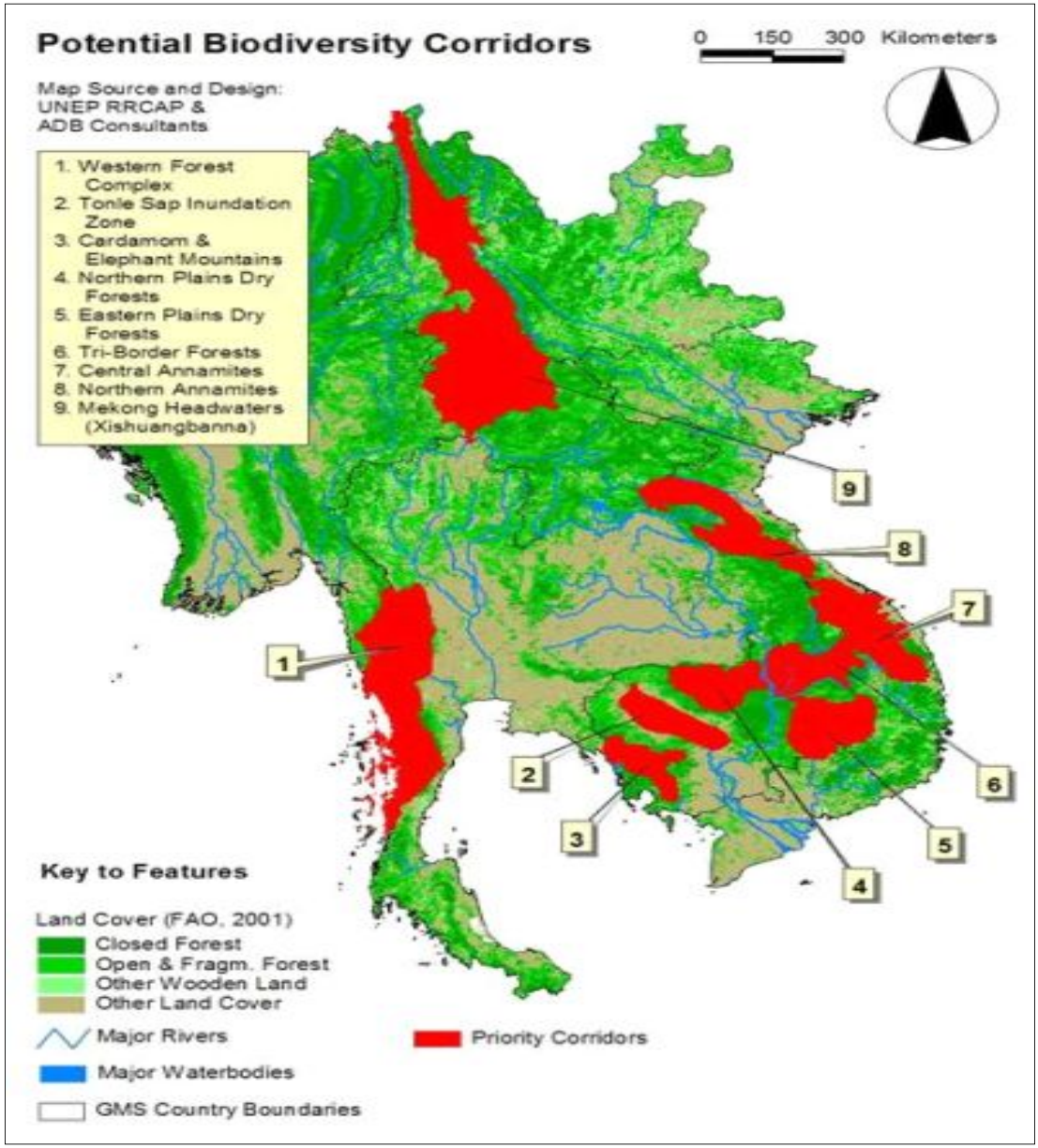


Figure A5. Greater Mekong subregion biodiversity corridors

Annex 6. Approaches to mapping an area of biodiversity importance

Baseline spatial data

Based on its themes, the spatial data required to conduct GIS-based analysis can be classified into two major classes: land cover, and elevation data.

Land cover
Land-cover information is important for identifying potential areas for conservation. The existence of specific land-cover types might be an important clue of the right area for conservation. Several government agencies provide a 'desktop-ready' land-cover maps, although there are concerns about the accuracy of these maps. In some cases, the available land-cover map does not show specific land-cover types that are important for biodiversity conservation. Another approach to obtain land-cover information is by using remote-sensing technology, in which satellite image is the main source of information about land cover.

Elevation
Information on elevation is commonly obtained from topographical maps. However, converting the map to digital format requires great effort. The more rapid way to obtain elevation data is by using SRTM (Satellite Radar Topographic Mission) data. SRTM is a 90-m-resolution digital elevation model with a worldwide coverage and it can be downloaded from the Internet free of charge (http://glcf.umiacs.umd.edu/data/srtm/).

Processing and Analysis

Land-cover classification using remote-sensing data

Land-cover classification, which is the basic application of remote sensing, is an activity to identify physical cover of the earth surface based on interpretability of reflected sunlight captured by satellite sensors above the earth. The classification begins by identifying land-cover classes through field observation or any other reference available. Information from field observation will then be used as a sample to develop the *spectral signature* of a land-cover type. The signature will be used to identify similar land cover over the whole image, by means of a *classification algorithm*. The resulting image classification has to go through an *accuracy assessment* process to ensure its quality and precision. The steps of land-cover classification are shown in figure A6-1.

The output of the image-classification process is a land-cover map with a certain degree of accuracy. Certain spatial information, like area, location, density and distance, can be extracted directly from a land-cover map. Further analysis can also be conducted to extract information on land-cover proportion over an administrative area such as a district, sub-district or village.

Spatial Analysis on Potential Area for Biodiversity Conservation

Once all the spatial data are available, analysis of the potential area for conservation can be conducted. Integration of baseline, elevation and land-cover map will form a *spatial geodatabase*, which will serve as a source of information for further analysis. By using the geodatabase, one can develop and spatially assess criteria and condition for potential biodiversity conservation.

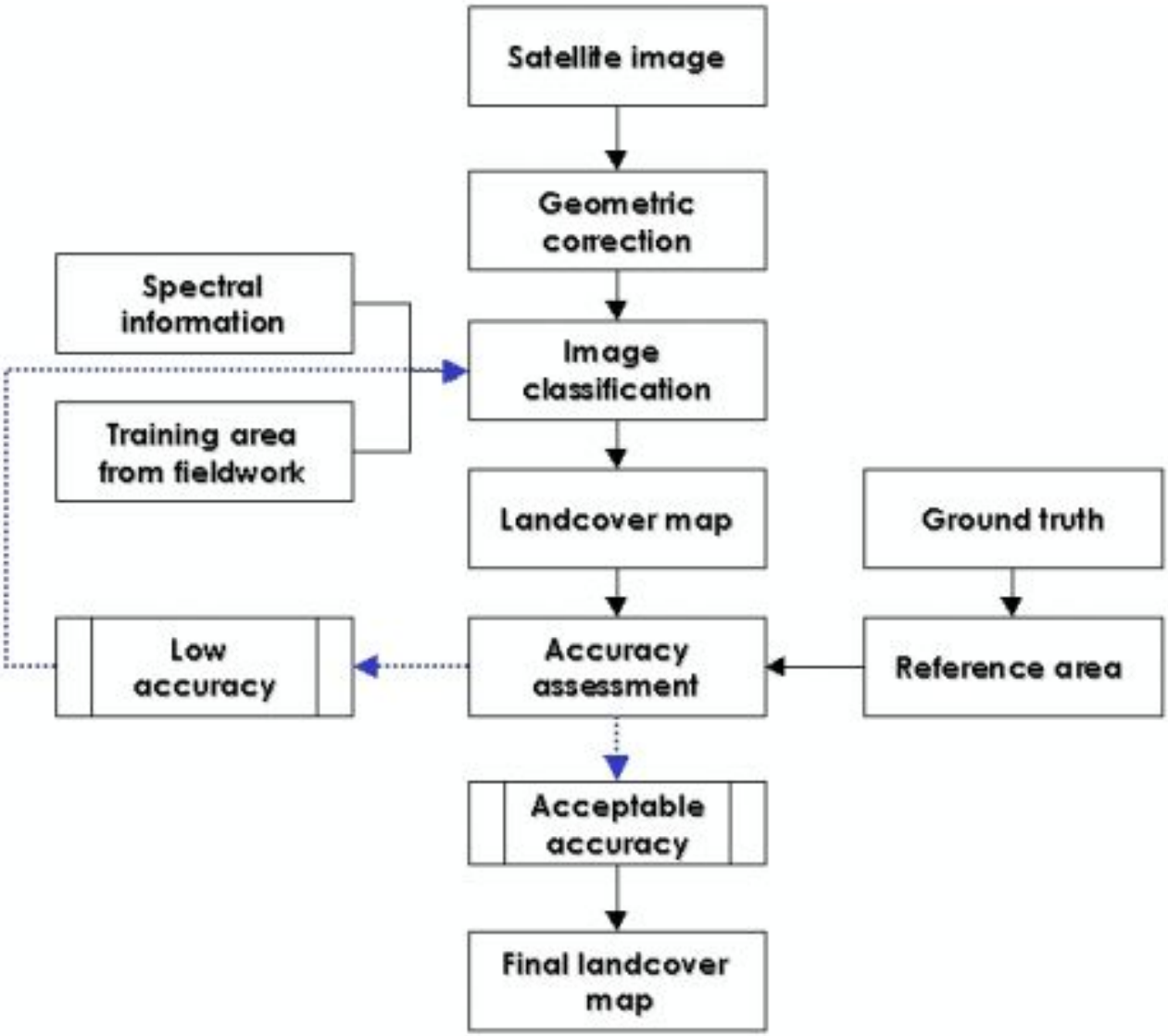


Figure A6-1: Land-cover classification workflow.

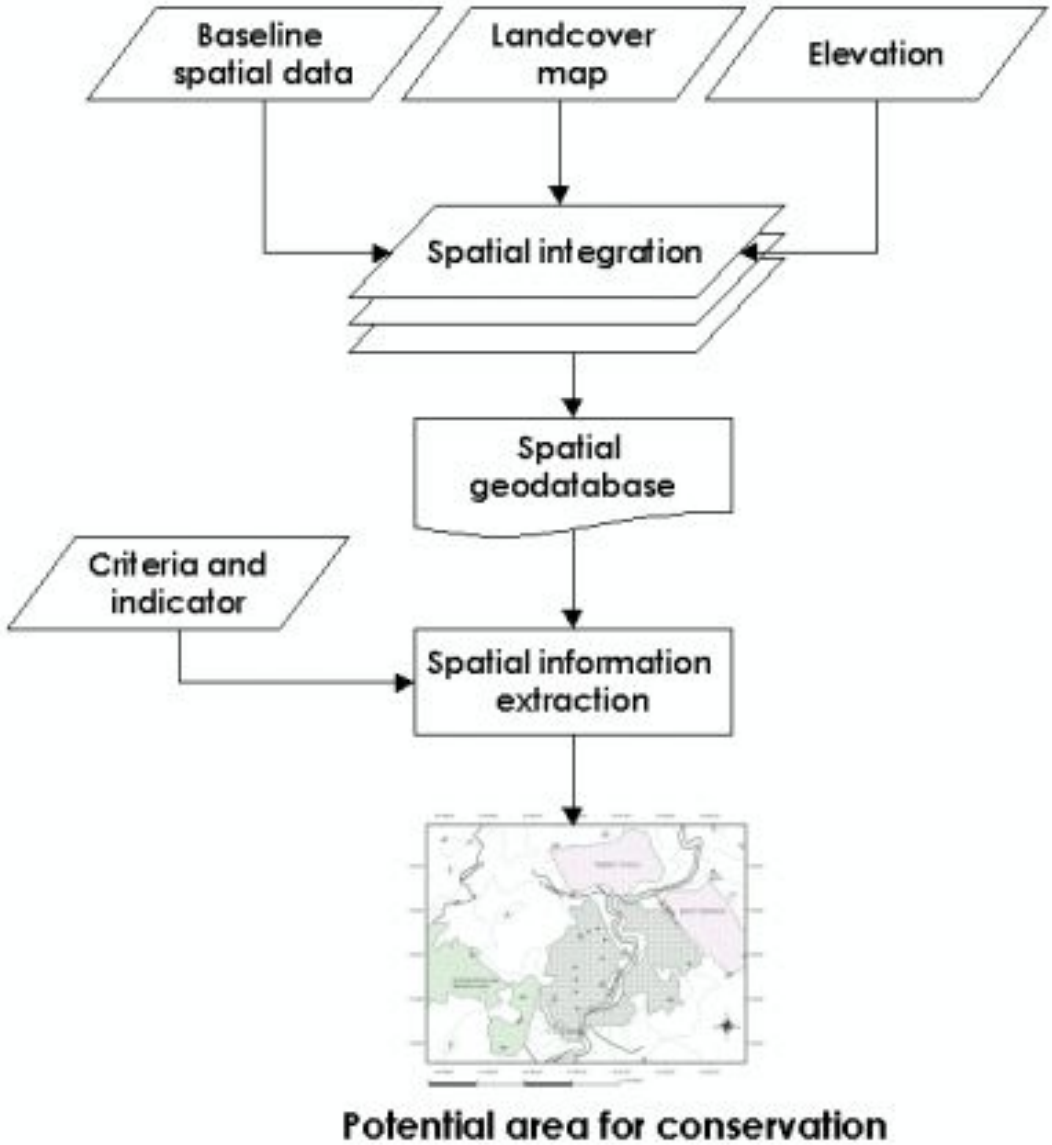


Figure A6-2. Spatial data integration and analysis.

Another way to obtain detailed spatial information is through participatory mapping. The conceptual framework to conduct participatory mapping is shown in Figure A6-3.

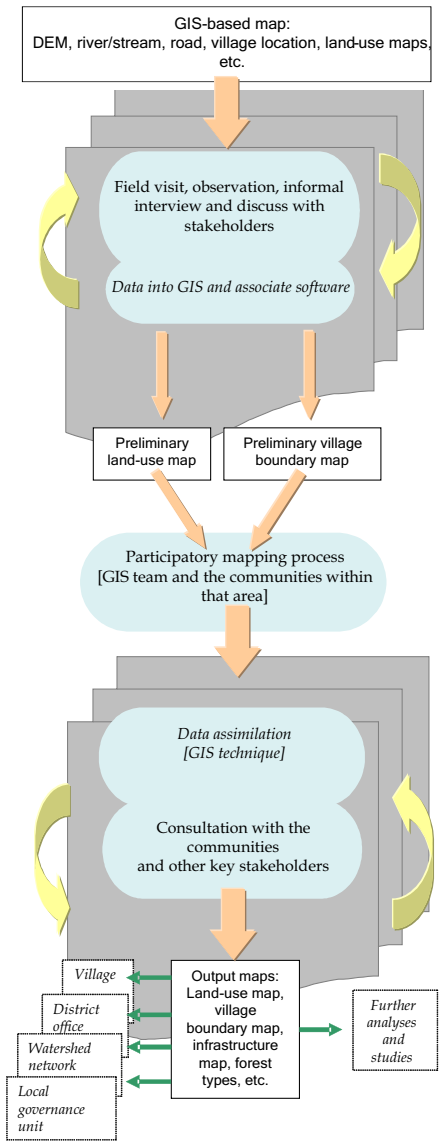


Figure A6-3. Methodology of a participatory mapping to link local and expert knowledge

Annex 7. Conducting a stakeholder analysis

Stakeholder analysis is done using a four-step process:

1. *Identifying* key stakeholders
2. Assessing stakeholders' interest and potential impact
3. Assessing *influence* and *importance*
4. Outlining a stakeholder *participation* and *strategy.*

Identifying key stakeholders is done by emphasizing aspects of beneficiaries of the initiativethose who would be impacted, vulnerable groups, supporters and opponents, and description of relationships among stakeholders. Identifying key stakeholder can be done in various ways, such as identification by the stakeholder *themselves*, by *other stakeholders,* by *knowledgeable individual or groups*, by *field staff*, based on demography and based on written records from previous project(s). However, combinations of some of the methods would minimize the bias inherent in the use of a single approach. Additionally, Vermuelen and Koziell (2002) broadly group biodiversity interest groups into: *Government*, i.e. legislative and policy-making body as well as implementing agencies; *Environment*, i.e. conservation organizations; *Community*, i.e. local residents and representative bodies; *Private sector,* i.e. resource use or extraction business.

The third step – assessing influence and importance of stakeholders – is done by exploring aspects of power and status, degree of organization, control of strategic resources, power relations with other stakeholders, and the importance to the success of the project. The final step of the analysis is conducted by planning stakeholders' involvement (in accordance with interest, influence and importance), getting the stakeholders actually involved, and designing appropriate form of participation.

To simplify the analysis, all the information is 'stored' in a form of matrices. The outcomes of steps 1, 2 and 3 are put into tables A7-1 and A7-2. Table A7-3 shows the alternatives of participation, in which different institutions are to be engaged in different processes of the project.

Table A7-1. Identification of stakeholder groups, their interests, importance and influences

Stakeholder group	Interest at stake in relation to Project	Effects of Project on stakeholders interests			Importance of stakeholder for success of the Project*	Degree of influence of stakeholder over Project*
		+	0	-		

* Assign ranks/number: U = Unknown; 1 = Little/no influence; 2 = Some influence; 3 = Moderate influence; 4 = Significant influence; 5 = Very influential.

Table A7-2. Mapping key stakeholders' relative influence and importance

Influence of stakeholders	**Importance of the activity to stakeholder**					
	Unknown	Little/no influence	Some influence	Moderate influence	Significant influence	Very influential
Unknown						
Little/no influence						
Some influence						
Moderate influence						
Significant influence						
Very influential						
Note: Stakeholders are placed in cells in accordance with their potential to influence the project, and the importance of the project to the stakeholder						

Table A7-3. Formulation of stakeholder participation strategy

Stage in project process	**Type of participation**			
	Information sharing (one-way flow)	Consultation (two-way flow)	Collaboration (increasing control over decision making)	Empowerment (transfer of control over decisions and resources)
Project identification				
Preparation appraisal				
Implementation, supervision and monitoring				
Evaluation				
Note: Stakeholders to be placed in cells according to their potential roles.				

Annex 8. Introduction to Questionnaires for RABA

Operationalization of RABA is done by combining secondary data with empirical data on some facets of biodiversity and local knowledge. Local knowledge is broadly translated into the local people's knowledge per se and their perceptions, for which purposive interviews have been designed to obtain such information. Key informants from existing formal and informal institutions, stakeholders from outside the village, and people from different occupations as well as women are to be interviewed.

Data acquisition through interview consists of two stages: key stakeholder and household, and group discussions. In juxtaposition with the result from literature study and other secondary data, the main objectives of the interviews are to contribute to:

1. obtaining 'feasibility indicators' of a potential landscape to become a protected area under a ESR scheme;
2. capturing a broad range of local issues to be used as basic materials to further develop the questionnaire for households for the next step of rewarding environmental services;
3. the identification of alternatives to rewards for environmental services.

The key informants are purposively selected on the basis of their knowledge[17] of natural resources, its management and other cultural-anthropocentric aspects. In the case of Bungo, Indonesia, the informants were selected based on initial observation, past and ongoing research, and experience of direct interaction with villagers. Several classes of key informants can be identified, namely:

1. representatives of both formal and informal institutions;
2. those from different economic backgrounds, including intermediaries, tenants or other landless farmers, and people who own large areas;
3. extractors of natural resources, mainly hunters, loggers and trappers;
4. officers from local departments, whose offices are related to rural development, natural-resources management at district and sub-district levels.

As for the second stage of interview – household survey and group discussion – the informants are selected in two steps: *purposively*, the people who own agricultural lands with conservation value are selected as a group, and then selections are made *randomly* from that group. The material for this stage is to be developed from the result of the exploration stage. Equality between male and female respondents at this stage is very important.

In order to be as comprehensive as possible, the use of local language and idioms are suggested. It is often found that local idioms have no analogues in other languages. Therefore, a local translator will need to further explain and describe local idioms.

[17]For the case of Bungo, two indicators of knowledge were used, namely age and origin (length of stay). It is suggested that an initial exploration be conducted for better selection of key informants.

Explanation of sub-sections in the questionnaire

The questionnaires are divided into several sections, each of which consists of a number of question addressing one topic.

History of Village
The objective of this section is to obtain a general description of the condition of a village in the past, including administrative systems and village borders. The information is used as a basis to infer information about 'bonding social capital' among the inhabitants of a village.

Other reasons, such as border or leadership, are sometimes left unfinished, and thus have potential to become issues of conflict. We aimed to elaborate on the quality of social capital by exploring these aspects. Additional information about the cause of village separation can also be used as an indication of the potential of conflict to arise in the future.

Distribution and form of rights over natural resources
This section is intended to obtain information about local people's definitions of land uses in their surrounding landscape, their distribution and rights. The outcome would be complemented with the result from spatial analysis and be used to delineate potential land uses for conservation. Additionally, rules and regulations concerning rules for utilization and how the rules are applied are also addressed in this section.
In addition to the above information, land-ownership distribution, especially ones with conservation value, would be used to answer the question about location and what there is to conserve (in relation to management options and access rights).

Local institutions and organizations in resources management
The objective of this section is to get information on existing institutions that relevant to conservation. In order to achieve the objective, questions focus on on locally protected areas, customary rules and the perspective of local people regarding the protected area.

Useful animals and plants
This section explores the use value of plants and animals by gathering knowledge of key informants on the whereabouts and means of utilization of animals and plants, as well as whether it will be necessary to change people's behaviour and how urgently conservation actions need to be taken. Included in the section is information concerning the existence and rationale of rules and regulations administering the utilization.

In order to accelerate data collection, local terms for plants and animals are used in this section. The respondents are also asked to describe the specific characteristics of the animals and plants they know, and to verify the animals and plants using references.

[18] The area is derived from spatial analysis.

Services (and products) from environment
The objective is to explore local knowledge concerning the environmental services and products provided by the agroecology, and the effect of local perceptions on land-use decisions and its relationship with quantity and quality of surrounding land uses. This section is the basis for deriving perspectives of local people toward conservation.

Resources and land-use change and the effect to biodiversity
This section is dedicated to explore respondents' perspective on whether or not intensive agriculture has effects on biodiversity. Their knowledge and point of view about appropriate land use for conservation are also explored.

Preferences and threats
In contrast to local perception on resource and land-uses changes and their effects on agrobiodiversity, the objective of this section is to obtain village preferences for land uses as well as perceived threats to current land uses. For the first stage of interview, only the perspectives of a few key informants and outside stakeholders are to be obtained; however, perspectives of individuals on current landscapes are necessary to reach the recommendation stage of the RABA.
The information will be analysed to infer perceived threats to the existence agrobiodiversity from individual, community and other potential beneficiaries.

Social capital – Collective actions
This section is developed to obtain information about the existing institutional arrangement and types of engagement, as indicated by the term 'collective actions', both those that are still being practised and others that are no longer being practised. For the latter, reasons why the activity is no longer practised are to be explored. As for the former, the outcome from the key stakeholders' interviews will be used to develop individual/household questionnaires to further elaborate the quality of bonding and bridging social capital. Social capital is a topic upon which rewards mechanisms for environmental service would be developed.

Annex 9. Questionnaire for representatives of institutions.

The questionnaire is divided into two parts most of the questions are asked in a small-group discussion (2-3 representatives per group), and one part is asked to individuals. The questions written in blue are to be asked in group discussion.

Interviewer
Date
Location (Province/District)

1	Sub-district	
2	Village/Sub-village	

3	Name		
4	Age		
5	Sex	☐ Male	☐ Female
6	Ethnic background		
8	Key persons for (name of Institution)		
	Representative of Institution	☐ Customary institution	
		☐ Administrative	
		☐ Religion	
		☐ Other (specify)	

History of village (other settlement unit) development

9	*Where was the original location of this village?*	
10	*What area did the village (or other unit) cover then? (Mention the border, specify the land use if natural border)*	
11	*When was the village separated from the original unit?*	
12	*Why did it get separated? (Mention the reason for separation or abandonment)*	
13	*What is the current use of that area?*	

Distribution and Form of Rights over Natural Resources

14	*What are the types of land use in this area/village (use local terms)*	*1* *2* *3* *4* *5*	*6* *7* *8* *9* *10*
15	*Who can access and use the lands in this village? (Fill accordingly to land uses identified in question 14)*	*All villagers* *Society/Communally-based* *Lineage-based* *Family-based* *Government Officer* *Other (specify)*	*(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10)* *(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10)* *(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10)* *(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10)* *(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10)* *(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10)*

16	*What do you mean by:* *All villagers* *Society/Communally-based* *Lineage-based* *Family-based* *Government Officer* *Other (specify)*	
17	*What was the land cover and land use before the current land use?* *When was it converted?* *Why was it converted?*	

Local institution and organization in resource management

18	*Is there any place that is completely or partially protected? (Mention what types of practices are not allowed and how the boundaries are defined)*	*Activities NOT allowed*
19	*By what is it protected? (customary rule, government regulation, etc.)*	
20	*What kind of punishment would be given for non-compliance?*	
21	*Who monitors these lands and how is it done?*	
22	Do you think customary rule is enough to regulate resource use in this area? Why?	
23	Can an Outsider enter the protected area? What if the non-compliance is by an outsider?	
24	In general, what do you think peoples perspectives are towards the existing customary rules? (Use scale 1 5; using higher number to identify the better level of acknowledgment and acceptance)	

Resource and land-use changes and their effects on biodiversity

32	Do you think you and this area still have sufficient resources (richness and uniqueness) of plants and animals? (e.g. wood, fish, fruit, rattan) If YES, go to 36; if NO, go to 33
33	What is the cause of this decline of plants and animals?
36	Do you think agricultural extension and intensification are threats to richness of resources? (If YES, explain how)
37	Apart from the above-mentioned factors, is there any other factor/activity that can reduce richness of resources?

38	What do you reckon is the most suitable landscape for conservation of resources? (Describe and draw if necessary)

	Preference and threats
39	Is there any plan to change current lands/landscape in the near future (next 5 years)? (I f Yes, continue to 38)
40	What kind of land use is it and to what is it going to be converted?
41	Whose lands are they? (1. Village, 2. Community/Group, 3. Lineage-based (define), 4. Family (define), 5. Individual, 6. Government, 7. Others (specify)
42	What do YOU think about the idea of conversion? (In communally and individually-owned lands)
43	What does the village think about the idea of conversion? (In communally and individually -owned lands)

	Social capital Collective action (CA)		
44	What are the existing CAs in the area? (use local term and describe)	1 2 3 4	5 6 7 8
45	Is there any CA that is no longer practised?		
46	Since when has it not been done?		
47	Why is it no longer practised?		

Annex 10. Questionnaire for key person selected on basis of economic background

Interviewer	
Date	
Location (Province/District)	

1	Sub-district	
2	Village/Sub-village	

3	Name		
4	Age		
5	Sex	☐ Male	☐ Female
6	Ethnic background		
8	Key person for Economic background	☐ Land ownership ☐ Merchant/Trader ☐ Tenant/Agricultural labourer ☐ Other (specify)	

Useful plants and animals

25	Please mention the useful plants (use local language)	Usefulness	Found in forest	Found in agro-biodiversity type[19]	Found elsewhere (specify)	Name of the area/locations
	a. b. c. d. e.					

26	Please mention useful animals (use local language)	Usefulness	Found in forest	Found in agro-biodiversity type	Found elsewhere (specify)	Name of the area/locations
	a. b. c. d. e.					

27	In comparison to 10 years ago, what do you think about the abundance of the resources? (Increasing, Decreasing) Why do you think this change has come about?
28	Are there any rules that limit/forbid utilization of the useful animals and plants? (Give details)

[19]Agrobiodiversity type is agricultural land use hypothesized to have high biodiversity value.

Services (and products) from environment

31 What are the most important benefits, both direct and indirect, that you think can be produced from the following land uses in respect to quality of environment? (The benefits can be water regulation, source of livelihood or biodiversity conservation)

Forest	
Agrobiodiversity-rich land-use type 1	
Agrobiodiversity-rich land-use type 2	
Agrobiodiversity-rich land-use type 3	
Competing land use 1	
Competing land use 2	
Non-plantation/agricultural land uses	

Resource and land-use changes and their effects on biodiversity

32 Do you think you and this area still have sufficient resources (richness and uniqueness) of plants and animals? (e.g. wood, fish, fruit, rattan, in comparison to 10 years ago)
If YES, go to 36; if NO, go to 33

33 What is the cause of this decline of plants and animals?

36 Do you think agricultural extension and intensification are threats to richness of resources? (If YES, explain how)

37 Apart from above-mentioned factors, is there any other factor or activity that can reduce richness of resources?

38 What do you reckon is the most suitable landscape for conservation of resources? (Describe and draw if necessary)

Preference and threats of Land Uses

39 Is there any plan to change current lands/landscape in the near future (next 5 years)? (If Yes, continue to 40)

40 What kind of land use is it going to be converted into and who suggested the conversion?

41 Whose lands are they?
(1. Village, 2. Community/Group, 3. Lineage-based (define), 4. Family (define), 5. Individual, 6. Government, 7. Others (specify)

42 What do YOU think about the idea of conversion? (In communally- and individually-owned lands)

43 What does the village think about the idea of conversion? (In communally - and individually-owned lands)

Annex 11. Questionnaire for gender-based perspective on agrobiodiversity

The questionnaire is divided into two parts, one is to be asked to individuals and the other to be asked in a small-group discussion (2-3 representatives per group). The questions written in italics are to be asked in group discussion.

Interviewer	
Date	
Location (Province/District)	

1	Sub-district	
2	Village/Sub-village	

3	Name		
4	Age		
5	Sex	☐ Male	☐ Female
6	Ethnic background		
7	Occupation		

Useful plants/animals

	Please mention the useful plants (use local language)	Usefulness	Found in forest	Found in agro-biodiversity type[20]	Found elsewhere (specify)	Name of the area/ locations
	a. b. c. d. e.					
26	Please mention useful animals (use local language)	Usefulness	Found in forest	Found in agro-biodiversity type	Found elsewhere (specify)	Name of the area/ locations
	a. b. c. d. e.					

27	*In comparison to 10 years ago, what do you think about the abundance of the resources? (Increasing, Decreasing) Why do you think this change has come about?*
28	Are there any rules that limit or forbid utilization of the useful animals and plants? (Give details)

[20] Agrobiodiversity type is agricultural land use hypothesized to have high biodiversity value.

Services (and products) from environment

31 What are the most important benefits, both direct and indirect, that you think can be produced from the following land uses in respect to quality of environment? (The benefits can be water regulation, source of livelihood or biodiversity conservation)

Forest	
Agrobiodiversity-rich land-use type 1	
Agrobiodiversity-rich land-use type 2	
Agrobiodiversity-rich land-use type 3	
Competing land use 1	
Competing land use 2	
Non-plantation/agricultural land uses	

Resource and land-use changes and their effects on biodiversity

32 *Do you think you and this area still have sufficient resources (richness and uniqueness) of plants and animals? (e.g. wood, fish, fruit, rattan)*
If YES, go to 34; if NO, go to 33

33 *What is the cause of this decline of plants and animals?*

34 *Do you think that there are animals, plants, land use, etc. that should be protected but that are NOT YET protected?*

35 *How do you think those animals, plants, land use, etc. should be protected?*

36 *Do you think agricultural extension and intensification are threats to richness of resources? (If YES, explain how)*

37 Apart from above-mentioned factors, is there any other factor/activity that can reduce richness of resources?

38 What do you reckon is the most suitable landscape for conservation of resources? (Describe and draw if necessary)

Social capital Collective action (CA)

44	What are the existing CAs (use local language and describe briefly)	1 2 3 4	5 6 7 8
45	Is there any CA that is no longer practised?		
46	Since when has it not been done?		
47	Why is it no longer practised?		

Annex 12. Questionnaire for key persons selected on the basis of occupation

Interviewer
Date
Location (Province/District)

1	Sub-district	
2	Village/Sub-village	

3	Name (or code)			
4	Age			
5	Sex	☐ Male	☐ Female	
6	Ethnic background			
8	Key person for Occupation	☐ Hunter	☐ Former hunter	
		☐ Logger	☐ NTFP collector	
		☐ Bird catcher	☐ Merchant or middleman	
		☐ Other (specify)		

Local institution and organization in resource management

18	Is there any place that is protected and cannot be used or can only be used for certain need? (Mention for what and where)	Activities NOT allowed
19	By what is it protected? (customary rule, government regulation, etc.)	
20	What kind of punishment would be given for non-compliance?	
21	Who monitors the land and how is it done?	
23	Can an Outsider enter the protected area? What if the non-compliance is by an outsider?	

Useful plants/animals

25	Please mention the useful plants (use local language)	Usefulness	Found in forest	Found in agro-biodiversity type[21]	Found elsewhere (specify)	Name of the area/locations
	a. b. c. d. e.					

26	Please mention useful animals (use local language)	Usefulness	Found in forest	Found in agro-biodiversity type	Found elsewhere (specify)	Name of the area/locations
	a. b. c. d. e.					

[21] Agrobiodiversity type is agricultural land use hypothesized to have high biodiversity value.

27	In comparison to 10 years ago, what do you think about the abundance of the resources? (Increasing, Decreasing) Why do you think this change has come about?
28	Are there any rules that limit or forbid utilization of the useful animals and plants? (Give details)

Rare plants and animals

29	Are there any plants/animals that have become rare or even disappeared?

30	Name of the plant/animal	Last encounter	Place of encounter
	a. b. c. d. e.		

Services (and products) from environment

31 What are the most important benefits, both direct and indirect, that you think can be produced from the following land uses in respect to quality of environment? (The benefits can be water regulation, source of livelihood or biodiversity conservation)

Forest	
Agrobiodiversity-rich land-use type 1	
Agrobiodiversity-rich land-use type 2	
Agrobiodiversity-rich land-use type 3	
Competing land use 1	
Competing land use 2	
Non-plantation/agricultural land uses	

Local perception on conservation

32	Do you think you and this area still have sufficient resources (richness and uniqueness) of plants and animals? (e.g. wood, fish, fruit, rattan) If YES, go to 36; if NO, go to 33
33	What is the cause of this decline of plants and animals?
36	Do you think agricultural extension and intensification are threats to richness of resources? (If YES, explain how)
37	Apart from above-mentioned factors, are there any other factors/activities that can reduce richness of resources?
38	What do you reckon is the most suitable landscape for conservation of resources? (Describe and draw if necessary)

Annex 13. Questionnaire for individual/household

	Interviewer
	Date
	Location (Province/District)

1	Sub-district	
2	Village/Sub-village	

3	Name				
4	Age				
5	Sex		Male		Female
6	Status in the house		Head of Family		Other e.g. teen, retired
			Other (specify)		
7	Ethnicity				
8	Origin		Born here		Immigrated
9	Length of stay in the area				
10	Occupation		Farmer		Other (Labourer)
a	Farmer (on-farm)	Primary Secondary	Land owner	P S	Other (specify)
b	Non-farmer (off-farm)	P S	(Former) Hunter	P S	Fisherman
		P S	NTFP collector	P S	Government official
		P S	Home responsibility	P S	Mining industry
		P S	Manager/worker	P S	Logger
		P S	Other (specify)		

Physical attributes and infrastructure of household

11	Access	Unlimited	Limited	No Access
	Transportation			
	Electricity			
	Water			
	Communication (telephone, Internet)			
	Education			
	Others (specify)			

When something unexpected happens and you need money for it (e.g. funeral, accident), how are you able to get the money you need?

1. Savings
2. Loan
3. Extra work
4. Selling asset
5. Unable to fulfil the need

Satisfaction level

12	Do you feel you are able to provide a good life with all necessities for you and your family here with the current land use?	Very good life	Good life	Occasionally unable to provide basic needs	Regularly unable to provide even basic needs
13	Are there aspects of your economic situation that worry you?	Never worry	Sometimes worry a little	Often quite worried	Frequently very worried
14	What do you worry about?				

15	In comparison to surrounding villages, how is the economic situation here?	Same as other villages	Slightly better off	Much worse off	Slightly worse off	Much better off

16	Why do you think this is so?					
17	In comparison to other households, how do you think your economic situation is?	Same as other households	Slightly better off	Much worse off	Slightly worse off	Much better off

Economic goals/Future investments

19	How would you like your economic situation to be in 3 years?	
20	What do you think your economic situation will be in 3 years?	
21	How would you like your economic situation to be in 10 years?	
22	What do you think your economic situation will be in 10 years?	
23	Do you have an economic goal that you are working towards?	
24	Are you planning any major purchases in the next 3 years? If so, what?	

Land-related information

25	Economically, what type of land use/landscape do you prefer?			
26	Why do you like such land use?			
27	Do you have any plan to open new land/convert you lands?	Yes		No (go to 30)
28	How would you do it? (Financially and technically)			
29	What type of land use do you plan to develop?			

Social capital

30	What are the existing collective actions (CAs)? (use local language and explain briefly)	1	5	
		2	6	
		3	7	
		4	8	
31	Is there any CA that is no longer practised?			(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8)
32	Since when has it not been practised?			
33	Why is it no longer practised?			
34	Which of the CAs are you member of?			(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8)
35	Which of the CAs is your spouse a member of?			(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8)
36	Which of the CAs are your children members of?			(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8)
37	When was the last time you participated in the CA?			
38	What organizations exist in this village?	1	4	
		2	5	
		3	6	
39	Which organizations are you member of?			(1 - 2 - 3 - 4 - 5 6)
40	Which organizations is your spouse a member of?			(1 - 2 - 3 - 4 - 5 6)

42	When was the last time you engaged in an activity run by the organizations?
	Local perception on conservation
43	Do you think you and this area still have sufficient resources (richness and uniqueness) of plants and animals? (e.g. wood, fish, fruits, rattan) If YES, go to 45; if NO, go to 44
44	What is the cause of this decline of plants and animals?
45	Do you think agricultural extension and intensification are threats to richness of resources? (explain)
46	Apart from above-mentioned factors, are there any other factors/activities that can reduce richness of resources?
47	What do you reckon as the most suitable landscape for conservation of resources? (Describe and draw if necessary)
	Reward mechanism
50	Do you think it is necessary to provide a sort of incentive/reward to maintain the current landscape so that it is suitable for conservation in this area? (If YES, continue to 51; if NO, why?)
51	What kind of incentive/reward and to whom should it be given? (not only money as a reward)
52	What is the most appropriate scope to apply the mechanism? (Village or other government -induced administrative unit or other traditionally-developed unit?) Why this scope?
53	What do you consider the most appropriate amount for it and how should the amount be determined? (how about the scale and equity of the payments)

Annex 14. Questionnaire and checklist for group discussion

There are two ways of conducting a group discussion, by interview and by 'playing' a game; both of them are to be used for two groups, male and female. The former is used to obtain information about land uses and tenure, local perception of conservation and information about reward for environmental services. The latter is used to obtain the livelihood importance of agrobiodiversity and forest. In Annex 14, we present the questioned to be answered; instructions for playing the game are given in Annex 15.

Interviewer	
Date	
Location (Province/District)	

1	Sub-district	
2	Village/Sub-village	
3	Time	
4	Number of Participants	
5	☐ Men	☐ Women
6	Location	

Land uses and tenure

7	What are the types of land uses in this area (use local terms)	1 2 3 4 5	6 7 8 9 10
8	How big is the area of each land use? (Use approximate percentage if actual (even approximate) size unknown)	1 2 3 4 5	6 7 8 9 10
9	Who can access and use the lands in this village? (Fill accordingly to question 7)	Village-based Society/Communally-based Lineage-based Family-based Other (specify)	(1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10) (1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10) (1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10) (1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10) (1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9 - 10)

Local perception and conservation

10	Do you think agricultural extension/intensification is beneficial to biodiversity?
11	What do you think is the cause of decreasing biodiversity (animal/plant richness)?
12	What kind of landscape do you reckon as an ideal conservation area? (describe, draw if necessary)

	Reward mechanism
13	Do you think you are doing something of which some of the benefits are shared by outsiders?
14	Do you think it is necessary to provide a sort of incentive/reward to maintain the current landscape in this area that is suitable for conservation? (If YES, continue to 15; if NO, why?)
15	What kind of incentive/reward and to whom should it be given? (form of reward can be money or other)
16	What is the most appropriate scope to apply the mechanism? (Village or other government -induced administrative unit or other traditionally developed unit?) Why?
17	What is the most appropriate amount for it and how should the amount be determined? (how about the scale and equity of the payments?)
18	Who should monitor the incentive distribution and compliance with practices/land uses for which the incentive is given?
19	Is it necessary to make an agreement/contact among villages/people with donors? (If YES, go to 20; if NO go to 21)
20	Why is it important?
21	Who should punish a non-compliant?

Annex 15. Instructions for livelihood importance game

Prepare about 40 to 50 empty 'cards' and about 150-200 counters (e.g. small seeds, rocks or matches) as materials to play the game. Prior to playing the game, there is information that should be determined, namely:

- Information about various employments and sources of local livelihood
- Information about the amount and local price of a comparison unit.[22]

You need at least 3 (and at most 10) people to form a group.

I. Preparation

1. Write down 5 or 6 most important sources of livelihood on cards. However, all the existing off-farm livelihood sources are to be written on just one card. Name the off-farm card "EMPLOYMENT".
2. Prepare one card and write down a 'relative value' that is familiar to people you are playing with (e.g. monthly consumption rate of local staple food; rice in the case of Indonesia).
3. To elaborate the economic importance, you should make cards for each of the elements that make up an on-farm employment (e.g. you can write down components of livestock as goat, sheep, chicken, buffalo, etc.; or wood and NTFPs for forest).
4. As for the agrobiodiversity land uses, write down 10-12 products that can be derived solely from the land use (each on a separate card).

II. Playing the game

To play the game, you have to introduce the concept of employments and economic importance to your participating group.

1. Ask them to review your livelihood cards (see preparation no. 1) and ask them to make necessary corrections. It is nevertheless important to stick to the 5-6 employments.
2. Do the similar approach to livestock.
3. The game initiates when you introduce the cards of agrobiodiversity. Ask the group to review the list you have made for the products/elements from the agrobiodiversity land use. You may add 5 more products to your list/cards.
4. Ask the group to rank the priority of the products from the existing list/cards. You must narrow-down the list/cards to a maximum of 12. The relative importance can be arranged vertically (i.e. if one is more important than others), and equal importance shown by horizontal alignment/arrangement.

[22] A comparison unit is an entity to which the products from a group livelihoods sources are compared. Therefore, the comparison unit/product should be well known, widely consumed and have a well-established market. As an example of comparison unit is a rough average of household consumption of staple food. In most of South-East Asia, a yearly average of rice conception for four to five people is a widely-known unit.

5. Introduce the Comparison Card (see preparation no. 2) and ask them to put the card relative to the existing 'importance structure' as elaborated in step 4.
6. Ask the group to distribute the counters in accordance with the values they perceived. A card with more counters should be put above the ones with the fewer counters. The group can modify the relative structure at any time (i.e. the structure is flexible).
7. Write down the numbers of counters that have been distributed by the group to the product cards.
8. Having re-collected the counters, stack the product cards under the agrobiodiversity land-use card.
9. Ask the group to compare the agrobiodiversity card with 5 other livelihood cards (chosen by the 'game master') and ask them again to prioritize and distribute the counters.
10. Write down the number of counters the group allocates.

III. Data management

At the end of the game, you should having the following information:

- The amount and unit price of the comparison unit
- Lists of counters distributed to products from agrobiodiversity land use
- List of counters distributed to livelihood cards.

In order to calculate the value of the comparison unit, you can multiply the amount and the price of the product. Dividing the value of the comparison unit by the number of counters assigned to it gives the value assigned to one counter.

For example, if the comparison unit is rice annual consumption of 500 kg, its cost is USD 1 kg^{-1}, and 10 counters are assigned to it; then the value of each counter = 500/10 = USD 50.

The products themselves can be grouped into wood/timber and non-timber products – essential indicators for sustainable resource management (wood/timber is considered unsustainable given the small area of forest available). Additionally, the perceived value of each product is obtained by summing up the number of counters (and multiplying by the value of each counter). Summing the most important products from agrobiodiversity land use indicates the livelihood importance of that land use.

As additional information, the relative importance of agrobiodiversity land use compared with other sources of livelihood can be derived by calculating the allocation of counters to each type of livelihood both on and off farm.

Annex 16. Fauna, flora and conclusions of Bungo District case

16A. List of animal species found in Bungo during the observational walks

Local name	Scientific name	Status in BirdLife (1992)	Status in IUCN Red List (Baillie et al. 2004, IUCN 1994)	Notes
Agile Gibbon (mammal)	*Hylobates agilis*		LR/nt ver 2.3 (1994)	2 gibbons in sub-cluster Laman Panjang; 2 gibbons in sub-cluster Lubuk Beringin
White-handed Gibbon (mammal)	*Hylobates lar*		LR/nt ver 2.3 (1994)	2 gibbons in sub-cluster Lubuk Beringin
Banded Leaf Monkey/Sumatran Surili (mammal)	*Presbytis melalophos*		LR/nt ver 2.3 (1994)	1 group (*ca.* 5 7 individuals) in sub-cluster Laman Panjang; 2 groups in sub-cluster Lubuk Beringin
Long-tailed or Crab-eating Macaque (mammal)	*Macaca fascicularis*		LR/nt ver 2.3 (1994)	3 groups (total *ca.*10 20 individuals) in sub-cluster Lubuk Beringin; 1 group in sub-cluster Laman Panjang
Black Giant Squirrel (mammal)	*Ratufa bicolor*		no category	1 squirrel in sub-cluster Lubuk Beringin
Common Tree Shrew (mammal)	*Tupaia glis*		no category	1 shrew in sub-cluster Lubuk Beringin
Lesser Malay Mouse Deer (mammal)	*Tragulus javanicus*		no category	Footprints found in sub-cluster Laman Panjang
Feral Pig (mammal)	*Sus scrofa*		no category	Footprints were found in all sub-clusters
Sun Bear (mammal)	*Helarctos malayanus*		DD (*Data Deficient*) ver 2.3 (1994)	Claw scar was found on tree bark in rubber agroforest near fallow area in sub-cluster Lubuk Beringin
Rhinoceros Hornbill (bird)	*Buceros rhinoceros*	not threatened	no category	2 birds in sub-cluster Lubuk Beringin
Slender-billed Crow (bird)	*Corvus enca*	not threatened	no category	Found in all sub-clusters
Blue-rumped Parrot (bird)	*Psittinus cyanurus*	not threatened	no category	2 birds in sub-cluster Laman Panjang
Black Drongo (bird)	*Dicrurus macrocercus*	not threatened	no category	2 birds in sub-cluster Laman Panjang
Greater Coucal (bird)	*Centropus sinensis*	not threatened	no category	2 birds in sub-cluster Lubuk Beringin

16B. List of important plant species for RUPES-Bungo

Local name	Scientific and Family names	IUCN Red List Status (Baillie et al. 2004)	Notes
Tebalun	*Parashorea lucida* (Dipterocarpaceae)	CR = Critically Endangered	Quite often found in RAF, especially those close to forests
Meranti kalip	*Shorea parvifolia* (Dipterocarpaceae)		Found in old RAF that has become a fallow (with very few rubber trees, *ca.* 50 100 trees ha [1])
Meranti bungo	*Shorea* sp. (Dipterocarpaceae)		Found in old RAF that has been abandoned and become a fallow (with very few rubber trees, *ca.* 50 100 trees ha [1])
Bunga bangkai (Titan Arum)	*Amorphophallus titanium* (Araceae)		Based on farmers information ; could not be found during observation period
Bedaro putih/pasak bumi	*Eurycoma longifolia* (Simourabaceae)		Very common in RAF, is a slow-growing plant and has medicinal function
Jelutung	*Dyera costulata* (Apocynaceae)		Many in sub-cluster Lubuk Beringin. This species is difficult to regenerate naturally. Nowadays, this species is already quite rare in rubber agroforest or even in the forest
Kulim	*Scorodocarpus borneensis* (Olacaceae)		Found in some rubber agroforests, like the one found in sub-cluster Laman Panjang. Farmers usually maintain this species in their gardens because it has very good timber quality (export quality), but this is a slow-growing tree and it has difficulty naturally regenerating (fruiting trees very rare)

16C. Overview of the conclusions and supporting evidence for the Bungo case

Primary criterion	*Bungo:* **Rubber agroforest (RAF)**	Evidence	Methods to provide the evidence
VALUE (to sellers and buyers) is clear	Sumatra is biodiversity hotspot; lowland forest not effectively protected; RAF is main remaining refugium	• Maps of existing conservation priorities • Studies of decline of forest cover & RAF dynamics	• Web search of documents • Existing studies of land-use change in the broader domain
	RAF is equivalent to natural secondary forest in tree richness	Vegetation structure, tree species richness at plot & landscape scale (Saida personal communication) Bird data of Thiollay (1993) Mammal (Mary, Hendra and Pandam in progress) Insects (Nur in progress) *First step:* vegetation structure *Second step:* tree (de Foresta) & fern (Beukema 2000) species + birds at plot level *Third step:* trees at landscape scale (Saida in progress) *Fourth step:* Mammals, insects, below-ground biological diversity (BGBD), mycorrhiza—test 'indicator' value of forest trees	• Comparing forest remnant, old RAF, intensified rubber and other agriculture systems: systematic observations of 'indicator' groups • Remote sensing, maps for sample-site selection • Interview farmers (1 month, less reliable taxonomically, indicates local knowledge and use values) + direct observation (>6 months, more reliable taxonomy) • Plot comparison: > 1 month • Landscape-scale studies: > 1 year
	RAF gives good income per day of work for the farmers	One tapping day (6-11 o'clock) will yield 5-15 kg of rubber, with a current price of Rp 4500 kg^{-1}, i.e. Rp 20 000-60 000 per day (still leaving time for other work in the afternoon); regional minimum wage (factory labour) is a little less than Rp 20 000 per day; rubber agroforest also contains fruits & other useful plants for home consumption	• Interview with farmers • Longer-term studies of yields & income; observations across price levels of rubber • Non-rubber products: interview, market-based study, participatory landscape walk • Ranking study—FAO standard method • Analysis of share-tapping rules for 'poverty' analysis
	RAF is good buffer-zone habitat & still forms stepping stones	Spatial analysis at district & provincial level: location of protected areas, RAF and current intensification No critical data yet on dispersal of threatened animals & plants ~ stepping stones	• Remote-sensing imagery interpreted • Analysis of dispersal mode of key species (e.g. among tree flora, primates, birds) • Analysis of home range of flagship mammal species • Local knowledge of seasonal patterns in animal distribution • Beyond RABA: studies of animal behaviour

THREATS linked to land-use activities are urgent	Conversion to monoculture seems to be more profitable, but leads to loss of agrobiodiversity	• Actual conversion takes place now that the forest frontier is closed, especially close to roads • In one tapping day, one person will tap about 300 trees; in old RAF there are 100–200 tappable trees per hectare, so a farmer needs 2–3 ha to have acces to enough trees; a plantation has 400 500 trees ha^{-1} and 1 ha is enough for 1 person-day. So, the yields per ha can be 3 times higher for plantation; net present value (expressed per ha, discounted future benefit flows and investment costs) is about twice as high for plantation • Farm-level income, at current prices, is about the same for oil palm and intensive rubber; labour efficiency is higher in oil palm (harvest only 1 day per 2 weeks on 2 ha), but dependent on transport (same day); investment costs for both are high, 4–5 years needed to pay back investment credits • There are already four oil palm factories in Bungo District; 5 years ago there were two; 10 years ago the first one was being built (the first one opened in 1996): each factory processes 90 tonnes per day; at 2 ha per 2 weeks, 2-3 tonnes bunch	• Analysis of land-use change • Economic analysis: policy analysis matrix (PAM) studies of input & output tables (RAF, intensive rubber and oil palm) • Various students of economic aspects (Rubber Agroforest System project); Olympe[23] calculations • Studies of actual latex production (CFC project) • Interviews with farmers on the oil palm rubber comparison • Monitoring development of oil palm factories in the district

[23]Olympe software enables the modelling of farming systems in order to characterize them, to identify typologies (and potentially recommendation domains) and enable prospective analysis according to price and yield evaluation. There is also a module for analysis at the level of farm groups (regional level). Positive or negative externalities can be integrated. The Olympe software was developed by INRA/ESR, IAMM and CIRAD.

OPPORT U NITIES exist to overcome the THREATS	Policy threat from existing government plans: transmigration, oil palm, mining, etc.	• In the Rantaupandan valley, transmigration projects have recently started; there are plans for further transmigration sites, including Lubuk Beringin; 50% from Java and 50% local selection by village heads (local parliament wants 70% local to 30% external; DKI Jakarta); 2 ha per household – planned for oil palm • Transmigration is supported by the village elite and Sub-district government, the rest of the local community is not in favour, but has little voice; the Sub-district government would be able to stop it under local autonomy; transmigration also absorbs overflow from previous transmigration sites • Most of the land used for transmigration comes from secondary forest, old RAF, resting lands; former land owners are allowed to join the programme • Some of the villages dont want to get involved with outsiders and are afraid to lose the indirect products and services of RAF • In one of the villages, there is experience that the original inhabitants ended up as labourers on other peoples land (Sungai Telang) • Coal mine story in Rantaupandan: initiated by District head (after *otonomi daerah* [local autonomy]), some farmers sold their land, disappointed with the price; conflicts over benefit share for local government; plans for another 2800 ha in Rantaupandan	• Participant observation of village politics and discussions • Focussed group discussions on perceptions

	People still like RAF for the local environmental services it provides (esp. water supply)	• In test villages, the people indicated that RAF is as good as forest in providing regular flow of clean water, and also provides all the local needs for fruits, firewood and traditional building material • Group discussions show mixed feelings and objections to transmigration plans	• Interview using the RABA protocol
Sufficient *TRUST* exists to negotiate deals	There are technical opportunities for increasing competitiveness of RAF relative to other options	• On-farm experiments of RAS & CFC project show that clones can be productive with much lower management intensity and that they can be introduced within a sisipan context (traditional gap or enrichment planting) of patch-level slash-and-mulch system	• 7 years data from on-farm experiments, demonstration plots, farmer-led trials • More rapid results might come from observing what farmers are currently trying with their own resources • Analysis of explanatory local ecological knowledge
	Low level of trust between local community and government plans and projects	• There have been many failures of investment plans to materialize – the local community blames this on the local government that does not play an effective broker role; local officials are seen to pursue private rather than public interests	• Participant observation of village politics and discussions • Focussed group discussions on perceptions
Overall RECOM-MEND-ATION to potential SELLERS and BUYERS	Local people are willing to negotiate with outsiders if the benefits are clear	• Oil palm investors have been able to make deals after being responsive to local concerns and by providing appropriate credit systems	• Participant observation of village politics and discussions • Focussed group discussions on perceptions
	Yes, there are good opportunities for biodiversity conservation in rubber agroforest (RAF) landscapes through rewards for targeted areas		

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