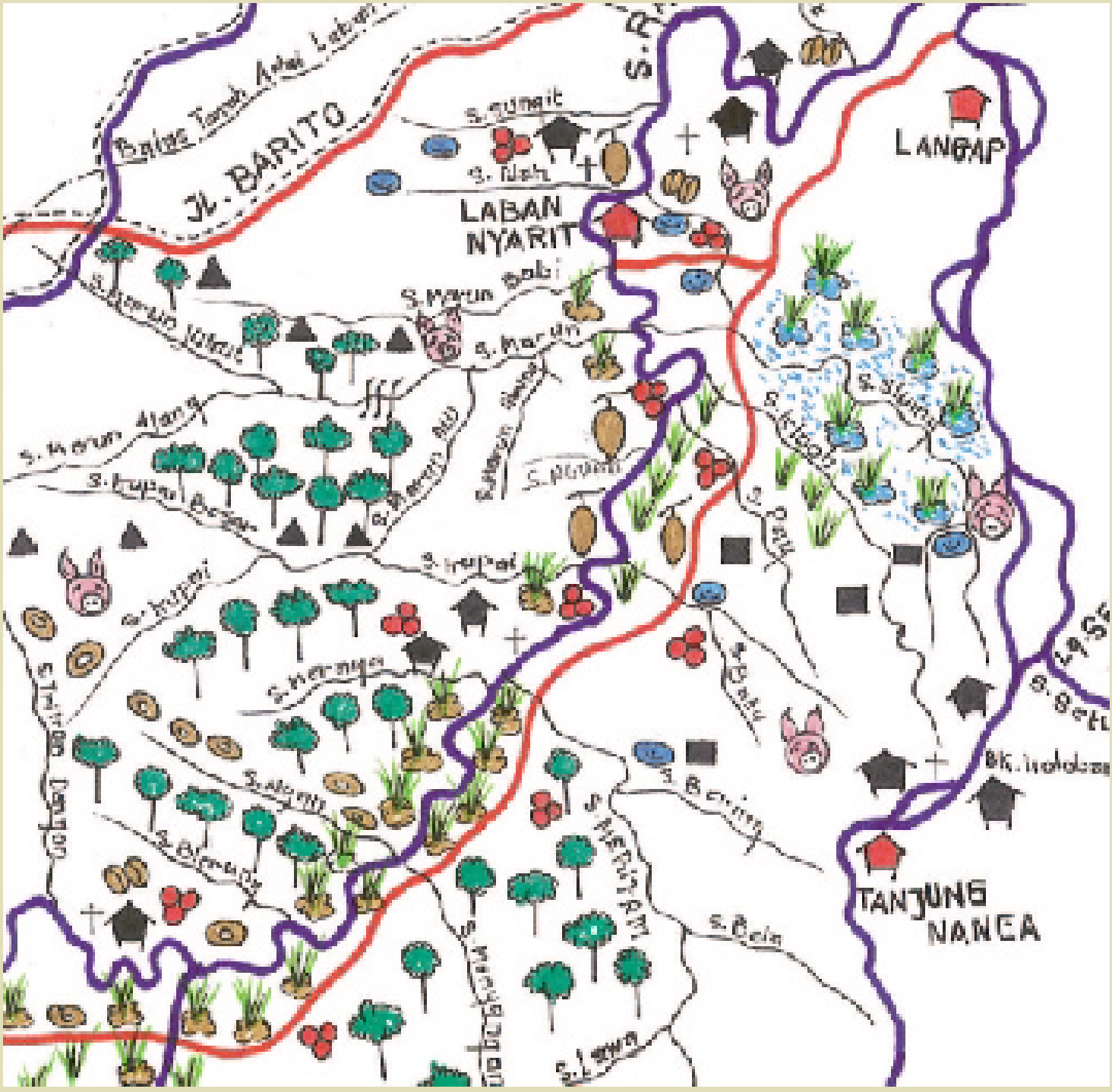
Exploring biological diversity, environment and local people's perspectives in forest landscapes

Methods for a multidisciplinary landscape assessment



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With help from the people of Paya Seturan, Long Lake, Rian, Langap, Laban Nyarit, Long Jalan, Lio Mutai and Gong Solok

The Center for International Forestry Research (CIFOR) was established in 1993 as part of the Consultative Group on International Agricultural Research (CGIAR) in response to global concerns about the social, environmental and economic consequences of forest loss and degradation. CIFOR research produces knowledge and methods needed to improve the well-being of forest-dependent people and to help tropical countries manage their forests wisely for sustained benefits. This research is done in more than two dozen countries, in partnership with numerous partners. Since it was founded, CIFOR has also played a central role in influencing global and national forestry policies.

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Some of the team with community members at the welcome gate to Laban Nyarit

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Abbreviations

ACM	Adaptive Co-Management
AHP	Analytical Hierarchy Process
BAF	Basal Area Factor
BIOMA	*Yayasan Biosfer Manusia* [Human Biosphere Foundation]
C	Carbon
CEC	Cation Exchange Capacity
CIFOR	Center for International Forestry Research
drh	Diameter at Reference Height
Ds	Data Sheet
Fe	Iron
FGD	Focus Group Discussion
FI	Furcation Index
FORDA	Forestry Research and Development Agency
FPP	Forest Product and People
GIS	Geographic Information System
H_2O	Water
Ht	Height (of tree)
ITTO	International Tropical Timber Organization
K	Potassium
KCl	Potassium Chloride
LIPI	*Lembaga Ilmu Pengetahuan Indonesia* [The Indonesian Institute of Sciences]
MLA	Multidisciplinary Landscape Assessment
P	Phosphorus
PDM	Pebble Distribution Method
PRA	Participatory Rural Appraisal
Qs	Questionnaire Sheet
Ref., Refno, -refno.	Reference numbers
RIL	Reduced-Impact Logging
S.D.	Standard deviation
Sample-nr	Sample number
SFM	Sustainable Forest Management
sp.	A species (name unknown)
spp.	Species (plural) in a given genus
TPTI	*Tebang Pilih dan Tanam Indonesia* [The Indonesian Selective Logging and Planting System]
UTM50	Universal Transverse Mercator (a geographical coordinate system), zone 50
WGS84	World Geodetic System (a fixed system of geographical reference), as defined in 1984

Preamble

What is this and who is it for?

This document is intended for those interested in gathering natural resource information that reflects the needs of local communities. We describe a multidisciplinary survey developed with indigenous communities in the forest-rich landscapes of the Malinau watershed in East Kalimantan (Indonesian Borneo). The final methods reflect a mixture of judgements, compromises and reactions to trials over many months. We have tried to make the text useful to readers from diverse backgrounds given the multidisciplinary nature of the procedures described. Our experiences show that what is obvious to one is novel to another.

This is not intended as a manual. We would rather it was viewed as a summary of lessons learned. Our reluctance to being overly prescriptive arises from both the ongoing nature of the work and the specific context in which our methods have been developed. Only some of the benefits and possible pitfalls of the methods described can be assessed now.

It is difficult to know what to call our methods. The title 'Exploring biological diversity, environment and local people's perspectives in forest landscapes' at least describes the aim of our approach and 'Methods for a multidisciplinary landscape assessment' describes the content. Some already refer to our approach as 'participatory biodiversity surveys', certainly shorter and clearer. However, whether the formal portion of our methods can be considered 'participatory'–is debatable. Certainly, 'biodiversity surveys' fails to describe the breadth of information gathered: this includes many aspects not traditionally considered 'biodiversity'. Readers may form their own opinions.

It is important at the start to distinguish two aspects of these methods: first, the questions we are addressing and second, the specific methods we have chosen to tackle them. The first can be promoted with little reservation. More caveats are required in presenting our methods. We have encouraged similar studies elsewhere to develop alternative approaches and we look forward to a wider suite of tried and tested methods in the future.

Douglas Sheil, 19 January 2002

In producing this revised version we have aimed to correct minor errors found in the first version. We have also clarified and improved the text in several sections. This provides the basis for translations in Spanish, French and Indonesian.

Douglas Sheil, 28 July 2003

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These activities were funded by the International Tropical Timber Organisation (ITTO) through the project PD 12/97 Rev. 1 (F): Forest, Science and Sustainability: The Bulungan Model Forest.

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We are very grateful to the villagers of Malinau, especially the Kepala Desa (village head), Kepala Adat (traditional leader) and the people of Paya Seturan, Long Lake, Rian, Langap, Laban Nyarit, Long Jalan, Lio Mutai and Gong Solok.

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We thank Gideon Suharyanto, Eko Prianto, Widya Prajanthi, Sally Wellesley and Paul Stapleton for layout, editing and cover design.

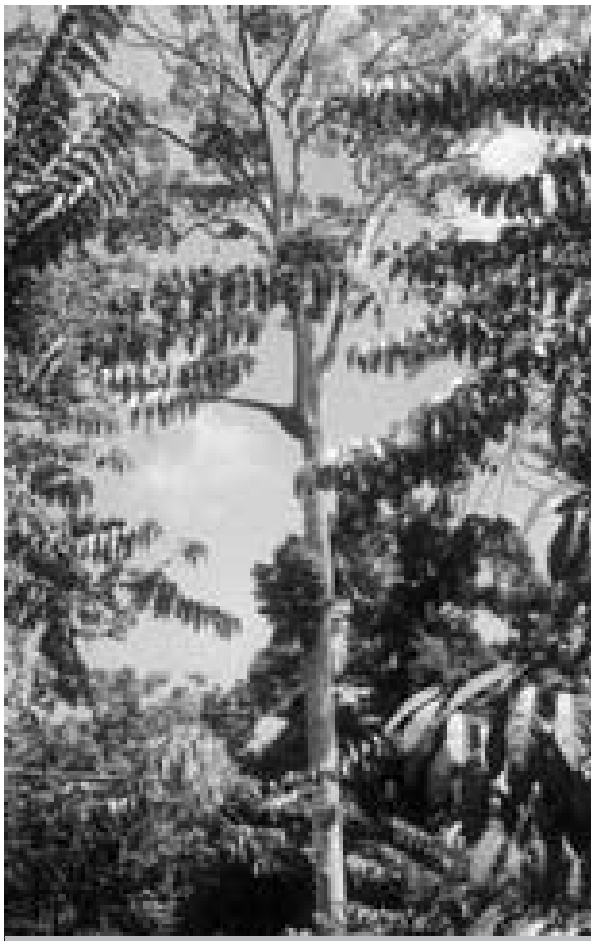
To demonstrate local customs our teacher wears a traditional headdress incorporating Argus pheasent feathers, he carries a rattan bag and prepares a poison dart for his blowpipe

1 Introduction

Much of the global concern about tropical rainforests derives from fears of major impending extinctions. Considerable efforts have been focused on identifying the most important sites for sensitive management. Biodiversity surveys have become a major preoccupation of conservation agencies and are increasingly included in impact assessments. However, the information generated usually has little impact as most decisions reflect other priorities. The notion that 'every species must be maintained at all costs' is not a view held by most relevant decision makers. Decisions can only balance 'biodiversity' goals with other demands if the values and preferences of stakeholders, especially local forest dependent communities, are addressed.

For many stakeholders, especially commercial enterprises such as timber concessionaires and mining companies, their motivations are relatively clear and easily communicated. But, for indigenous rural communities, their needs and perceptions remain veiled to most outsiders unless a specific effort is made to uncover them (Scott 1998).

Is there a solution? Ideally, detailed knowledge should be gained through intimate personal experience, but few decision makers are willing to live for long periods in the communities they will influence. What is needed is a practical method, or indeed a suite of methods, that can reduce the understanding gap, to provide a comprehensible summary of what actually matters locally: to determine what is important, to whom, how much and why, and a means to make these local preferences more relevant to the decision making process.



Koompassia *with bees nests.* Koompassia *trees are generally left standing when land is cleared for cultivation by local people*

As a means to address the multiple interests and values of landscape and natural resources, we developed a suite of survey methods to identify what is 'important' to some local communities in the district of Malinau in East Kalimantan, Indonesia. *This information provides an initial diagnostic baseline of information to develop deeper dialogue with these communities, to guide future research and make recommendations on options about land use and policy to decision makers.*

We did not want to examine biodiversity information in isolation, but within a broader framework where its relevance to real decisions is apparent. Hence, our methods also include factors such as agricultural options and the location of cultural sites. There are several reasons for suggesting that this information increases relevance. Firstly, decision makers normally take account of multiple factors before arriving at a conclusion (Saaty 1996), but have greater difficulty weighing information presented separately and without context, especially in regards to less tangible terms like 'biodiversity' (Kamppinen and Walls 1999). By integrating information, we can already imply tentative 'weightings' for each element of the information included. Secondly, while local communities may not claim an interest in the notion of 'biodiversity', their key interests may nonetheless provide relevant scope for exploration. For example, gravesites also provide value for local biota. By placing biodiversity data in this wider context we generate information of greater relevance to decision makers, while ensuring that we do not restrict its potential to reflect the priorities of local communities.

Some concepts

Given our multidisciplinary readership a brief discussion of certain concepts may be helpful. Additional detail is given in the context of specific methods.

Value and importance – A detailed definition of what *we* mean by 'value' could be counter-productive as our emphasis is on reflecting the views of the local communities. We have tried to emphasise 'importance' as what we are assessing rather than 'value', given that the latter term has numerous economic associations. In market economies, choices are made based on individual value judgements in respect to certain qualities of the good or service, its price and available budget. The basic concept of value in such a context is the 'willingness to pay' – generally expressed in monetary units. However, we take a different route in which importance can be determined and restricted by wider concerns such as social and moral factors. Recognising and not-excluding these factors is necessary if 'importance' is to reflect the views of local people. In some exercises, we assume that this importance can be effectively expressed not as a price but as a statement of relative preferences.

Landscape – This is a holistic and spatially explicit concept that is much more than the sum of its components: terrain, soil, land cover and use. It can be viewed as a cultural construction.

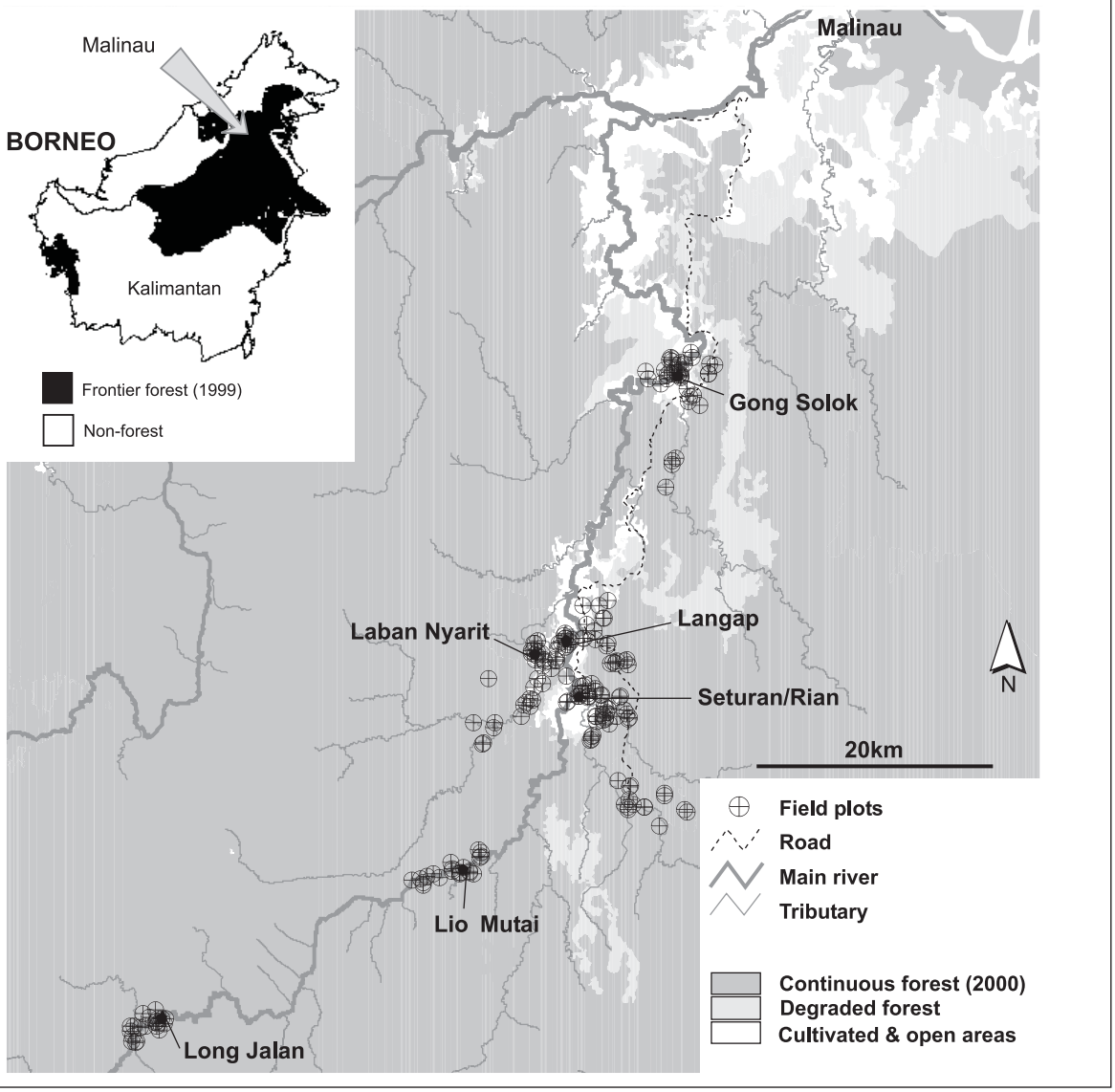
Biodiversity – By this we mean the flora and fauna of the region. We do not use any restrictive definition though our fieldwork focused on vegetation. Domesticated species were included but were not an emphasis.

Context

Location

When CIFOR was established in 1993, the Indonesian Government committed itself to providing a forest area where CIFOR could conduct long-term research. An area in East Kalimantan was finally selected (see Figure 1). The area is about 3 degrees north of the equator in a block 2º45' to 3º21' North and 115º48' to 116º34' East, adjacent to the Kayan-Mentarang National Park, and lies in the heart of the largest more or less continuous area of rainforests remaining in tropical Asia (more than 5 million ha encompassing parts of Central and East Kalimantan, Sarawak and Sabah). This agreement between the Indonesian Government and CIFOR represented a clear commitment to work together to develop and apply policy-relevant research.

Figure 1. Location of research area and sample sites. Inset derived from World Resources Institute "Frontier Forest initiative". Main Map based on manual interpretation of Landsat TM-image (May 2000)



People and the landscape

The indigenous population in the Malinau watershed consists of several Dayak groups, including the Merap, Punan, Kenyah, and several others. There is a small but influential immigrant presence. In certain villages, the number of outsiders is growing rapidly, due to the reliance of most concession activities on a non-local workforce.

Amongst the Dayak groups, traditional rights relate to land in two different ways involving either individual household holdings or community land. Government processes such as those that grant concessions have long ignored traditional land claims. This tension between state tenure and traditional systems is one of the greatest challenges, and one that is found in many regions of the world. The entire area is divided up by traditional claims. Nonetheless, previous governments have allocated most of the area to timber concessions with scant regard for these prior claims. Past government policies have favoured concessionary claims over traditional rights and most of the area is officially seen as production forest estate. Some of the steeper land is designated as *hutan lindung* or protection forest, though this designation is haphazard. Much of the more accessible area has been logged or will be in the near future, including many local forest areas.

Pak Aran Ngou and Imam discuss soil properties

Further conflict arises from policies that have resettled some communities from remoter areas in the same or neighbouring watersheds, into more accessible areas that traditionally belong to other communities. The government has made special efforts to settle the Punan and encourage their agricultural development (see Kaskija 1995; Puri 1998; Sellato 2001). Improving health care services and educational opportunities in Malinau and some of the larger neighbouring settlements has also attracted families from remoter sites. This gives rise to new local pressures and conflicts, and means that some communities claim traditional areas distant from their present location (see Heist, van and Wollenberg 2000).

Economic growth during the late 1970s exerted various influences on local communities. In the early 1990s, coal mining began to encroach into the area and has had a growing impact on the forest resources and immigration. The economic crisis in Indonesia (beginning in 1997) has driven further changes. The depreciation of the Indonesian currency and the increase in the export market value of palm oil and coal led to a rapid expansion of prospecting, often through poorly regulated private investors. The recent devolution of power from the central government to the district level is having major effects. Local authorities were able to allocate logging and land clearing permits. For instance permits for oil palm estates were given for areas that are still the subject of prior logging agreements. However, local people are also finding themselves increasingly empowered in the decisions that affect them, and there is an increasing willingness to bring conflicts or protests to local authorities. At the time of writing, the overall situation is one of confusion: regulations, roles and ultimate authority on land issues are in flux.

CIFOR's goals in Malinau

CIFOR is committed to undertaking long-term multidisciplinary research activities in the Malinau area with a broad range of local, national and international partners. The work reported here is a contribution to this larger effort and has, in turn, benefited from the coverage of other research

activities (especially CIFOR's ACM, FPP and SFM programs). These will not be detailed here (see http://www.cifor.cgiar.org; CIFOR 2002).

CIFOR emphasises research to enable more informed, productive, sustainable and equitable decisions about the management and use of forests (useful references include Campbell and Luckert 2002; Colfer and Byron 2001; Wollenberg and Ingles 1998). More specifically the aim of the CIFOR research program in Malinau is to contribute to achieving forest sustainability for a 'large forest landscape' in the humid tropics, where diverse, rapidly changing and often conflicting land use demands exist. Approaches to achieving 'sustainability' on a larger landscape level are needed. As a whole, CIFOR's initial efforts could be said to represent an 'exploratory' or 'developmental' phase, within a longer-term research strategy. The final objective is to achieve long-term forest management for multiple uses, integrating social, environmental, biodiversity and silvicultural objectives. The first phase of the project has consisted mainly of gathering baseline information on the bio-physical, social and economic situation of the area (Puri 1998; Fimbel and O'Brien 1999; Boedihartono 2000; Iskandar 2000; Rachmatika 2000; Rossenbaum *et al*. in prep). A major investment has been made in developing relations with the political, industrial and local communities with an interest in the area. The main support for these activities has been ITTO, which has funded the core of the research program.

Biodiversity research - the place of this study

The Malinau area of East Kalimantan is little known biologically. It was suspected that the rugged and forested landscape, adjacent to the Kayan Mentarang National Park, would contain a wealth of plant and animal species (see MacKinnon *et al*. 1996; Wulffraat and Samsu 2000). A major emphasis of our activities has been the documentation of this diversity in such a way that its relevance is explicit.

This broader program of 'biodiversity'-related research (under the supervision of the lead author) has been developed around three major components: 1) finding out what occurs where, 2) assessing to whom it matters and in what way, and 3) identifying what steps are needed to maintain this biota in the future. The first two are addressed in large part from the methods detailed in this account. The last component is even more exploratory and has been limited to a taxa by taxa review of current scientific knowledge. Together, these three strands of information *define priorities that reflect local considerations and can inform a wide range of processes, from the revision of 'good practice' in forest harvest management to local land use decisions and international forestry and conservation policy.*

In addition to the main study, there have been a small number of zoological evaluations. These included studies of fish, reptiles and amphibians – in all cases, local informants gave detailed information on the use and significance of the species encountered. These more restricted zoological studies will be reported elsewhere (e.g. Iskandar 2000; Rachmatika 2000; Lang and Hubble 2000; Sheil *et al*. 2002).

Impact opportunities

One critical aspect of the current study relates to impact: how can the information and insight be used, once obtained? Unlike some countries, Indonesia does not have a long history of community involvement in officially sanctioned forest management. During the Suharto era in Indonesia, concessions were granted with disregard for local peoples and their claims to land and natural resources, though concession holders were expected to 'gain permission' from affected villages and make contributions towards community development. Our work clearly implies that local communities have complex dependencies upon forest landscapes that *need to be respected and understood*. For Indonesia, this message requires a revolution that must impact all the institutions and processes related to forest management.

There are many potential opportunities for influence. CIFOR is in the fortunate situation of building a long-term research agenda in the region (see 'Context' above), and enjoys good relations with many local stakeholders (see CIFOR 1999, 2000). The local government offices are

increasingly turning to CIFOR for advice on forest related issues. At both regional and national levels, CIFOR is deeply engaged in contributing to policy reform. At the international level CIFOR is well placed to promote due attention to local requirements in forest use. However, we should not rush to conclusions: our methods are largely new, especially to our intended 'decision maker audience,' and credibility needs to be earned.

How these methods were developed

Our methods were developed and used during surveys in Malinau, East Kalimantan, between 1999 and 2000. They were developed during discussions, workshops, a series of pre-trials, a full-scale pilot study in two communities with subsequent revisions and finally, application in five additional communities. This has been an explicitly multidisciplinary and collaborative process, to define and collect the most useful or *decisive information* with special regard to environmental impacts and local people's perspectives.

While government policy makers are the most obvious ultimate targets for our results, we did not attempt to identify the information that they currently use, but rather sought to clarify the information that would most efficiently represent the environmental concerns of local communities. To consider these perspectives our method development was built around the proposition that the Malinau watershed is divided into various land uses and management regimes. We assumed that we needed to collect the information required to advise how such divisions should be made and how multiple interests might be accommodated. This approach was seen as valuable in highlighting genuinely important issues, and points of conflict. Given CIFOR's longer-term commitment to research in the area we felt our approach would benefit this larger effort in two specific ways: by allowing it to focus efforts on what we know matters and by clarifying methodological concerns whenever 'importance' remains elusive.

Some of these ideas may appear vague: what type of landscape changes, of diagnosis, of decisions, etc? This is in part a consequence of our striving to reduce assumptions. We did not start by claiming to know the best questions or the appropriate scale to assess; this is a departure from assessments where such clarity is usually a prerequisite. However, our exploratory evaluations can be viewed as the diagnosis that may allow these more refined approaches to be applied. An analogy could be made to a doctor and patient relationship: we do not expect a medical specialist to prescribe surgical procedures and medications without talking to the patient, evaluating symptoms and having an in-depth knowledge of possible treatments. Our research is intended to be iterative: the diagnosis provided by the first survey, as described in these methods, is only the first step.

It was the task of the pilot survey team to develop preliminary information gathering techniques. Various background documents were developed to ensure we all shared some idea of the overall objectives (e.g. Box 1). Brainstorming during the initial workshop produced a list of 'categories of information' that we supposed to be relevant for developing decisive information. We initially included all suggestions, without critical review, as the emphasis was on comprehensiveness. Hence, we accepted that the list contained disparate and

Box 1. Guiding propositions

Survey work is not intrinsically hypothesis-driven. However, for our initial workshop we felt that some general propositions would help guide the team and emphasise the broad basis of the survey.

Proposition 1: *Local knowledge provides valuable insights into ecological aspects of landscape, and increases survey efficiency and value.*

Proposition 2*: Local values are not independent of local ecology/vegetation, and provide guidance for managing landscapes.*

Proposition 3: *Landscape history is often well known and accessible through local informants. These histories provide insight into past landscape change and current vegetation patterns.*

Proposition 4: *Some cryptic and restricted habitats are critical for 1) various groups or segments of local society, and 2) restricted flora and fauna, and forest types.*

Proposition 5: *Forest types can be better explained by considering environment and history together than by either alone. In this way, we can better predict the distribution of forest types and understand which formations are likely to be rare, vulnerable, or require specific regulations to be maintained*.

Box 2. Initial categories of information

This list is developed from a draft 'brainstorming' of the types of information that team members felt might be relevant.

1. O Vegetation cover and habitats
2. O Soil characteristics
3. O Physical site characteristics
4. O Climate
5. O□ Abundance/distribution of forest products
6. O□ Abundance/distribution of animal and wildlife resources
7. O Abundance/distribution of endemic or threatened species
8. O History of natural events
9. OΔ Local environmental services
10. OΔ Global/wider services
11. O Ecological dependence
12. □ Abundance and distribution of wealth/ material culture and technology
13. □ Access and accessibility
14. □ Agricultural schedules and phenological cycles
15. □ Dependency on natural resources
16. □ Distribution of villages and cultivated/ managed lands
17. □ Diversity of cultigens
18. □ Economic geography—range of local extractive practices
19. □ Extraction industries
20. □ Local land/forest management practices
21. □ Potentials for ecotourism, rest stops, scenic vistas
22. □ Prices and incomes—off-farm labour and government subsidies
23. □ Tenure
24. □ Trade and commerce—markets/trade routes/stores
25. □Δ History of settlement and land use
26. □ Demography of villages
27. Δ Distribution of sacred sites and other cultural areas
28. Δ Local classification and assessment of landscape
29. Δ Local people's aspirations/desires with respect to natural resources and landscapes
30. Δ Perceptions of risk
31. Δ Political structure social cohesion and government influence.
32. Δ Traditional 'conservation sites'

Three classes: O = Biophysical, □ = Social/Economic, Δ = Cultural/Cognitive

overlapping concerns (see Box 2). This nonetheless illustrated a multidisciplinary perspective and illuminated the possible breadth of activities that might be relevant. Listed items were later prioritised by both significance and practicality, and refined in various ways. This reduced activities to a more manageable set of questions.

We then devised field methods that emphasised landscape-scale characterisation through high replication of small data-rich samples, and community-based assessments based both on these field locations and on a series of village-based exercises designed to assess local values of forest products and landscape units. These were evaluated and refined in an iterative way. Many changes were made over the course of the survey; for example, the initial household questionnaires took more than three times longer to complete than the final ones. For brevity we do not attempt to fully document how our methods evolved but focus on the final methods.

Participation

These methods were not designed to be a fully participatory approach to doing biodiversity studies. They are, rather, a first step in seeking a means of increasing the legibility of local priorities and concerns to outsiders (and possibly vice versa–see later). Here the immediate 'outsiders' are the researchers themselves, who defined the objectives and the methods. We did, however, depend on participation of community members as research assistants and field guides, and relied on their knowledge of the landscape to help us determine sample sites. The feedback we received was immensely important and had a strong influence on our final methods. Participation is relative; it can cover a range of local involvements in defining objectives, selecting methods, application, analyses and interpretation. We do not claim a 'participatory approach' in the way this term is often used, as this would have involved greater levels of local responsibility for the project, especially in defining the study objectives, but this was not an aim of our research. Our study is best seen as the first 'consultative' steps in an iterative process in which local views and priorities can guide the emphasis of later stages, and thus has relevance in developing 'participatory' approaches.

Our approach makes local preferences more legible and we use this to make a relatively broad but shallow assessment of local views. However, these methods can also serve to facilitate further

It is important that records are checked with community members, as with these plants in Gong Solok

discussions and clarifications, a dialogue on what actually matters and why. This dialogue would be an essential contribution to *any* form of collaboration that involved outsiders in trying to address local needs. It is also very clear from community feedback that they recognised the unexpected benefits of both explicitly addressing topics that they recognise as important but may otherwise not give adequate attention; also, in learning how to make their views apparent to others.

The methods

In the following account, we shall start with an overview of the survey and the practicalities involved. This is followed by a fuller account of the survey activities undertaken in the village, then of those undertaken in the field, and finally some notes on how the data are handled. Note that two specific methods are described in more technical detail than the rest: the scoring approach (pebble distribution method or PDM) and the variable area sample unit. This is because these methods are novel, requiring a presentation of the underlying theory. Though some other parts of this account have drawn comment for their 'basic' content, many will find it a useful guide to those with less experience, or at least serve to show some options.

Maps created with the community formed a shared geographical basis for planning field assesments

2 Operational overview

Team

For most purposes, the team was divided into two: the village team and the field team. The *village team* collected a wide range of information about the judgements, needs, culture, institutions and aspirations of the local communities, and examined their perceptions of and relationship with the local landscape. The *field team* collected biophysical and ethnographic data at specific geo-referenced sample points. The initial community introductions were undertaken jointly, and team members typically came together for meals in the morning and evening and reviewed their experiences and plans.

A standard team consisted of eight to twelve outsiders specialising in different parts of the study. This included one or two botanists; a field plot

The field team including local informants from Lio Mutai

coordinator, a soil scientist, two field (plant use) interviewers, two to four village-based interviewers/researchers, and one or two logistics coordinators who also helped with other tasks as the need arose. The field team also included local experts from each ethnic group: usually a man and woman plant expert, and a male soil expert, with usually, two additional local assistants. Due to various factors, the team was occasionally smaller, requiring team members to assume additional roles.

Villages and communities

We worked with two ethnic groups along the Malinau River (with a greater emphasis on the more distant 'forest-dependent end'). We chose not to work in communities where we felt there were already many researchers or where land use issues were already politically charged and high levels of conflict might colour local views and affect their interactions with naïve outsiders. We chose the Merap and Punan communities as representing two distinct and prominent cultures in the Malinau watershed. The Merap are a politically influential grouping in the local context with strong affinities to the more regionally powerful Kenyah. The Punan have been less politically visible. Both groups hunt, fish, cultivate home and swidden gardens, and use the forests for food, medicines and building and handicraft materials. The main difference between the two groups, at least until very recently, is that the Merap place an emphasis on rice farming, while the Punan have emphasised extractive forest-based activities.

Each community was studied for three to four weeks, though follow-up visits occurred beyond this period (see Table 1). One village, Paya Seturan, had Kenyah and Merap members, and another, Laban Nyarit, had Punan and Merap members. In general, efforts were made to keep these ethnic groups separate in the data recording though this was not always practical in general activities such as community meetings.

The time given to each community, like so many aspects of these methods, reflects a pragmatic appraisal of our initial experiences. We had originally proposed developing methods that could be applied rapidly to give valuable information in a two-week period. Through the field trials, we came to recognise the benefits of a longer-term presence in the community. Trust and a sense of community involvement take time to nurture, but 3–4 weeks seemed adequate for the initial surveys.

The communities we worked with are sometimes suspicious of outsiders, thus to build trust and avoid overtly strategic responses by informants we avoided highly politicised or cash-oriented emphases, even though such questions *are* potentially relevant and were heavily discussed in early stages of the project. For example, we did not ask questions such as 'What compensation/ exchange would you accept for the following sites and/or goods and services?'[1]

Field sample selection

We chose a number of sample sites from the landscape surrounding each community (Figure 1). These were selected to represent the range of variation in the local environment. While variation in forest was an emphasis, we also included a wide range of non-forest sites for comparison. Special locations and unusual sites were specifically sought out through local informants, as these are associated with restricted biota and special importance. Site selection was mainly guided by a map of principal resources and land use developed by the community

Table 1. Survey phases, locations and dates

Phase	Village	Ethnicity	Period and notes
1 (Pilot)	Paya Seturan Rian - Long Seturan	Merap & Kenyah Punan Rian	25 September to 23 November 1999 (with Punan Rian), with follow-up (revised methods) in December 2000.
2	Langap	Merap	23 April to 21 May 2000.
	Laban Nyarit	Punan & Merap	22 May to June 16 2000.
3	Long Jalan	Punan	23 July to 24 August 2000.
	Lio Mutai	Punan	25 August to 14 September 2000.
4	Gong Solok	Merap	7 November to 28 November 2000.

Plant specimens are preserved for examination and identification

with the aid of supplementary information such as satellite imagery.[2]

Two hundred research plots were established in the Malinau watershed in four separate data collection periods between November 1999 and November 2000. Each plot included a wide range of biophysical information and local knowledge. Around 40 trees over 10 cm diameter were generally recorded using an innovative variable area method, while other vegetation was assessed in a 5 x 40 m transect.

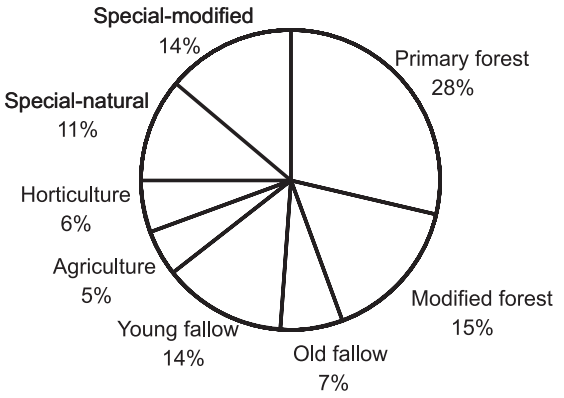
The 200 samples have also been classified into eight categories of land cover (see Figure 2). We coded samples into three classes of representation, 'typical', 'restricted', and 'special'. A sample was 'typical' if the site was an unexceptional example of a widespread kind of vegetation cover, 'restricted' if it represented a limited type of cover or had unusual features (a few hectares at most), and 'special' if the sample contained some very local feature or characteristics, e.g. a salt water seep or spring. The typical class included more than half of all samples (60%), with the latter two accounting for around 20% each. Local people have many specific terms for these landscape classes that can be operationally defined, though this may vary somewhat between communities. This more detailed local terminology and their meanings have been recorded for each site, along with details of site history, use and value. These local classes have also been assessed in a more summary way in the villages (see later).

The intention was to cover the range of variation in a reasonable geographical spread of points within logistical constraints—so, for example, we were rarely able to sample at large distances away from the villages. It should be noted that because we were trying to cover both typical and special sites, normal sampling criteria could not be applied. When a sample area was selected we would usually start by determining the direction of the transect and then take a random number of 1–5 steps either left or right to avoid small scale local biases. However, the topography was often extreme and local cliff exposures or open water could require the plot position to be adjusted. We justify this 'lack of objectivity' by the many site types we were able to assess in a limited time, and our ability to include special sites. This would not be possible with less flexible approaches.

Each site was assessed for various biophysical characters including a detailed investigation of soil, vegetation properties and identification of individual plant species. In each case, local informants provided detailed information on various aspects of each site, including soil and species composition, use history, and tenure.

The time taken to complete one plot varied according to travel time and plant richness. In agricultural sites with little vegetation the soil data took longer to collect (1½–2 hours) than the vegetation data. In the richest sites, the botanical and ethno-botanical data collection could take in excess of five hours on site. The longest travel time to reach a sample site was around two hours, allowing one plot a day, though for accessible sites we could sometimes manage two. In practice, the team managed roughly 30 plots per month.

Figure 2. Distribution of plots by eight summary site classes. The classes are used only for initial review. They do not limit further evaluation in any sense; they broadly reflect local terminology, though details sometimes vary between users.



Sample sites have been coded and sub coded as follows:

PF = Primary forest – Forest that has never been greatly modified. This includes all forest that has never been logged, cut, slashed or modified by fire, wind or flooding. If the primary forest is of 'special character' (on limestone, coal, shallow soil, swamp, at a salt spring or has sago) and is restricted in extent, it is labelled as 'Special-Natural' (see SN below).

MF = Modified forest – Forest modified by human (includes logging) or natural cause (wind blow, floods, landslide). If the forest has been logged, cut, slashed or modified by fire, wind or flooding, it is labelled 'Modified' and given one of the following subtypes: logging (lo), pole cutting (p), wind (w), drought (d), fire (fi), flood (fl), understorey slashing (u). See also SM.

OF = Old fallow – Previously cultivated area abandoned more than 10 years ago. Old fallow is generally dense woody regrowth.

YF = Young fallow – Previously cultivated area abandoned less than 10 years ago. A subcode indicates 'years since cultivation'.

A = Agriculture – Cultivated in the year of survey. Generally used for plots that were cultivated or tended at the time of sampling, with an additional subcode for the type of crop: rice (r), cassava (m), beans (k), sometimes an (s) for swampy location. Plots that were just burned (less than two months since) were avoided.

H = Horticulture – Perennial crops (often cash crops). If a garden or plantation is not at the same time an old village site, the label 'Horticulture' is given. The following subcodes are used in addition: fruit garden (f), cocoa (cc), coffee (c).

SN = Special-natural – Vegetation at a special site or with special character, usually very localised, and never modified by people. If primary forest is of 'special character' (e.g. on limestone, coal, rock, swamp, at salt spring or has sago) and is restricted in extent, it is labelled as 'Special - Natural' and will be given one of the following subtypes: swamp (s), salt spring (ss), coal (co), limestone (li), shallow soil (sh), sago (sa).

SM = Special-modified – Vegetation at a special site or with special character but modified in some way. As SN, but with modified character as defined above for 'Modified forest'. Also other sites of restricted and/or special character like old village sites or graveyards and bamboo stands. Use the following subtype codes: old village site (ov), graves (g), bamboo (b).

Special sites include graves. In this picture a jar containing human reimains is embedded in the upper portions of a fig tree near Gong Solok. There are many taboos associated with such locations.

3 Village-based activities

Initial community meetings

The first *community meeting* was used to introduce the survey, explain the research and the reasons for doing it. Our final procedures read as in Box 3.

In a second meeting, usually on the following night, all these points were recapped and further questions from the community were answered. Further emphasis was placed on identifying potential local experts, who were approached directly afterwards. The main exercise, however, was the mapping (see following section). In all these meetings, we provided tea and coffee, biscuits, betel nut, and cigarettes, in an attempt to maintain an informal atmosphere. We aimed to keep the activity within two hours though they generally started late and then overran.

Community members help to identify and name significant features to provide a base map for further annotation

Box 3. Introductory community meeting

1. Arrange a meeting in a community building.
2. Agree a time with the leader (usually after dinner).
3. Personally Invite all the leaders of the village and as many residents as possible.
4. Start by introducing all the team members.
5. Encourage the community to introduce themselves/their village. Get background information about the village: population and number of households, ethnicity, people's present activities, etc. Do they have time to participate in some way? If they do, when do they have time?
6. Introduce CIFOR's aim in the region.
7. Explain the background of this study, and the role of our organisation(s)—including what we can and cannot offer to the community. Avoid promises.
8. Explain survey objectives.
9. Describe the research activities and what they intend to achieve and provide. Explain how the community can participate, and how we would like them to help and advise us.
10. Explain key aspects of the research schedule and activities and listen carefully to identify any problems or conflicts with local activities. Make a first attempt to define an acceptable schedule for main activities.
11. Explain possible local involvement: research assistants, translators and interview assistants; boatmen, field-assistants; cooks or house-helpers, purchasing of local foods. Wages and responsibilities.
12. Through informal discussions, start to identify field experts and key informants.
13. Invite questions and attempt to provide clear and honest answers.
14. Check that the community members are happy with the proposed activities—seek to clarify if there are specific aspects that may be unacceptable. Be willing to accept restrictions.
15. Arrange a follow-up meeting with **full** community participation for mapping, etc.
16. Close meeting. Begin to schedule activities based on likely availability.

Community landscape mapping

Community mapping is a means for gathering information about natural resources, special sites and local perceptions within a shared geographical framework. In the second community meeting community members were divided into groups (according to age, ethnicity and gender) who, under the guidance of a facilitator, were encouraged to illustrate their natural resources on pre-drawn base maps. These base maps, as far as possible, showed major rivers, roads, village locations, and mountain ridges, though they were limited by the unavailability of general geographic information.

Box 4. Guidelines for preparing a base map

1. Collect and compile suitable information from all available maps of the area (major features, particularly rivers, roads, villages, logging camps and peaks).
2. With local informants and a basic map, begin to collect and check location names around the village, at forks of main tributaries, and at road intersections. If possible create a global positioning system (GPS) database of these points. Add these to the base map.
3. Prepare a simple map of the main rivers, tributaries, location of present villages and landmarks, with the local names as provided by informants.
4. Make sufficient copies for the community meeting on large paper (A1 or A0).

Some community members had little experience with maps, so careful explanations were needed. The mapping exercise usually started with the community members finding their orientation with respect to the map, naming, charting and identifying the direction of flow of numerous tributaries[3]. This often took a lot of time. The groups were asked to draw additional reference sites (such as old village locations and hill tops) and then to start locating positions associated with specific land cover types, resources, features, or activities, including special or unusual sites (see Table 2). A key of specific symbols and colourings was developed. We found that many elements of this key became standardised across the villages we worked in, as examples from previous work often served as templates in subsequent villages.

Community members continually revised these maps over the course of the following weeks. These further refinements required the combined efforts of both the field and village-based teams, as discussions or field observations during the day

Box 5. Mapping meeting instructions

1. Explain the process of mapping to the participants. It should take two sessions of 2–3 hours. Schedule your time.
2. Divide participants into groups. Make sure there is a facilitator/secretary for each group who is responsible for writing things down. Ensure each group includes someone who speaks the local language and Indonesian and is willing to help explain and answer questions as they arise. Arrange for other team members to circulate and help as needed.
3. Encourage participants to list and name:
   - Types of land use
   - Different types of land and landscape elements
   - Types of natural resources
   - Types of soil or drainage (e.g. swamp)
   - Special features, natural and anthropogenic – suggest limestone, forest area blown down by wind, waterfalls, graveyards[4].
4. Ask the group to start drawing the map: first, put in the locations villages, abandoned villages, graveyards, sacred sites, restricted access areas. Continue with the location/area of forest products, land types, and soil categories.
5. The village team then compiles all maps drawn during the community meeting into one or more 'master maps'. This map can be updated, corrected each day. The final map and the maps drawn during the community meetings are returned to the village before the team leaves for the next location.

often led to minor changes or additions. The resulting map served as a basis for discussions and selecting sites for samples. The maps were generally pinned up on a wall where they could be viewed by community and team members and updated as needed. Before leaving the village, copies of all maps were neatly redrawn and combined and clear copies were left with the village leaders (*Kepala Desa* and *Kepala Adat*).

Selecting local informants

Based on information gained during community meetings, community mapping and other informal discussions, prospective 'local experts' were identified. The criteria for selection included the following:

1. Community member from each relevant ethnic group.

Table 2. Example categories of land-units that might be mapped by community members

Indonesian	English gloss
Kampung	Village grounds
Bekas kampung	Abandoned village
Kebun pisang	Banana garden
Kebun singkong	Casava garden
Kebun buah	Fruit garden
Kebun kopi	Coffee garden
Kebun kakao	Cocoa garden
Ladang gunung	Swidden (rain-fed)
Ladang berawa	Swidden (swampy)
Belukar ladang baru 1 thn.	New swidden fallow
Belukar >2 kali pakai	Swidden fallow used more than twice
Belukar ladang 2–3 thn.	Swidden fallow (2–3 yrs old)
Belukar 3⁺–5 thn.	Swidden fallow (3⁺–5 yrs old)
Belukar 5⁺–10 thn.	Swidden fallow (5⁺–10 yrs old)
Belukar 10⁺–25 thn.	Swidden fallow (10⁺–25 yrs old)
Belukar >25 thn.	Swidden fallow (>25 yrs old)
Hutan belum ditebang/hutan rimba	Primary forest (never cut)
Hutan gunung	Mountain forest (moss)
Hutan rawa-rawa	Swamp forest
Hutan sekunder (alami)	Secondary forest (natural)
Kelompok rotan	Clump of rattan species
Kelompok palem sagu	Grove of sago palms
Sungai	River
Rawa	Swamp
Sumber air asin	Salt spring

2. 'General consensus' by the community on who 'knows most' about natural resources and village territory.
3. Gender; the field team attempted to use one male and one female informant for plants and site factors in each plot.
4. Availability and willingness to participate.
5. Fluency in both Indonesian and the local language was preferred though we also worked through local translators to allow access to some older, less confident informants (the younger field assistants were usually confident

Table 3. Forms used in community-based data collections

Form	Title	Method
***Qs1**	Village description/perspective of land use	Interview with village head only
Qs2	Cultural background of land use	Interview with traditional leader only
Qs3	Price of traded goods	In shop interview with 3–5 shopkeepers
Qs4	Household survey	All (or at least 30 households)
Qs5	Traditional knowledge on land use	Interview with 3–5 key informants
Qs6	Forest product collection and sale	Interview with 3–5 key informants
****Ds1**	Settlement history and land use	Interview with village head or traditional leader
Ds2	Disasters and important events	Interview with village head or traditional leader
Ds3	Land and forest types	Community meeting
Ds4	Forest products	Community meeting
Ds5	Demography	Household survey (Census) and documentation from village head
Ds6	***PDM Land and forest types	Focus group discussion. Respective groups for women/men, old/ young or ethnic group
Ds7	PDM Past – Present – Future	Focus group discussion. Respective groups for women/men, old/ young or ethnic group
Ds8	PDM Distance of land and forest types	Focus group discussion. Respective groups for women/men, old/ young or ethnic group
Ds9	PDM Sources of products	Focus group discussion. Respective groups for women/men, old/ young or ethnic group
Ds10	PDM Most important species per use category	Focus group discussion. Respective groups for women/men, old/ young or ethnic group

**Qs= Questionnaire sheet, **Ds= Data sheet, ***PDM= Pebble Distribution Method (See page 17)*

in Indonesian and could be called on to explain or clarify to either interviewer or informant).

Generally, experts were changed every few days to ensure we used a range of informants, and to identify those who were most knowledgeable and able. Older informants were sometimes unable to work in the more remote and demanding sites. Due to labour shortages we were unable to maintain any rigid program for rotating or changing informants. However, we could always alternate informants to some degree, ultimately spending most time with those who (we felt) knew most and maintained interest in the work. Using several informants also helped to ensure that employment benefits were shared and that informants could satisfy their other obligations. We lost some potential for consistency in plant identifications by using a variety of informants in the field. But on the other hand, this allowed a better representation of 'general local views' and we addressed consistency directly by establishing focal groups of community members to review field identifications from collected voucher specimens (see below).

Community-based data collections

Once the community meetings were completed, the teams set out to gather their respective data. The village team, along with several local assistants, was charged with collecting socio-economic and cultural cognitive categories of information (see Box 2). Their methods combined data at the village level, through community meetings, household surveys and interviews with key informants to identify the perceived values of local landscape units and their associated products. A scoring exercise, known as the Pebble Distribution Method (PDM), was used to quantify group assessments of the importance of forest products and landscape units. The schedule for implementation of these methods is outlined in Appendix I, while the forms used to guide interviews and record data are listed in Table 3 and included in Appendix IV (A–P). Since all the data collection involved some form of interview, we also developed guidelines for interviewing (see Box 6).

Box 6. Guidelines and suggestions for interviewing

1. You go to them.
2. Try and keep interviews private with as few people as possible; personal relationships and political power may influence responses.
3. Establish rapport, put informant at ease.
4. Relax, watch posture and body language.
5. Explain purpose.
6. Explain confidentiality rules.
7. Lay down ground rules–be clear that if they don't know an answer that's all right.
8. Keep it short, watch time and watch for fidgeting, changing the subject, lack of attention. Stop or call a break if necessary. Don't rush.
9. Be patient and easy-going, but serious.
10. Use simple language, prepare alternate ways of asking the same thing.
11. Never lead an informant by suggesting an answer or giving your own opinion: be patient and give respondent time to think.
12. Determine and respect local views, rules and rites.*
13. Use tact: leave sensitive issues to the end or a second interview.
14. Don't force informants to answer.
15. Allow informants to talk and even drift from the questions a little, but not for too long.
16. Have props, maps or pictures to help you explain an idea.
17. Activities, such as map-making, are good for maintaining interest.
18. Accept their hospitality and offer some compensation for missed work, but do not buy information.
19. Don't make promises.
20. Make sure you thank your informants. Leave open the possibility that you may need to return to check information.

** An example we found relevant was that men could not interview Merap women alone.*

Key informants

In every village or with every ethnic group consulted, three to five key informants were interviewed to elicit names of forest products and their uses, and knowledge of local land use categories. Information on local history, management institutions and practices, trade and religion was collected from local experts in each of these domains (see Appendix IV). This complemented the site-specific information gathered in the field samples. In some cases, the interviewees were invited to visit field sites or to join informants in the field where specific points were better clarified.

Census

A household census was carried out early on to confirm population statistics. Household members were also asked about their sources of income, perceptions of the local environment and their aspirations for their land. A minimum of 30 households were visited to collect basic demographic data (per village or per ethnic group if there were more than one). If the village was smaller than 30 households then all households were visited. Defining such numbers is in many ways an arbitrary but pragmatic requirement. Thirty was considered sufficient to summarise general responses and to uncover general patterns of variation within each community. In most communities, as they were small, our sample was 100%. Such numbers should be reviewed depending on needs and context.

Focal interviews

In the pilot study we attempted to document variation in the use and valuation of forest products and land unit categories at the household level, but this proved too time consuming for both informants and interviewers. There was also concern that relying on recall data was unreliable when it came to remembering all the forest products used in the recent past. Instead, in later phases four focus groups of old men, young men, old women and young women (for each ethnic group present) were formed to carry out the valuation exercises on the land cover/land use categories (see next section on 'Scoring exercises'). These teams were developed based on our invitation to individuals spread over the village as identified from the household survey. Data collected at the household level were reduced to demographics and a general series of questions including hopes and perceived problems.

Scoring exercises: the Pebble Distribution Methods (PDMs)

Introduction: concepts of 'importance'

One objective of our research was to develop practical methods to assess the importance of biodiversity to people who are partly dependent upon

Scoring excercise in Long Jalan

wild resources. A number of techniques were used in our studies, and in all these it was assumed that local people are the best judge of what is directly important to them. We thus assessed importance by eliciting information from the community and developed a system that implies a coherent relative assessment across a wide range of biota and types of values.

Emphasis was on gaining a local community view, thus we have generally avoided any explicit definition of 'value' or 'importance'. In some ways, this presents a paradox, as we needed to have clarity in our questions. So let us examine our approach to this. We start by assuming that *importance* is, in any form, a relative judgement: it is the property of the relationship between that being judged and whoever makes the judgement at some point in time, or within some hypothetical scenario. We further accept that such judgements are subjective—depending on personal experiences and knowledge—and may or may not bear any direct relation to tangible costs and benefits.

We assumed that *importance* is effectively expressed not as a list of prices and quantities, but rather as a more holistic rating of relative preferences. A full account of the reasons behind this decision will not be given here but three main aspects can be highlighted: 1) that this indication of 'preference' and 'importance' adequately captures local priorities, while 2) avoiding complex quantification, and 3) avoiding the obvious financial associations. As an example of our intended emphasis, local palm sago may be worth little to buy and sell, but is potentially vital as a famine food, and hence is important to the communities that rely on it. We do not need to measure sago palms or record actual use to learn this. To maintain this generality, when we were required to explain our aims we explicitly avoided words associated with prices (Indonesian [BI]: *harga, ongkos, uang, mahal, murah*), while emphasising concepts of 'general value' (BI: *nilai*), 'usefulness' (BI: *manfaat*) and 'importance' (BI: *penting, sangat penting*). Where possible we translated these concepts into local languages.

We explored a number of methods to assess people's judgement of the relative importance of various products and landscape units. Simple or ordinal ranking was felt inadequate to assess the relative magnitude of differences in importance among a set of items. We experimented with a well-known paired comparisons procedure (AHP, see Saaty 1996) but found it to be awkward to execute and difficult to explain in simple terms. Finally, we opted for a scoring exercise that we called the 'pebble distribution method' (PDM) (alternative names include 'weighted ranking' or 'PRA scoring' exercise) (Table 4). In each stage of the exercise, informants were asked to distribute 100 counters (buttons, seeds or pebbles) between labelled and illustrated cards in proportion to their 'importance'. Interviewers also ensured that the comparative nature of the exercise was understood by giving at least three examples at the start of each exercise.

Why do we seek numbers? We should be clear about the reasons for doing this and acknowledge the possible pitfalls. There were four reasons why we sought to elicit 'importance' using numerical

Table 4. Overview of scoring exercises

Data Sheet	PDM Scoring Exercise	Purpose
Ds6	Landscape units	Overview of which types of land are valued for what kind of use.
Ds7	Past – Present – Future	Overview of the relative importance of the forest for different types of uses and values in the present, 30 years ago, and 20 years in the future
Ds8	Distance of landscape units	An attempt to gauge how distance from the village (travel time 1 and 4 hours) influences the relative importance of different types of land.
Ds9	Sources of products	Overview of the overall importance placed on different sources of plants and animals used by the community: bought, farmed, wild from the forest and from other wild sources.
Ds10	Most important species	An identification and relative weighting of the most important plants and animal taxa per use category (up to 10 for each).

Each exercise is intended to provide a summary that can be understood by both the community members and the researchers. The results are ideally seen as a clarification of overall patterns of importance that can, and often should, be examined further.

methods. Firstly, as already noted, 'ranking' provides order of preference but not relative magnitude. Secondly, without relative magnitudes we cannot make robust comparisons between diverse items unless we explicitly ask for such a comparison. If the quantities elicited are robust enough to allow comparisons, such methods offer hope for dealing with the long lists of products and species that characterise the tropical biota used by communities. Thirdly, there is a credibility issue. Numbers simply look more convincing and provide more authority. If decision makers are asked to assess a cost benefit analysis where all the benefits are in monetary currency calculated to six digits and all the costs are given as lists of species that 'are said to be important' the argument is less likely to be given due merit. However, a table of the importance of these species with quantified statements about local needs emphasises that there are meaningful underlying data. Simply put, we suspect that many decision makers like numbers. The fourth reason is that, as researchers, we are interested to assess how far we can succeed in measuring importance, and how it behaves as a quantity, or series of quantities. Once we have collected these numerical data, various analytical methods can be used to gauge their properties (see for examples Colfer and Byron 2001).

We do not deny that there are pitfalls in the use of such numerical approaches (reviewed in Campbell and Luckert 2002, Nemarundwe and Richards 2002). Numbers can give an inappropriate air of certainty. Do the community members understand what we are trying to do, are results adequately consistent to be meaningful? The point here is that these numbers are not a final result, but can be revisited. Individual numbers do not have to be interpreted in precise detail for patterns to be highly expressive (e.g. see Table 5) – the pattern of blanks (0) and larger numbers are well defined and it seems undeniable that this pattern has meaning. These PDM exercises are particularly valuable in allowing the development of dialogue with the informants.

An example

As an illustration of a simple PDM scoring exercise, we shall consider data sheet number 6 (Appendix IV-f). The group of informants, here six women over 35, were asked to place 100 maize seeds amongst cards representing types of land according to the total importance of each land type. Each card had a drawing of a land type with its name in both Indonesian and the local language. One by one, the cards were introduced by the facilitator, and laid on the floor visible and accessible to all. The hundred seeds were piled in the middle. An explanation of the exercise was given and discussed as needed.

Before scoring started, the facilitator would give three demonstrations of how the seeds could be distributed and what that would imply. If 10 seeds were placed on the 'village' card and five on the 'forest' one it was explained that this would mean the village is twice as important as the forest; if three were placed on the 'river' card and one on the 'young fallow' card then the river is three times as important as the fallow; if the 'old fallow' gets five seeds and the 'forest' gets five then they are equally important. The titles of all the cards were then repeated (this should happen many times during the exercise if some respondents are illiterate as was often the case in our study).

The informant group was then invited to distribute the seeds onto the cards as a group. How they worked was largely up to them. Sometimes they took it in turns, each with a hand-full of seeds, in other cases one participant placed all the seeds but was guided by others. Sometimes they disagreed and discussions arose–the facilitator did not usually intervene in these discussions unless the title of a card or the meaning of the scoring needed restatement or clarification. The facilitator did intervene to elicit the responses of any withdrawn or quiet group members. The simplest way was for the facilitator to pass such members a handful of seeds for their distribution on the cards.

When the initial round of activity was finished, and all the seeds were allocated, the facilitator read the title on all the cards again allowing time to gauge the pile of seed on each and asked each team member in turn if it was alright–often this started a new round of minor changes. When agreement was reached, the scores were counted for each card and recorded. The total seed number counted must add to 100. The exercise continued for each type of use or value –so one round would look at 'importance for food', the next round at importance for 'medicinal products', etc, until all the classes had been scored. After the first two or three such exercises there was less need for detailed explanation on the scoring and the exercises became quicker. Nonetheless, each time an exercise started with a new team or on a new day, it was compulsory for the facilitator to repeat the overall explanation and demonstrate three example scorings.

An actual result is shown in Table 5. Note that the general scoring exercises for landscape-units are complemented by the field assessments. Note also that the results of any one exercise can be seen as a statement for further discussions.

The PDM exercises provide a clear and simple overview of relative importance. **We recommend a few brief lines describing the justification for each individual scoring outcome should be recorded as part of the process** (depending on the exercise, key questions may relate to what, why, how, to who). There is no data-sheet for this. In some cases more detailed notes may be needed to clarify cultural aspects or explain apparent contradictions or arguments within the group.

Hierarchical weighting for assessing the most important species

One aim of our work was to identify the most important biological resources from a local perspective. We also wanted to have some idea of the types of uses and values involved. We anticipated that more than a thousand species would have some

Table 5. Example PDM (Data sheet 6 – first part) of importance of different landscape units as assessed by older women in Long Jalan. Note all rows should add up to 100, as checked in the final column.

	Village	Old village	Garden	River/lake	Swamp	Cultivation	Young fallow	Old fallow	Forest	*Sum*
All (Overall importance)	20	7	13	5	10	9	9	5	22	*100*
Food	9	7	10	9	7	9	9	9	31	*100*
Medicines	46								54	*100*
Light construction								45	55	*100*
Heavy construction									100	*100*
Boat									100	*100*
Tools	17							20	63	*100*
Firewood				31		28		20	21	*100*
Basketry/cordage							39		61	*100*
Ornamentation/ritual				46					54	*100*
Marketable items	18		19	11		20			32	*100*
Hunting function	40								60	*100*
Hunting place				39					61	*100*
Recreation	37			29		34				*100*
Future	22		8	12	9	9		11	29	*100*

Scoring excercise in Long Jalan

use or value. The challenge then was to come up with a process that allowed us to deal with this diversity of species and still recognise the most important taxa, both overall and in terms of specific types of use. We dealt with this using a more sophisticated approach than in the previous exercises.

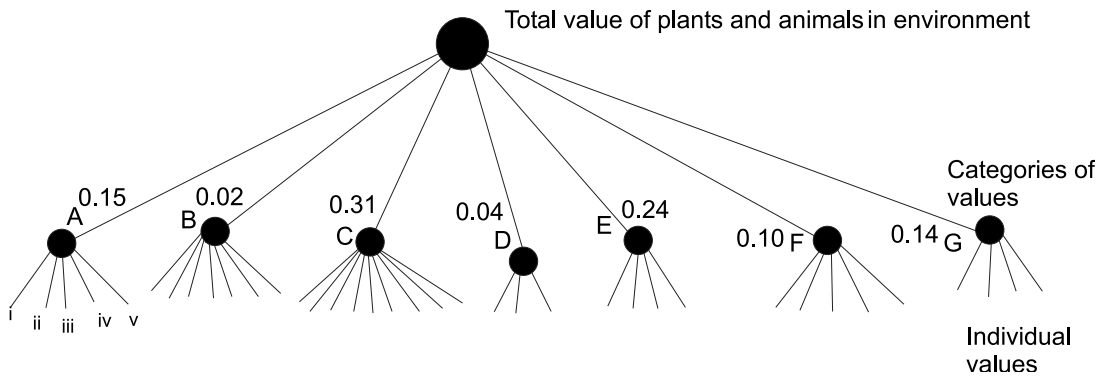
Our procedure is based on eliciting local information about important species through a hierarchical weighting procedure. If it works, the method offers an efficient means for assessing the relative significance of 'biodiversity' at species level for local users. In this section, we outline the basis and principal assumptions behind this approach. As the procedures are based on a series of mathematical principles we will attempt to set this out formally. However, it is not necessary to understand the mathematics to appreciate the rationale. This method assumes that scores of 'importance' are additive and can be subdivided, through a hierarchy of increasing resolution, ultimately including the importance of types of use of specific plants and animals. These assumptions are formalised within the context of decision-making and priority theory (Saaty 1996). This hierarchical approach allows us to evaluate the relative importance of a diverse system such as the group of locally valued forest species, and allows examination in both a holistic and a reductionist manner, depending on the level we look at. Figure 3 shows a two level hierarchy as an example. Such a hierarchy has three useful analytical properties:

1. the sum of all parts at any given level in the hierarchy add up to one, and
2. the value of each category is the sum of all members of the category at the level immediately below it.
3. the value of any lower level 'entity' can be calculated as a proportion of the whole by simply multiplying together the fractions that lead towards it at each branching point.

For example, in Figure 3, the values ascribed to categories A to G add up to one. Similarly, the value of the five elements i to v of A add up to 0.15. If the score of i is 0.25 then the overall score of i is 0.0375 (0.25 x 0.15).

We developed such a system to ascribe values to taxa that forest users regard as important. Our first

Figure 3. General hierarchical principle used in analysing importance of species



division is into the 14 classes of use described in Table 6 (equivalent to A, B, C in the figure). The second (when applicable) is a simple division between plants and animals (Figure 4). It should be stressed that these steps are arbitrary, chosen for convenience and ease of communication. Other divisions and levels could be used to allow more species to be assessed. For example, plant food items could be divided into fruit, leaves, roots, and others, or as types of foods.

We assume preferences are most readily expressed when like is compared with like. In some cases the valued entities are classes themselves as more than one species is involved (e.g. the fruit *durian*). We have accepted this as the taxa correspond to the form in which the respondents themselves chose to list them. The only absolute properties required for the value classes are that they are 1) comprehensive (the combined classes are inclusive of everything that needs to be assessed), 2) they are exclusive of each other (the same values are not counted more than once), and 3) they are simple and clear enough to be explained to and understood by the respondents within an acceptable time. Ideally, these classes conform to the use categories as people understand them but this requires some compromises to keep the list short enough to be manageable. Letting the community make the classifications would be better, but would involve considerable comparative research and reconciliation of inter-informant, inter-cultural, and inter-community variation, thereby complicating comparisons between communities. For our purposes, we compromised by imposing a system developed from a fixed series of classes based on our previous work with the people in the area (Puri 1997, 1998, 2001) and refined in our pilot studies. Despite some misgivings, we felt that the pros of

Table 6. Use and value categories

No.	Category	Our explanation (based on pilot study)
1	Food	Primary and secondary foods; famine foods
2	Medicine	Medicinal and health-related
3	Light construction	Poles and cut timber for huts, forest camp structures, fences
4	Heavy construction	Poles and cut timber for houses
5	Boat construction	Timber for boats (not including oars or punting poles)
6	Tools	Plant parts used for tools in agriculture, hunting, boating; includes blowpipes, spears, oars, punting poles, rice pounders, tool handles
7	Firewood	Used for fire
8	Basketry/cordage	Cord made from vines, rattan canes and bark for weaving or tying
9	Ornamentation/ritual	Plant parts used in ceremony, dress, jewellery
10	Marketable items	Plant parts and processed products that are sold for cash
11	Hunting function	Poisons, bait, gums used to catch animal prey
12	Hunting place	Indirect use of plant as hunting location, usually when fruiting
13	Recreation, toys, fun	Area or forest products used for entertainment needs
14	The future	General (not explained in detail)
+++	*Other*	*Ask what we have missed* (aspects that do not fit in 1 to 14)

having a fixed system outweighed the cons. Again, having a list of products in advance helps this, and so does allowing the respondent(s) to include and exclude species as they feel is required.

Some care is needed to ensure that classes do not overly restrict thinking, and reminders may be needed during the exercise to ensure that classes maintain the intended breadth, for example suggesting that honey is an animal product.

Some uses are harder to class (e.g. medicine for dogs, drinking water in lianas, food wrappings, chews for energy, items that are smoked), though they are generally the less important types of use. Performing the exercises with a group reduces differences amongst respondents, so the item can be argued over as required. In fact, this rarely happens. The greater risk is that some item may be totally omitted. If something is consistently forgotten it may be assumed that it is not important, but there is a risk that items may be consistently omitted not because they have been forgotten but due to the nature of the questions. In this regard the field activities, in which the respondents identify species, the type of use, and the class it should belong to, augment the village exercises.

Analytical logic and application

At the lowest level, the importance of a *type of use* (***j***) of a *species* (***i***) will be represented as an individual value G_{ij} (these being at the level of the i, ii, iii, etc. in the figure)[5]. A useful species may have one or several uses with its own G_{ij} within one or several classes, e.g. one plant may provide two different medicinal preparations from the roots and leaves, and also be good for fish poison from the bark and for firewood from the stem—this being four G_{ij}, two of which belong in the same medicine class.

The importance of a species (Local User's Value Index: 'LUVI') is the sum of all a species' G_{ij} values, i.e.

$$\text{LUVI} = \Sigma_{i=\text{species, for all } j,} G_{ij} \qquad \text{(Equation 1)}$$

The direct approach is that each G_{ij} can be weighed directly within a grouped comparison by PDM. In this system a comparison is made within each class to weigh each $G_{ij,}$ as a series of exercises, then the classes themselves are compared in one exercise. This order (lower before higher members in the hierarchy) ensures the respondents have reflected upon what each class actually contains. Also, it is important that species are ranked according to the class of value (not their total value), when they have more than one use. This process allows direct estimation of the sum of all G_{ij} of individual species within a given class j (call this G_{iJ}) as

$$G_{iJ} = \sum_{category=J} G_{ij} = RW_J \text{ x } RW_{ij} \quad \text{(Equation 2)}$$

RW_J is the weight given to the broad class of use to which the specific use j belongs. RW_{ij} is the relative weight within the category ***J*** for the uses of species ***i*** that qualify as members of ***J***. This direct weighting approach can be used for the most important species in each of the value categories. We determined that the lists must contain no more than ten items (the PDM will not work well if there are too many items or the differences between them are too great—i.e. greater than a factor of ten [zero scores not included]). As the lists are not usually comprehensive, a residual value term is needed (call this S_J—also used below[6], see equation 5) in the weighting exercise for *all* the species not listed for evaluation but belonging to the class. This residual value is needed for maintaining a scale between entities on different branches of the hierarchy, and is required as a general weight for all species-uses omitted in direct assessment (see below). For these individually less important species, high relative precision is of less significance, as the error will be small in absolute terms. However, we are interested in these other species as they could constitute an important total—this being *directly* assessed by inspection of the S_J term.[7]

N.B. In setting the context of the exercise there is an additional PDM (Ds 9) which asks community members to assess the importance of wild plants and animals from the forest, along with wild products from elsewhere, self-cultivated, and bought products. The assessment of these eight classes provides a context for scaling the overall product hierarchy.

While the simpler PDM exercises remain transparent to all participants, these more complex hierarchical methods are not so easily explained to them. However, we did believe that each *step* in

Table 7. Example results from a PDM exercise scoring medicinal species, by older men in Gong Solok (a Merap community)

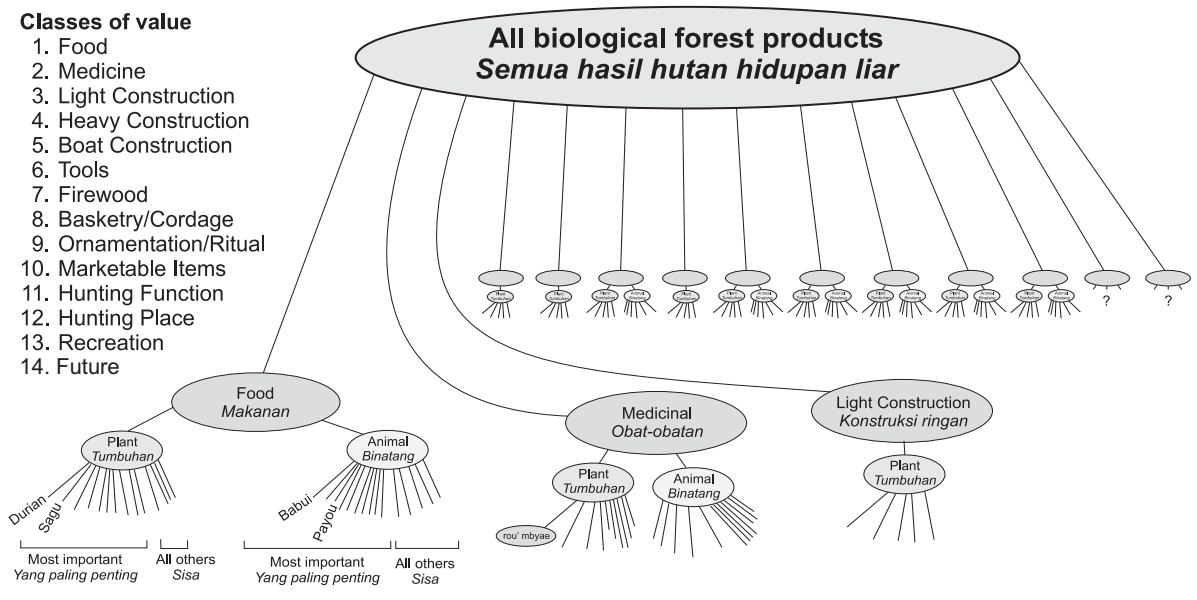
Plants		**75**	
Provisional ID	**Local name**	**PDM**	**LUVIx100**
Dissochaeta gracilis	**Rou' Mbyae**	12	0.350
Argostemma sp*(?)*	Rou' Helalai	12	0.350
Zingiber purpuracea	Rou' Ya' tengan	12	0.350
Aristolochia sp2	Kah Kedayan	11	0.321
Zingiber officinalis	Rou' Ya' Mla	10	0.292
Tinospora crispa	Kah Paay	9	0.263
Ziziphus angustifolius	Kayau Tanpaehelaue	9	0.263
Stephania hernandifolia	Rou' Klingiu	9	0.263
Schefflera singalangensis	Kah Kuceih	9	0.263
Kleinhovia hospita	Kayau Kenga	7	0.204
	Total	*100*	*2.917*
	Remainder	100	2.917

the process was relatively well understood in itself. Informants themselves do not take part in the calculation. They only provide the species lists and weightings within the context of each exercise. In a final summary a species can rank highly either because it is important for one use, or because it is relatively useful in several classes. This is not the case for most other such procedures; also the weightings derive from direct assessment by the community, not by arbitrary allocations by the researchers (such as in Turner 1988). We recommend that the final relative scores be evaluated with the community.

Example calculation

To illustrate the calculation we consider one species from one group of respondents in one exercise. We will consider the medicinal importance of a species which the informants (older men in Gong Solok, a Merap village) called **rou' mbyae** (with a likely herbarium match to *Dissochaeta gracilis,* Melastomataceae) (Table 7). First, starting at the top of the hierarchy (see Figure 4), and moving from the general to the specific, the class 'medicinal products' was given a score of 7 out of 100, but as

Figure 4. Schematic view of the PDM approach applied down to species-use level



Any specific figures arising should be treated with some caution, but with replication our hierarchical weighting approach provides a practical and logical quantification process with which to identify the species that local people feel to be most important.

10 counters were also given to two classes where no specific products were identified by the informants ('future' and 'recreation') we re-allocate the remaining scores (an admittedly arbitrary solution) giving a weight to the class of $7/(100\text{-}10_{\text{re-allocated}})$ or 7/90. The next division is between plants and animals which were given 75 and 25 counters respectively as a division of the total class 'medicinal products' (weight for plants thus 75/100). The final division scores the top ten most important plant species, and **rou' mbyae** received 12 seeds out of the 100 counters placed. The informants indicated that another hundred counters worth of medicinal plant importance was not included amongst the ten species they had listed and scored, hence the proportion of the value of **rou' mbyae** is $12/(100_{\text{included}}+100_{\text{extra}})$ or 0.06 of the value of the medicinal value attributed to all plants.

Our example LUVI measure (one $\boldsymbol{G_{i,J}}$) is simply the product of all these weights, i.e. 7/90 x 75/100 x 12/200 = 0.0035, or as a percentage (x 100) 0.35%. So this estimate implies that this single species' medicinal use has a third of one percent of all the relative importance of products recognised by older men for all uses and value. (For comparison, in this same village the LUVI of **rou' mbyae** based on responses from young men was 0.286%, young women 0.156% and from older women 0.655%.)[8]

Other species

The following is to be considered a footnote to the above method. It is not essential for the use of the PDM approach for assessing the most important species. It is only one way in which the other species could be considered.

There are too many valued species to rank them all in relation to each other for all types of use; imagine trying to sort piles of several thousand cards with plant or animal names on them! One suggested approach when direct comparison is not practical is a cruder assessment of each species, such that $\boldsymbol{G_{ij}}$ will be derived as

$$\boldsymbol{G_{ij}} \approx \boldsymbol{E_{ij}} \text{ x } \boldsymbol{P_{ij}} \text{ x } \boldsymbol{C_J} \qquad \text{(Equation 3)}$$

where $\boldsymbol{E_{ij}}$ is the exclusivity of this species, *i*, for this specific use *j*. $\boldsymbol{P_{ij}}$ is a parameter to denote preference; it must score higher if this species is the preferred source of this use. $\boldsymbol{C_J}$ will be defined later. The combination $\boldsymbol{E_{ij}}$ x $\boldsymbol{P_{ij}}$ has three possible outcomes: a) no alternatives, b) preferred but has alternatives, and c) not preferred. A species that is the unique source of this specific use ranks higher than one in which the species can be replaced by alternatives. Though arbitrary, weighting such alternatives with fixed scores has been a standard approach in some similar studies (Turner 1988; Halmo *et al.* 1993; Stoffle *et al.* 1990, 1999). We suggest recognising that the actual weights are arbitrary but have ranking (in ranking of importance, we assume the generality of the three outcomes a>b>c). If more careful scoring is required it will be necessary to use $\boldsymbol{C_J}$ to allow comparisons across classes. $\boldsymbol{C_J}$ is the correction weighting for the use class $\boldsymbol{J}$, to which j belongs, and is calculated with respect to the full data set of species with values within this class. The actual form that can be used is:

$$\boldsymbol{C_J} = \boldsymbol{RW_J} / (\textstyle\sum_{ij \subset J} \boldsymbol{E_{ij}} \text{ x } \boldsymbol{P_{ij}}) \qquad \text{(Equation 4)}$$

where $(\sum_{ij \subset J} \boldsymbol{E_{ij}} \text{ x } \boldsymbol{P_{ij}})$ is the sum of all the values of all the species (all *i* and *j*) which have values *j* and which are members of the $\boldsymbol{J}$ use class. Note that as the weights for $\boldsymbol{E_{ij}}$ and $\boldsymbol{P_{ij}}$ are not measured, this is only an index. This system could be improved by some form of calibration, e.g. taking a sub-sample of the lesser species and making a direct weighting with which to derive mean weights according to the preference/exclusivity classes.

As some species have already been assessed directly, the residual value noted above must be used instead of the whole category summation value, i.e.

$$\boldsymbol{C_J} = \boldsymbol{RW_J} \text{ x } \left[\boldsymbol{S_J} / (\textstyle\sum_{ij \subset J} \boldsymbol{E_{ij}} \text{ x } \boldsymbol{P_{ij}})\right] \qquad \text{(Equation 5)}$$

where this denominator term includes *only* the species being assessed with the index.

Rugged terrain affects accessibility throughout the region. Visiting remoter villages involves days of difficult river travel

4 Field-based activities

Site, vegetation and trees

Once the general sampling area was agreed on, the initial stage in establishing the sample plot was to mark out a 40 m long line marked with a strong tape measure. This transect was laid out at 45º to the prevailing slope, unless the ground was very steep, in which case more moderate angles were used. Markers along the tape indicated every 4 m and every 10 m. Only if the slope along the transect line was more than 30º did these distances need to be corrected for slope (a slope correction table is given in Appendix V).

In general, the plot and markers were established and the site sheet filled in while the informants were also being interviewed about the site. Then the herbs would be recorded, followed by the dominant seedlings and saplings and finally the trees. The interview team and their informants followed the botanists and cross-referenced data with them. When sufficient people were available it proved useful to measure the trees in advance, but each stem then required a marked number so the botanist and informants could follow up with adequate reference. The soil scientist assessed and collected soil at the same locations during the same period.

Three separate datasheets were used to record plant information. One recorded a site description, another recorded smaller plants and a third recorded trees. Before leaving the field the datasheets were carefully checked for omissions or errors, first by the recorder and then by another team member.

Equipment included a compass, a clinometer, an altimeter, and a GPS (ideally with an external antenna, and set to an agreed datum and output, in our case WGS84 and UTM50 respectively). Plant collection materials included secateurs, pruning poles, catapults (to collect leaf samples), tree-climbing gear, plastic bags, watch tags (card tags on thread), and tape, spirit, and newspapers. Initially we planned to take photo images of every site (to serve as a basis for post-visit interviews and as a memory aid) but we found this impractical and it was not maintained. We carried maps when needed.

Site description

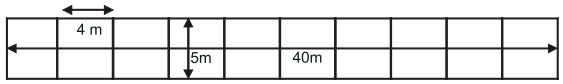
The site description included notes regarding the physical terrain of the site, how it was reached, the direct surroundings of the site, artificial artefacts, the structure of the vegetation as well as administrative notes (sample number, date, team, GPS coordinates). A sample data sheet with detailed explanations is given as Appendix VI.[9]

Non-tree transect

The 40-m transect was subdivided into ten consecutive 5-m-wide subunits (see Figure 5), where the presence of all herbs, climbers with any part over 1.5 m long, and other smaller plants was recorded. The ten transect subunits were searched in sequence, each being complete when no additional species were found. The 2.5 m to either

side of the centre-line was marked with accurately cut sticks that were laid or held horizontally and were shifted along as the team moved forward. The sticks were used to check where a borderline plant originated, as only those originating inside a subunit were recorded. A data sheet with detailed explanations is given in Appendix VII.

Figure 5. The 5 m x 40 m transect



Trees

We used a new and versatile sample unit suitable for rapid assessments of tropical forest in heterogeneous areas. The method generally collects information on about 40 trees with a diameter ≥10 cm drh (diameter at reference height, that is at 1.3 m, or above any buttress or deformation).

A data sheet with detailed explanations is given in Appendix VIII.

The method used multiple applications of variable area subunits, in which the area was defined by simple and objective rules. Compared with any fixed-area approach, the sample unit was quick and easy to apply even in difficult terrain, and the amount of information collected varied little with stem-densities. Unlike most variable-area methods, difficult judgements were rare. Further, it could not be extended to arbitrary size, but remained compact, allowing data to be linked to local site variables. We believe this approach can be beneficially applied elsewhere, even in patchy environments.

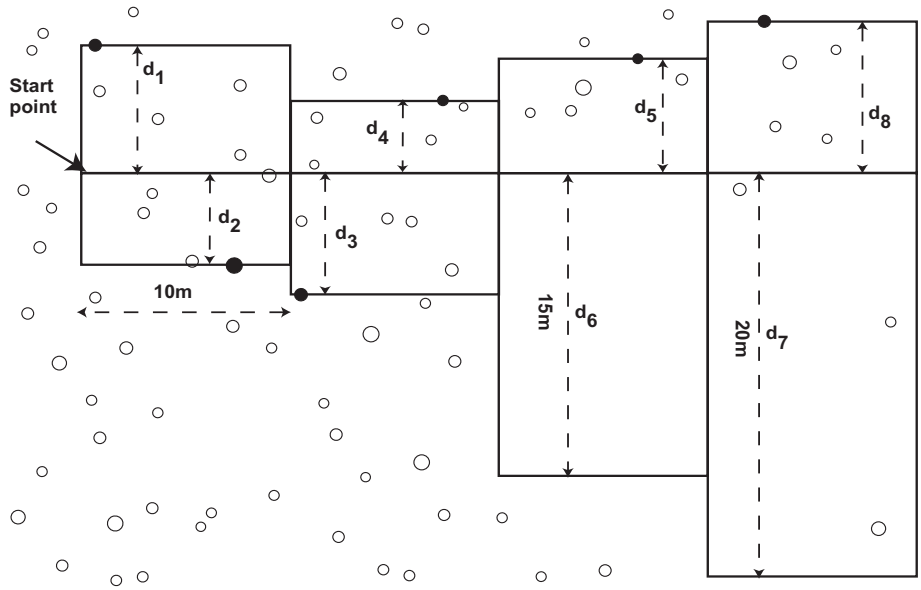
A series of short variable transect 'cells' were directed perpendicularly sideways from a central baseline (Figure 6). Each of the eight transects provides information on five trees or less. Each cell reflects a decision-tree approach to terminating the sampling effort on that transect, in order to ensure a good trade-off between the goals of similar number of trees sampled, compact sample area, and ease of implementation. Thus, in each 10-m-wide cell, sampling proceeded as follows.

1. If a horizontal distance of 15 m was travelled without encountering any trees (≥10 cm diameter at reference height), that cell was scored as empty (a zero).
2. If at least one tree was tallied before reaching 15 m, and five trees were tallied and measured before reaching a maximum horizontal distance of 20 m, the cell was recorded as containing five trees, and its length was recorded as the perpendicular distance from the centre-line to the fifth stem (this measure was recorded to the stem centre, not to the nearest point).
3. If 20 m was reached before five trees had been tallied and measured, then sampling stopped. The cell was recorded as containing the number of trees tallied, and its length was recorded as 20 m.

These distances and measures were based on what was found to be practical and workable in the field, coupled with some general analyses (presented in Sheil *et al.* 2003). We initially field-tested this method with only four cells, and later extended it to eight cells, providing a maximum of 40 stems per completed sample unit.

Sample lines are established to guide the vegetation assessment. Here a limestone site is being evaluated by Dr. Kade Sidiyasa and Pak Zainal Arifin from Wanariset Sambodja

Figure 6. The 8-cell variable area sample unit



This is composed of eight 10-m-wide cells that extend from the 40 m transect line. All distances are defined horizontally. Each cell captures up to five trees and the distance to the most distant tree included (filled in the figure) is recorded (d_1, d_2,.. etc.). The maximum distance to search in each cell before deciding it is 'empty' is 15 m (see d_6). The maximum search distance to collect up to five stems is 20 m (see d_7).

Tree sample unit—a note on data analyses

As this is a new approach, some explanatory notes on how to calculate basic stand parameters are required. Here we provide a basis for these estimates based on the specific method presented (as in Figure 6). Sheil *et al*. (2003) provide some worked examples along with generalised formulae in case the method is modified (the transect width, maximum number of trees per cell and search distances can be changed). Calculations start with a per-cell summary. For each cell (individual variable-length transect), we calculated a density estimate, and for a group of cells (eight in our implementation) the density estimate is the simple average of the cell density estimates. For a cell, we can distinguish three situations:

A. The transect is run out for a horizontal distance of 15 m, and no trees are encountered. The cell is tallied as empty. In this case, the total density estimate for the cell X_i equals 0.
B. The maximum number of trees (5) is encountered before 20 m is reached; the total length of transect run in the cell is L_i (e.g. d_i in Figure 6, in meters). The total density estimate corresponds to the variable-area transect estimate for a single cell: $X_i = 4/(10\text{ m} \times L_i)$. Each individual stem counts as $x_i = (4/5)/(10\text{ m} \times L_i)$ trees per unit area in calculations of density for that cell; in common forest biometry terms, x_i is the expansion factor (N.B. x_i is per tree, X_i is the required per cell mean).
C. The cell is extended to its maximum horizontal length of 20 m, and less than 5 trees are tallied. If n trees are tallied, the total density estimate is $X_i = n/(10\text{ m} \times 20\text{ m})$, i.e. n/200 m^2. The expansion factor for individual trees is 1/200 m^2.

Regardless of the proportion of cells meeting criteria A, B, and C, the estimate of total density based on the group of cells is then taken as the mean of the individual cell estimates.

For stand parameters to which individual trees contribute additively, such as stem density, basal area or biomass per hectare, we recommend the following procedure:

1. Calculate the value of the variable of interest for each tree *j* in cell *i*. Call this value y_{ij}.
2. Multiply the y_{ij} values by their corresponding x_i values to obtain per unit area estimates for each tree. Sum these values of $(x_i y_{ij})$ over all trees in

the cell to obtain the per unit area estimate for the cell. For cell *i* call the estimate Y_i.

3. Average the Y_i values to obtain the best estimate for a group of cells.

Calculating compositional information such as relative density or relative basal area, or the fraction of stems or basal area in a diameter class, involves a straightforward generalisation of the method for calculating stand parameters. First, total density and total basal area per hectare are calculated as above. Second, the density and basal area of a species are calculated following the same procedures as for a whole-stand parameter, except that the y_{ij} value for a tree is treated as zero unless the tree is in the species or diameter class of interest. Once the y_i values have been calculated, obtaining stems per hectare and basal area per hectare for each species follows directly from the calculation of the Y_i values and their averages as outlined above. Finally, relative values or fractional contributions may be obtained by dividing the individual species densities and basal areas by the estimates of total density and basal area.

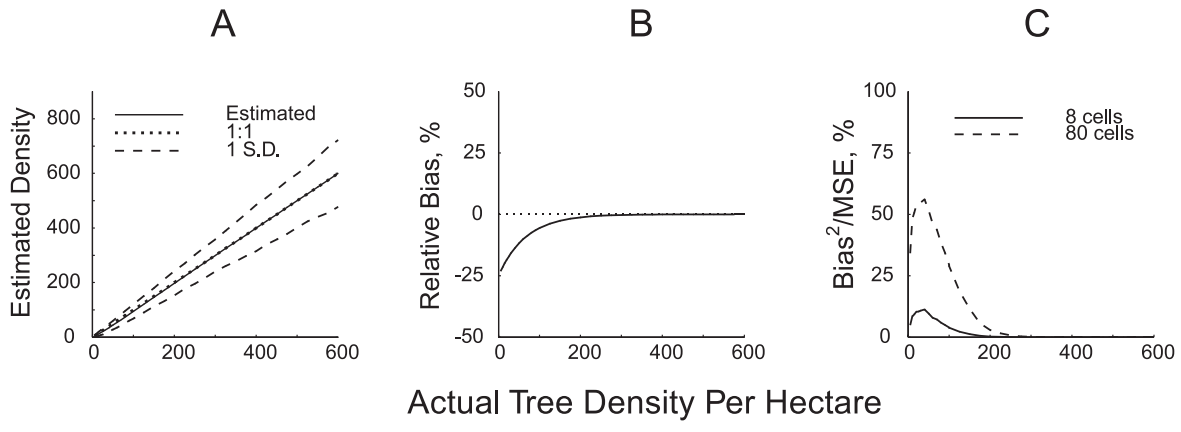
Species richness, unlike the other parameters, is best assessed at the scale of the entire sample, providing integer species counts quoted against the complete stem count. A simple index for making such richness data comparable over a limited range of count variation is provided from the power approximation suggested by Sheil *et al.* (1999). That is by Z = Log (species counts)/log (stem counts). More exact estimates of richness are available if required (e.g. Hurlbert 1971).

There are small biases that arise in very open communities. These are summarised by the simulation results shown in Figure 7. The relative bias is negligible except at very low densities, under which conditions it is minor when compared with normal sample variance.

Plants and site – ethnoecological data (local informants' descriptions)

Two interviewers handled the local informants' descriptions of sample sites and recorded plants. Generally, they worked with one male and one female informant. We tried working with two ethnic groups simultaneously but this proved unwieldy. Having informants who knew more than one local language was also a problem on occasion, with informants being unsure what language or dialect a given name came from. The collected information is the combined responses

Figure 7. Simulation results for bias and variance of the sampling technique when the members of the sample population are randomly distributed (adapted from Sheil *et al.* 2003)



a) Expected value (solid line) plus or minus one standard deviation (dashed line) when eight cells form the sample unit. The true density is shown for reference as a dotted line. b) Percent relative bias, equal to 100 x (expected estimate-true density)/ true density. c) Squared bias as a percent of mean squared error, for one 8-cell sample unit (solid line) and ten 8-cell sample units (dashed line). We have published a more detailed account of this new method (Sheil *et al.* 2003), which also provides a simple worked example and a generalised examination of its sampling properties and includes a theoretical treatment of estimated variance.

Collecting plants along the sample line

from the informants, who often discussed points but rarely disagreed. On occasion, the informants called upon other community members working with the team to confirm or clarify their responses. The interviewer had to be clear and explain each step. Pressure on the informants was avoided as far as possible, though this was not always easy to reconcile with the overall timing of the fieldwork schedule.

Once the plots were selected, the first step was to collect a 'site description' by interview, while others in the team established the plot. The next step was a systematic inventory and annotation of all the plants recorded. During this stage, the interviewers helped the local experts to examine and name each new plant.

Site information

Two local informants were interviewed to determine site description using the data sheet outlined in Appendix IX. Four main topics were covered by the data sheet: general questions to describe the site using terms that the local informants feel are suitable, questions regarding wildlife at the site, questions to evaluate the site for its use value, and lastly, questions regarding the history of the site. Details can be seen on the data sheet itself. Classifying of the importance of these sites followed a similar structure to that used in the community PDM exercises.

Plant names, uses and preferences

These data were collected for all plants recorded in the plot-based survey. The botanist's group recorded each new plant species and gave it a reference number. Then the interviewer asked the informant about that plant and linked this to the botanical reference number. The questions asked were:

Local names of plants: informants were questioned as to the complete local names of each plant, if they could identify them. They were encouraged to inspect the plant closely, and were gently queried for explanations if answers appeared inconsistent. While giving several local names to one botanical species and vice versa are well-known phenomena;

nonetheless, many errors were uncovered by giving attention to mismatches in the field[10]. If the informants did not have a full name, a generic name could be used. Indonesian names were not recorded. The informants were not pushed to give a name if they were uncertain. While we were generally certain of the main language being used, it was not possible to verify languages for each name in the field, though recorders soon developed a 'feel' for their origin. Spelling local languages was a challenge, though several literate local experts were able to help. In later surveys, words were also tape-recorded for future reference. Every plant recorded was cross-referenced with the botanical collection (each plant had a unique reference number, even if it could not be named).

Plant value and use-value class: a brief description was asked for each use or value. The informants were encouraged to remember additional uses—the list of possible types of use was repeated several times (particularly at the start of each plot) along with the list of plant parts (see next) to provide a stimulus. Each use was recorded separately (see forms in Appendix X). The uses were allocated, with the help of the informants, to one of the pre-defined use classes, though some proved difficult to match. We constantly reminded informants that uses referred to the named plant species in general, not the individual specimen(s) seen at the site, so for example seedlings can have 'timber values' and a non-fruiting individual durian tree can have 'food values'.

Part used: the part of the plant for each use was recorded as in Table 8.

Preference: if the plant was the *best alternative* for this *specific use* the score was '*YES*', otherwise it was '*NO*'.

Frequency: this recorded the *'last time of use'* in five classes, i.e. *>10 years ago, 5+–10 years ago, 2+–5 years ago, 2 years ago* and *within the last (1) year*. The question was 'When was the last time this plant was used?' Or 'How regularly do you use it?' Clearly, these classes are vague, and we debated their utility, but it was hoped that gross general patterns could emerge.

Table 8. The part of the plant for each use/value

Plant Part	*Porsi*	Code
Root (inc. buttress, aerial)	*Akar*	*A*
Leaf	*Daun*	*D*
Fruit	*Buah*	*Bu*
Timber	*Kayu*	*K*
Young leaf	*Pucuk*	*Pc*
Bark	*Kulit kayu*	*Klt*
Flower	*Bunga*	*Bng*
*All of plant is used	*Semua*	*Semua*
Stem (vine)	*Batang*	*B*
Stem (non-woody)	*Batang herba*	*Bh*
Sago	*Sagu*	*S*
Cane (rattan)	*Rotan*	*C*
Sap	*Getah*	*G*
Resin	*Damar*	*R*
Anything else	*Lain-lain*	*Lain*

*The *Semua* class was not included in the original datasheets. This was found to be an omission (made up by a note with each record) and is remedied here.

Exclusivity: is the plant *unique in this specific use?* '*YES'* means it was considered unique and replacement by a substitute was difficult or impossible. *'NO'* means natural substitutes were available.

As in the other sampling procedures, the datasheets were carefully checked for omission or errors before leaving the field, first by the recorder and then by another team member.

Many plants were collected separately from the main botanical collections for later crosschecking with other villagers (data triangulation). This was done 1) when the local informant could not name the plant, 2) when the local expert seemed inconsistent about a name and/or use, and 3) in a subset of plots selected for focus group discussion (as a general quality check) requiring collection of all species recorded.

Data checking and triangulation

The data were regularly controlled and revised for errors. This involved discussions with the informants and the botanists, but more importantly, numerous aspects of the field data were checked with other community members. The most structured approach was through focus

Pak Kirut explains the significance of some plants to Pak Edi Permana

group discussions that concentrated on collected plant specimens. Efforts were made to ensure that participants represented a broad range of the community, including all the local informants who were present in the field. The main objectives of these discussions were to check names and agree upon spellings for the plants already recorded, to check and complete plant use data already recorded, and to potentially extend information on uses and values. The participants were shown the plant sample and asked its name, uses, used parts, preferences, frequency, and exclusivity. Participants discussed these and some consensus was normally forthcoming.

Revised names, spelling and uses can be used to amend the field data, but in general, these data are stored separately. Consensus spelling is applied to standardise and revise the plant names list in any one community. When there were multiple names for the same species, the community consensus was taken. This generally resulted in one name per species per community, which we recognise may not reflect the true variability of plant classification in the community. In many cases informants were clear that multiple names did reflect a single entity rather than distinct taxa, in other cases they were not clear and used different names to distinguish different forms. We ensured that our notes captured this difference. Importantly, the original field names were never discarded but remain available for future reference. As we adopted local advice, spelling conventions did differ between villages even when apparently the same name (same botanical species, same phonetic name) was being used. Each meeting was usually conducted with men and women separately and generally took two to three hours. Five or more meetings were usually undertaken with each community. About ten plots per community were fully reviewed in this way.

Box 7. Ownership and exploitation of local knowledge

The ownership and exploitation of local knowledge is a concern, particularly the commercial use of medicinal plants. We told all community members our intentions and goals about data collection. We also made explicit that they need not tell us anything they did not want to tell us. We specifically did not record detailed accounts of how plants were used, such as details of how medicines are prepared and administered.

Once all the plant data had been compiled, the allocation of use-categories was revisited in an extra field visit. This review was conducted with a cross section of each community and clarified the consensus views on which uses fitted in each class, and identified the small number of miscellaneous values that do not fit. For the majority of uses there was no problem, though there was some difference in the details of classification between communities. Detailing these subtle differences means that each plant-use record now has two use classifications, the one given by the community (where identical uses can end up in different classes depending on the village they were recorded in) and a 'standard' one (in which all identical uses will be in the same

'overall consensus' class more useful for comparing species-use data between communities). It should be remembered that these classes are only a convenient simplification, as fuller details about each use-record remain part of the overall database.

Soil assessments

The field procedures for studying soil linked a biophysical and an ethnographic approach. Datasheets are shown in Appendix XI.

Soil technical data collection

Two holes, each 10 cm in diameter, were drilled with a Belgi augur, 10 m from each end of the 40 m length of the plot. The augur took soil in 0.2 m cores down to 1.2 m, unless this was impossible (in which case the depth was recorded). For each core, layers were described by texture and colour (using the Munsell soil colour chart).

A profile of approximately 1 m in length, 0.5 m in width, and 0.6 m in depth, was dug in the centre of the plot. Physical characteristics including soil depth, moisture regime, colour, texture, structure, consistency, matrix node, pores, and roots were recorded by horizon using standard methods (see Suwardi and Wiranegara 1998). Soil pH was field-measured with MERCK pH universal indicator paper: this guided later analyses of available P (acid soil requires different analysis procedures than basic soil). A centrally augured hole substituted for this profile if the plot site was flooded or waterlogged. Composite and 'undisturbed' soil samples were collected for laboratory analyses. The composite samples included soil from all three holes, from two distinct horizons (0–0.2 m and 0.2–0.4 m if soil depth allowed). The volume of each composite sample was about 1 dm^3. The samples were air-dried and roots were removed before they were sealed in plastic bags for transport to the Pusat Penelitian Tanah dan Agroklimat (Puslittanak) laboratory in Bogor, Indonesia, which undertook the analyses. Puslittanak first sieved the soil (2 mm) and then oven-dried it at 105°C. Undisturbed soil samples were taken from 0–0.2 m depth in the mini profile using 183 cm^3 stainless steel ring samples. These were also taken to Bogor where moisture and bulk density characteristics were measured (as in Jurusan Tanah 1991).

Samples were analysed as described in Puslittanak (1997). This included: pH value (KCl and H_2O procedures), organic-C (Kurmis procedures), total N (Kjeldahl procedure), phosphorus (Bray I procedure), potassium (Bray I procedure), exchangeable bases, base saturation, CEC, and Fe-content (23rd procedure). Physical analyses included texture (pipette procedures), bulk density (gravimeter), and total pores (gravimeter). Physical data such as strength and gravel content, and the chemical analysis of total P and K, were only analysed in the pilot survey. In later surveys these aspects were replaced by field observations and other analyses (for total-P and K content covered by available-P and K). Coded duplicate samples were included in the laboratory analyses to clarify consistency.

These soil data provided a detailed biophysical baseline from which the fertility and suitability of the land was assessed. They also allow an exploration of local soil classification and use.

Soil as viewed by local informants

Field informants were fully briefed about the study and were selected because they were known to have good knowledge of both soils and cultivation. The main objective was to understand how they assess soil and a site's agricultural suitability. Each informant was interviewed individually with a fixed questionnaire. Questions were made as simple and clear as possible, for example: 1) What do you call this type of soil? 2) Why do you call it that? 3) What kind of cultivation would be good on this soil and why? 4) How would you prepare such a site for cultivation? If the answer did not match the usual types of answer or appeared to be doubtful, the question was explained again, and examples discussed, until a consistent answer that the respondent was comfortable with was provided. 'Don't know' was an acceptable answer. As with the site, vegetation and tree sampling, the datasheets were carefully checked for omission or errors, first by the recorder and then by another team member, before leaving the field.

5 Data control and management

Plant taxonomy and verification

The preparation of a final reference list of vascular plant records of this survey took a long period of herbarium work, referencing, checking and revisions and the first draft was only ready in July 2001. Revision continues. Four main steps were needed to ensure data quality: 1) identification of specimen and data entry, 2) data checking and correction, 3) handling unidentified species, and 4) checking synonymy.

The first step was the identification all of vascular plant specimens using the expertise and facilities of the *Herbarium Bogoriense*. Around 8000 specimens, mostly infertile, were collected during the four survey periods. Two Bogor-based botanists, who had worked alternately as part of the field team, identified these and completed all records with family and authority information. Records of plants that had already been fully identified in the field were checked for spelling, family and authority.

Herbarium staff took care of entering the botanical details against the field reference in a spreadsheet, which was then incorporated into the relational database (see section below). Repeatedly collected and thus familiar plants were often referred back to prior collections in the data sheet and these cross-references were checked individually. Records were

The villagers of Gong Solok help us review plants and check survey data

sorted and summarised to facilitate the detection of errors (mainly differences in spellings and impossible taxonomic combinations). Apart from this checking process, we also applied database and spreadsheet functions to detect duplicate numbers, herbs with tree names and two spellings of the same name.

The Malinau area is not well-explored taxonomically and the majority of the plants encountered are not easily identified. Even when good herbarium matches have been made, standardising nomenclature and synonymy remains a major task. Though the first stage of the botanical identification has been completed, we still consider the names provisional. From the 15 430 records in the plant reference list, 97.5% have a name, with 2116 unique species. About 73% or 1549 have complete species names. The rest, 515 species, are still distinguished taxonomically to identify distinct and consistent morpho-species (usually named [*Genus*] sp1, sp2, sp3, etc). This required checking and grouping for all such reference specimens. For 52 of the unidentified forms, genus is unknown (79 specimens), and for 24, family is unknown (26 specimens). Some of this incompletely identified material may include previously undescribed taxa.

In the field survey, four botanists were intermittently involved, two from Bogor and two from Samarinda. Each of them used their own series of 'field names' that, though consistent in themselves in any period, were not necessarily consistent between collectors, or collection periods (e.g. one botanist's *Alpinia* sp1, *Alpinia* sp2 and *Alpinia* sp3 may be another's *Alpinia* sp2, sp4 and sp1). This required re-checking all such reference specimens. This task was exacting and involved accessing the entire specimen and reference data collections. One way to avoid this, as we knew in advance, would have been to work with the same botanists throughout, but this was not possible with our survey schedule. On the other hand, by having four botanists we were able to cross check all botanical names.

Due to the many references used, several of which are old, and the process of matching with a wide variety of named herbarium materials, some of which date from previous centuries, the synonymy and consistency of the nomenclature was a concern. We decided to use Brummitt (1992) as a standard reference to family and genus level and the *Index Kewensis* version 2.0 (1997), which also uses Brummitt as a standard. Synonymy was controlled with the same *Index Kewensis* (1997). During this process, a number of invalid names (mostly derived from Herbarium sheets) were also identified. This synonymy and validity checking process took more than five months.

The main references have been:

Ashton, P.S. and Arboretum, A. 1982 *Dipterocarpaceae*. Flora Malesiana. Series I Spermatophytes. Flowering Plants 9 (2).

Adema, F., Leenhouts, P.W. and van Welzen, P.C. 1994 *Sapindaceae*. Flora Malesiana Series I - Spermatophyta 11 (3).

Backer, C.A. and Bakhuizen van den Brink, R.C. 1963 *Gymnospermae* Families 1-7. Flora of Java (Spermatophytes only) 1.

Backer, C.A. and Bakhuizen van den Brink, R.C. 1963 *Angiospermae*, Families 8-110. Flora of Java (Spermatophytes only) 1.

Backer, C.A. and Bakhuizen van den Brink, R.C. 1965 *Angiospermae,* Families 111-160. Flora of Java (Spermatophytes only) 2.

Backer, C.A. and Bakhuizen van den Brink, R.C. 1968 *Angiospermae*, Families 191-238. Flora of Java (Spermatophytes only) 3.

Brummitt, R.K. 1992 Vascular Plant Families and Genera. Royal Botanic Gardens, Kew.

Ding Hou, Larsen, K. and Larsen, S.S. 1996 *Caesalpiniaceae*. Flora Malesiana Series I - Spermatophyta 12: 409-730.

Holttum, R.E. 1967 A Revised Flora of Malaya. An illustrated systematic account of the Malayan flora, including commonly cultivated plants. Ferns of Malaya 2.

Index Kewensis on Compact Disk Version 2.0. 1997 Royal Botanic Garden Kew, Oxford University Press.

Mabberley, D.J. 1986 The Plant Book. A portable dictionary of the higher plants.

Mabberley, D.J., Pannell, C.M. and Sing, A.M. 1995 Flora Malesiana Series I - Spermatophyta 12 (1).

Nielsen, I.C. 1992 *Mimosaceae* (*Leguminosae-Mimosoideae*). Flora Malesiana Series I - Spermatophyta 11 (1).

Sing, A.M. 1995 *Meliaceae*. Flora Malesiana, Series I Spermatophyta 12 (1).

Van Steenis, C.G.G.J. 1972 Flora Malesiana, Series 1 Spermatophyta. Flowering Plants 6 (6).
Van Steenis, C.G.G.J. 1976 Flora Malesiana (Revision). Series 1 Spermatophyta 7.
Van Steenis, C.G.G.J. 1978 Flora Malesiana. Cyclopaedia of collectors (Revision). Supplement II Series 1, Spermatophytes 8.
Van Steenis, C.G.G.J. 1987 Checklist of generic names in Malesian Botany, Spermatophytes. 162pp.

We anticipate that additional expertise will allow us to identify unnamed material and likely cause us to revise some of the lesser-known taxa. In some groups, such as the gingers (Zingiberaceae), taxonomy is confused and will need to be revised before meaningful species names can be applied. We must continue the process of data checking and reviewing to arrive at the highest possible data quality.

Database

A single coordinator kept an overview of the data and ensured that all corrections and updates led to a single best version. All data were entered into computer software and can be presented under three main headings: the *Database of plot data,* the *Database of village data* and the *GIS database.* The plot database contains data on terrain, soil,

Table 9. Core tables in the survey database

Title	General description of content	Main fields
Abundant seedlings/ saplings/ monocots/ shrubs	List of abundant seedlings, saplings, monocots and shrubs/treelets per sample	**Sample nr**, **Refno**, genus, species, family, authority
Administration/ location	Location and accessibility of the sample, method of sampling	**Sample nr**, team, date, village, access time, GPS, vegetation, representative, size of the plot for tree sampling, slope
Expert database	List of the informants in each of the villages	Name, village, age, gender, language, ethnicity
Herbs/ palms/ climbers/ epiphytes, etc.	Records of 'smaller' plants in 4x4 m subplots	**Refno**, field name, life form, presence/absence in subplots
Information about site by informants	Local informants' description of landscape, vegetation and land use history	**Sample nr**, full answers to all questions on local names, wildlife, site value and land use history, etc.
Reference list plants	Links the Refno (recorded in field) with the taxonomical ID (final identification by herbarium)	**Refno**, **Taxa id**
Taxonomy list	All the taxonomic details of species recorded in survey	**Taxa id**, genus, species, family, author, variety
Site description	Physical description of terrain at sample site	**Sample nr**, altitude, slope, aspect, water sources, artefacts, etc.
Soil field data	Soil observation data from the field, and interviews with local informant	**Sample nr**, surface description, horizon observations (see form for details), etc.
Soil laboratory results	Results of soil analysis by *Puslittanak* in Bogor	**Sample nr**, per depth layer: chemical components, texture analysis, etc.
Tree composition	Each record is one measured tree in one plot	**Sample nr**, **Refno**, field name, genus, species, drh, height, FI[11]
Plant use and scores	Every record is one specific use of one (specific part of the) plant in one sample plot	**Sample nr**, **Refno**, local name, used part, use category and description, preference, frequency, exclusivity
Vegetation structure	General structural information about the vegetation	**Sample nr**, relascope readings, estimation of abundance of rattan, lianas, epiphytes, mosses, seedlings and saplings

Sample nr = sample number; **Refno** = plant specimen reference number, a unique identifier for each plant collection; drh = stem diameter at 1.3 m; FI = furcation index (see appendix VIII); relascope readings = a standard forest survey procedure that provides an estimate of cover and basal area; **Taxa id** = taxonomic identification number

plants, animals, site history and ethnobotany from 200 field sites. The village database contains data on population, culture, traditional knowledge, and 'importance scores' from seven villages. Since each plot was taken in the territory of one of the seven villages and these villagers were our informants, these plot data also relate to specific villages. All plot locations are geographically referenced and thus can be linked with the Geographic Information System (GIS).

The team member responsible for each type of data entered it into the database. Others later verified the inputted data against the original datasheets. For certain data (e.g. life form, plant names, plant size) automated control routines were built into the database (see under 'Queries' below). Considerable effort was made to identify and remedy data errors.

Database of plot data

This database was developed using Microsoft® Access©. It is a *relational database*, based around links between the sample number of respective plots and the reference number of recorded species to link all data tables. Below, we first present individual tables, followed by a discussion of the relationship between them. Then we discuss some useful queries and lastly, we present the forms used to enter the data, but which can also be used to analyse them, and some special forms for the presentation of summaries and analysed data.

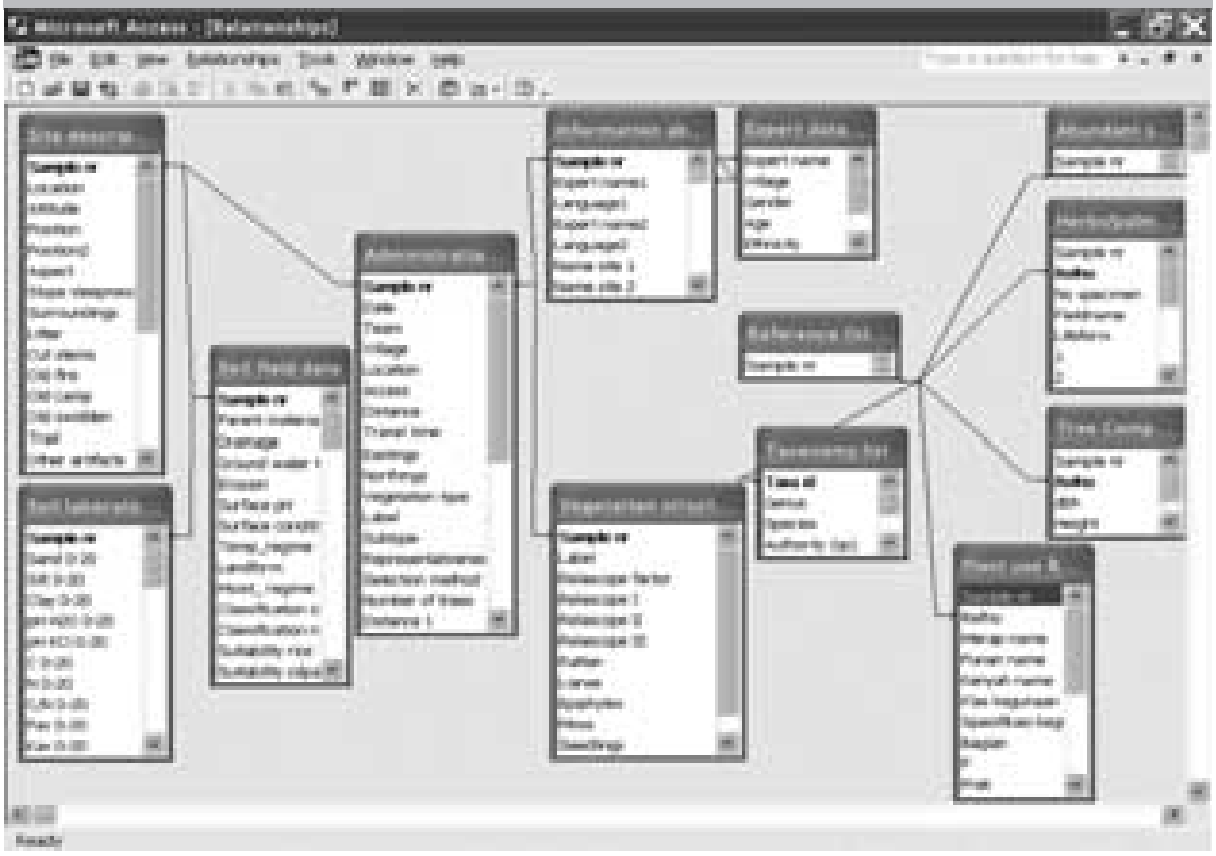
Core tables in plot database

Thirteen tables form the core of the database and their content have been summarised in Table 9. Most of these were filled in using forms that resembled the field datasheets.

Relationship between tables in the plot database

A graphic presentation of the main connections between the tables in the database is provided in Figure 8. Each block represents a table, and some, or all, of its fields are listed. Links between tables are shown as a line connecting a field of one table with that of another. This can be a one-to-one or a

Figure 8. Links between the tables in the plot database



one-to-many link and these are essential for the proper functioning of the database.

In one-to-one relationships a record in a specific table can only be matched with one corresponding record in the other table of the relationship. This is the case with most tables that link through 'Sample nr'. In a one-to-many relationship, there are typically unique records in one table used elsewhere via a look-up function. An example is the link between tables of plant records ('Herbs/palms/climbers/epiphytes, etc.', 'Tree composition', 'Abundant seedlings/saplings/monocots/shrubs' and 'Plant use and scores') and the 'Taxonomy list' containing data on all unique species identified after the survey. The 'Reference list plants' is a look-up table: every plant Refno (recorded in field) has been given a final Taxa id. One species (Taxa id) may have been recorded several times and can have several Refnos (a one-to-many link). Tables are also connected through the field 'Sample nr', allowing combined summaries by plot.

Basic queries

Queries were used for several basic functions, firstly as checks on data accuracy to verify odd data entries such as excessively large or small stem drh, strange life forms, and species placed in the wrong family. Queries have also been built in to link plant records with the table containing the final, scientific names for all plants ('Taxonomy list'). Where the reference number was used in the data entry process, family, genus, species (variety), and authority were filled in and updated whenever corrections or additions to the taxonomy list were made, by means of a query of this table with the 'Reference list plants'. Queries also provide basic data summaries, e.g. counts of species (at species, genus and family level) in total, per plot, vegetation type or village; and lists of samples where a specific species occurs and the number/list of uses per species.

Forms for data entry and presentation

The data entry forms contained in the survey database have a similar format to the respective field datasheets. This was intended to ease data entry, but also provides a more pleasant way to view the data. Some of the forms relate to only one of the tables in the database, while others connect to more. Table 10 gives an overview.

Special form: Tree Composition

The form 'Tree Composition' shows the tree measurement data per plot (usually 40 trees[13]). It also automates three analysis routines, based on the methods explained earlier (section 4 and Sheil *et al.* 2003) to enable calculation of:

Table 10. Forms in the field survey database and their connection with the tables

Form (name)	Data type	Table name
Herbs, palms, climbers, epiphytes, etc.	Refno, field name, life form, presence	Herbs/palms/climbers/epiphytes, etc.
	Scientific name	Reference list plants; Taxonomy list
Information about site by local informants	Names, uses, history, value ratings	Information about site by informants
Site description	Data relating to location and access, team, date	Administration/location
	Data relating to terrain	Site description
	Scores of rattan, etc.	Vegetation structure
Soil data	All direct field observations	Soil field data
	Laboratory analysis	Soil laboratory results
	Relascope data[12]	Vegetation structure
Tree composition	Size of variable area plot, slope	Administration/location
	All tree measurements and names	Tree composition
Plant uses & scores	Use data and scores	Plant use and scores
	Scientific names	Reference list plants; Taxonomy list

- *Summary of all trees*: this produces a table of all recorded trees in one sample, with density and basal area
- *Density per species:* this creates a list of species per sample (each species only once), with their density (per subplot as well as in total)
- *Basal area per species:* this creates a list of species per sample (each species only once), with their basal area (per subplot as well as in total)

A separate form called 'Crosstab' allows the calculation of both density and basal area per species for several, or even all, plots at the same time. The result is a matrix of species and plots in which cells contain the species' density or basal area (per ha) respectively. This provided a basis for many further analyses of composition.

Database of village data

Most files are in text format and some, like those from the PDM exercises, are spreadsheets. Seven subdirectories were created; one for each village. Within a village directory, there are 16 files, one for each questionnaire/data sheet type used. Files are named according to a logical system: first, the code of the questionnaire (Qs1 to 6) or the data sheet (Ds1 to 10) used to collect the data, followed by the full name of the village (See Table 11).

GIS database

The GIS database for CIFOR's Research Forest already contained the following information: satellite images (the most recent one taken in May 2000), rivers, roads, settlements, ridges and peaks, and (preliminary) village territory boundaries (from the CIFOR-ACM project, created in the context of activities described in Heist, van and Wollenberg (2000)).

GPS coordinates from all sample sites should allow links with tables in the plot database containing general descriptions of terrain, soil and vegetation cover. Other survey data incorporated into the GIS database include approximate locations of natural resources, good fishing/hunting sites and other special sites, as drawn in their relative positions by local communities during the participatory mapping process. Map compilations were prepared as an *Arcview* project. Because of links between tables from the database and the sample point layer, the geographic distribution of analysis results can be presented spatially.

Table 11. File structure of the village survey database

File name	Data content
Qs1*.doc	General description/perspective of land use
Qs2*.doc	Cultural background of land use
Qs3*.doc	Price of traded goods
Qs4.*xls	Perceptions and aspirations concerning land use and environment
Qs5*.doc	Traditional knowledge on land use
Qs6*.doc	Utilisation of forest products
Ds1*.doc	Settlement history and land use
Ds2*.doc	Disasters and important natural events
Ds3*.doc	Land and forest types
Ds4*.doc	Forest products
Ds5*.xls	Demography
Ds6*.xls	PDM: Land and forest types
Ds7*.xls	PDM: Land use values over time
Ds8*.xls	PDM: Distance and value of land
Ds9*.xls	PDM: Value and origin of plants and animals
Ds10*.xls	PDM: Value per use category and most important species

* name of respective villages

6 Conclusions

Experience to date

Our account is largely a description of methods, but some comment on our experiences is warranted. In general, we have been successful. We certainly have a better answer to the question 'How can we find out what we should know, in order to make better decisions about tropical forest landscapes?' We have an extensive amount of information to assess what is important for several communities in Malinau. We now recognise critical issues of which we were previously unaware. Especially important to us as researchers, is the fact that we can now in many cases also place these data in relation to our detailed biophysical information about this previously un-researched region.

We worked with seven communities and established two hundred research plots between November 1999 and November 2000. These data are already sufficient to cast light on some questions, and caution against over-generalisation. Several reports are in preparation detailing various summaries from these surveys. One initial overview is provided in our report to ITTO (Sheil *et al*. 2002), another is published online (Sheil *et al*. 2003).

For many results, their significance lies in the specific details they provide. Any brief summary will fail to illustrate the multi-layered and multi-faceted nature of the results. The insights that are gained simply by staying in a village and undertaking the surveys with the community are especially hard to capture. Many survey activities helped to develop shared references between researchers and community members, and to stimulate a less formal, but deeper dialogue. These may be some of the most precious results, potentially offering the key to various puzzles that appeared during the survey. However, these lie beyond the formalised systematic approach which has been our emphasis.

Despite fears about community impatience with the many exercises, they have stayed positive about our survey and interest. We have already mentioned how our methods are not truly 'participatory' in the sense that many might wish to see the term used, but nonetheless establish a basis for a more collaborative process. Another aspect of our positive reception is that the communities are genuinely pleased that outsiders seek them out and discuss their views with them–this may be specific to the local context. It is also clear from community feedback that they recognise benefits of openly discussing topics that they have previously not given such explicit attention, and in learning how to make their views clear to outsiders like ourselves.

Results can be used to promote local perspectives to decision makers. Some first examples are suggested below.

First results

Our approach aims to elucidate the kind of information required to make better decisions about forest conservation and land use. Systematic

assessment of local attitudes to landscapes using a range of techniques should make it possible to consider those values in any decision-making that may affect the area. Once we demonstrate how and why biodiversity matters to communities, it is harder for decision makers to overlook its importance.

The project has already demonstrated site-specific information that can help guide policies on local forest management and land use. The initial surveys show, for example, that many people in the region are troubled by a perceived decline in some highly valued resources, especially the animals they hunt for food and the plants they rely on for their daily needs. One important resource that has become scarce is rattan. A significant factor in its decline, according to the villagers in some areas, is government logging regulations (TPTI) that require timber companies to repeatedly slash all undergrowth and climbers, including all the rattan species, in an effort to encourage regeneration within the concessions. While the practice has clearly hurt local communities, its silvicultural benefits are also debatable and the policy should be reconsidered.

Unlogged 'forest' is considered the 'most important land' for the communities. Wild pigs and timber trees are amongst the most important species. Both are associated with good forest. Logged over forest is given a low preference by local communities. There appear to be a number of reasons for this. These include a diminished level of key resources, reduced physical accessibility and reduced access rights. For example, timber resources are no longer accessible. Even if they had the right to cut the timber, the best wood has often been taken already and the damage to the forest makes access harder. Pigs, a preferred food species, are said to decline in logged areas. Logging unnecessarily reduces certain forest based emergency foods, such as the hill sago palm *Eugissonia utilis*. This tends to grow on ridge tops and is damaged if skid trails are placed as they are supposed to be in 'reduced impact' methods (see Elias *et al*. 2001). Recognising such concerns allows us to investigate alternatives. By identifying important species and habitats for local communities, we provide a focus for management that can be supported in various ways including the more focused application of ecological principles (Sheil and Heist 2000).

Finally, culturally important sites are often damaged by company activities, which is damaging for already strained relations. Again, it appears simple to remedy this once the priority is accepted.

Further analysis

Future analyses will draw the various threads of the survey together to explore linkages and complementarity that can only be alluded to at present. It is also intended that many of our conclusions and the various queries they provoke will be discussed again with the communities. Indeed, such a checking will be necessary to avoid the many pitfalls of interpretation and generalisation. Many future activities will draw on the survey data. The scope of these goes beyond the results presented. Species list verification is ongoing, and initial results from several aspects of the survey must be reviewed again in Malinau. Once these critical 'checks' have been taken there is interest in extending the vegetation analysis to examine the links with other site characters. We also intend to relate the PDM patterns with biophysical determinants, to see how far we can use the species-based PDMs as a basis for assessing the importance of plots based on compositions. There is also a need to develop spatial analyses to identify the key spatial determinants of vegetation and local importance. Other aspects that need be explored are making the assessment of importance more pragmatic and finding efficient–yielding approaches that are sufficiently clear, valid and useful outside of research. This will be done with caution given the limited resources available to pursue conservation goals in most parts of the world (Sheil 2001).

The GIS database can be built on and used as a tool for planning, and for monitoring changes. This endeavour will benefit from an exploration of available remote sensing and GIS tools that may allow us to extrapolate the sample data in a spatially explicit manner. Our assessments of sample variation will be central in such analyses. Certainly, our data provide a baseline against which future trends may be assessed. The most valuable characteristic of this baseline is both its broad base and its clear links to local perceptions and priorities.

Community members from Langap discuss some plants with other members of the field team

Follow-up

Our results provide a broad basis for future research in the Malinau area. Immediate research will hopefully look at our initial results and conclusions together with community members to see if they approve of our assessments. If they do not, the reasons will highlight assumptions or other aspects requiring attention. It has already become apparent that some key aspects, such as access, are too complex and context-specific to elicit and quantify adequately with the data we currently collect. Such topics are now highlighted for further evaluation.

More explicitly, our research in the area can continue with the same basic three-pronged approach outlined in our overall research strategy: 1) finding out what occurs where, 2) assessing to whom it matters and in what way, and 3) identifying what steps are needed to maintain this biota in the future. By having good information for steps one and two we have priorities for evaluating in step three. We envisage more in-depth investigations of key resources and values: what are they specifically, what qualities influence importance, and what are the threats to these resources?

We will be looking at how to develop the conclusions of the surveys into relevant outputs, and engaging with other CIFOR components and partners to make full use of the opportunities that might arise. We are already discussing options to find funding to allow us to develop some more community-led activities in which we would try and assist in *synthesising information from communities, for them, in ways that they find useful*. Similarly, initial discussions imply opportunities to engage with local government activities and influence the process of concession contracting, local legal revision, and other processes brought about by regional autonomy that will impact forest lands and local people.

Endnotes

[1] Not only because of the hopes and fears that might be raised, but also to avoid overtly strategic behaviour, and because in a society where land and labour are the main factors of production, attempts to translate value into land prices are artificial, especially when rights over land are uncertain. In addition it should be noted that two other CIFOR research programs in the area have an interest that overlaps: firstly the Adaptive Co-Management team is looking at real issues of land-claims and conflict resolution (making this a topic that our group avoided) and the Forest Products and People team is looking at how incomes vary according to different opportunities in different villages.

[2] Map information was a problem. Little reliable information existed, base maps were patchy and poorly annotated, and cloud cover impacted all available remote imagery.

[3] Naming was complex when dealing with communities of mixed ethnicity as in some cases, especially for tributaries, a feature could have multiple names (depending on language). Usually community members are aware of alternative names so it was only us who were confused.

[4] We did this most extensively in the first surveys and generally could use these lists as prompts in each new village after some informal discussions with informants prior to the meetings.

[5] ***G*** comes from *guna*, the Indonesian word for 'use'.

[6] S comes from the Indonesian word *sisa*, meaning 'remainder'.

[7] There are conceptual problems when S is zero if the field evaluations later find additional species in this use class. A zero importance for a useful plant seems unsatisfactory, even if such errors of omission might be expected to affect only genuinely unimportant taxa. Two issues are the need to use classes in a manner consistent with local understanding, and the probable necessity of averaging answers.

[8] If this plant species also scored for other uses, its weighted score in different categories should be added to arrive at an overall score for the species.

[9] This sheet includes some vegetation data not covered by the other data sheets. These include seedlings, saplings and shrubs. The reason for this was that we felt any complete survey of these would be exceptionally time consuming and botanically difficult, but that abundant species are nonetheless important. It also includes a class called 'giant monocots' to be assessed in the vicinity. This was included because it was known that a large number of large monocot species including bananas, palms, pandanus, and gingers are valued by the local communities, but generally occur at much lower densities than herbs recorded in the transect and are thus not included in the herb data sheet (if they are found in this they are included). These species are relatively easy to find and identify, are often

restricted to specific habitats and thus may serve as useful indicators or surrogates of landscape properties. These data should be seen as rough and exploratory in nature rather than objective (as in the main plot data) as there is a necessary compromise between the wish for some information but not wishing to get involved with multiple complex and time consuming methods for all possible life forms.

[10] This was certainly not a one-way process. To illustrate one such example: Pak Incau in Laban Nyarit was at one point challenged about his giving two different names to two trees. 'They are the same' claimed the botanist. 'They are quite different' said Pak Incau who had not even walked over to the more distant of the two trees. To resolve the dispute, specimens of each tree were collected and passed to our second botanist who quickly confirmed 'yes …they are different'.

[11] Data needed for the calculation of density and basal area (distance to the fifth tree and slope for each of the [eight] variable area subplots) were stored in the Administration/location table, because it is a characteristic of the sample plot rather than of individual trees.

[12] Relascope records were included in the form for the soil sampling because it was the task of the soil scientist to collect these data. Relascope records provide an estimate of tree cover.

[13] In the first 20 samples only 20 trees were recorded; thereafter, the standard sample size was set at 40 trees.

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Appendix I. Schedule of activities per village

Steps/Objectives/Draft schedule	Components	Methods	Instruments Materials	Who and Remarks
PREPARATION *Day* <1 To introduce and explain the social, economic, and cultural aspects of the Survey to team members and to finalise arrangements for its implementation	1.1. Overall aims and concept 1.2. Socio-economic and cultural assessments 1.3. Village team management 1.4. Operational plan (sub-activities, schedule, and responsible persons)	Presentation Discussion	Background documents Checklists, etc.	Team members only
INTRODUCTION *Day 1* To introduce concept and team members to local communities, to inform people about the whole program schedule and procedure	2.1. Introduction of Survey team 2.2. Explanation of activities 2.3. General information, questions 2.4. Schedule of activities	Community meeting Presentation Discussion	Flipchart, pens, good lighting Snacks, drinks, etc.	Local leaders Village residents Other stakeholders Team
PRACTICAL PREPARATION *Day 2* (Naming features on base maps, informal discussions to identify key people and assess availability, etc.)				
LOCAL CONTEXT *Day 3* To obtain baseline information on the demography, culture, economy and history of the study village	3.1. Demography 3.2. Cultural values and practices 3.3. Economic activities, trade goods and consumer trends 3.4 History of settlement, natural disasters, and seasonal events	Document review Informal interviews Questionnaires with key informants	Village statistics Qs 1–3 Ds 1 & 2 Snacks, cigarettes, etc.	Village leaders Traditional leaders Shopkeepers/ traders
TEAM DISCUSSION *Day 4* (Progress monitoring, data checking, and next steps planning)				
LAND COVER & LAND USE *Day 4–7* To determine and map the extent of traditional territory, and identify and map major components of the landscape	4.1. Labelling features on base map 4.2. Identifying location of land cover/land use by categories 4.3. Identifying location of important natural resources	Community meeting Participatory mapping Key informants Open discussion	Base maps Ds 3 & 4 Flipchart, pens, good lighting. Snacks, drinks, etc.	Full or representative sample of village residents (male/ female; old/young)
TEAM DISCUSSION *Day 8* (Progress monitoring, data checking, and next steps planning)				
DEMOGRAPHY AND PERCEPTION *Day 8–16* To collect social and economic data (population, age, ethnicity, etc.), and community aspirations related to local resources	5.1. Household data 5.2. Micro economy 5.3. Education 5.4. Aspirations and perceptions	Document review Household survey Interviews with key informants Questionnaires	Village statistics Qs 4 Ds 5	Number of household do include: 30 per ethnicity (in case there are several ethnic groups)

Steps/Objectives/Draft schedule	Components	Methods	Instruments Materials	Who and Remarks
TEAM DISCUSSION *Day 17* (Progress monitoring, data checking, and next steps planning)				
DETAILED LAND USES AND FOREST PRODUCTS *Day 17–18* To identify plants and animals which are used by local communities as well as to determine their importance based on their categories	6.1. Forest land use types 6.2. Forest products 6.3. Assessing importance by categories	Interviews with key Informants Land use values assessment	Qs 5 & 6	Key informants (3–5 persons/ethnicity)
TEAM DISCUSSION *Day 19* (Progress monitoring, data checking, and next steps planning)				
LOCAL PERSPECTIVES OF LAND USE AND FOREST PRODUCTS *Day 20–27* To quantify preferences among local communities for various land types and forest products and other values	7.1. Land and forest types 7.2. Land values over time 7.3. Distance and value of land 7.4. Value types and land type origins 7.5. Assessing the most important species by type of use/value	Focus group discussion (FGD) PDM scoring exercise	Ds 6 –10 Cards and pebbles or buttons or maize seeds Snacks	Representative (purpose) 4 x (up to) 6 persons/ethnicity (male/female; old/young)
TEAM DISCUSSION *Day 28* (Progress monitoring, data checking, and next steps planning)				
REVIEW & FOLLOW-UP *Day 29–30* Checking and integrating all collected data (village and field teams)	8.1. Recapitulation 8.2. Revision/editing 8.3. Conclusions	Documentation study Discussion	Summaries Previously collected data.	Team members Local informants

Notes: Excluding transportation/movement, camp establishment; Qs=Questionnaire sheets, Ds=Datasheets

Appendix II. Further issues and cautions

Our objectives were ambitious, but every method has its limitations, and we have recognised aspects that could be revisited in future work. It is important to note that we made a choice to find out a little about many things, rather than a lot about a few. This inevitably means that follow-up activities and checks are required when important results are found. Our methods provide a baseline, or a diagnosis, not a complete answer to everything. Below we provide a collection of comments and notes that could be useful to bear in mind when using or modifying our methods, and interpreting results.

Multidisciplinary teams - Misunderstandings of purpose and method arose among scientists from different countries and disciplines, and between scientists and local informants. Tolerance and open-mindedness are essential personal characteristics when working together in such circumstances.

Strategic responses and behaviours from informants and perhaps from other team members may be inescapable, and may often be unconscious. For example, informants may emphasise values where they feel these may provide some benefit. Team members must learn to distinguish conflicts of interest from the problems of practicing science.

All team members, even local informants, can become more careless with fatigue. It is probably wiser to plan workdays as a series of short semi-independent data collection tasks that can be postponed or dropped if the team begins to tire and/ or the quality of work declines significantly.

Local informants - Community member availability for research activities can be highly seasonal. It is best to avoid the busiest agricultural periods and major festivals. The choice of informants can impact the quantity, quality and emphasis of the data recorded. Some informants have specialised knowledge. For example, an informant knowledgeable about medicinal plants is not necessarily knowledgeable about building boats. Some information may be considered 'sensitive' and may be hidden from outsiders, for example, we noted that most communities liked to deny or play down implications of intra-community conflict, even when this appeared self-evident.

Time of year and recent events probably affect informants' responses to questions of plant use and importance. For example, some of our work in Rian took place when they were short of rice, which appeared to influence their emphasis on food.

Some informants can dominate others. Some women we noted as unwilling to speak up or to publicly disagree with men. Working with Punan and Merap together sometimes reduced the volubility of the Punan and, we suspect, made them more unlikely to disclose certain kinds of information.

Our methods were sometimes confusing for local people, for instance why we recorded some plants and not others. Perhaps more detailed explanations would be useful.

Some plants, such young lianas, are difficult to identify for local informants.

Intellectual property rights are an issue. Residents in one community had been warned not to give any information on medicinal plants to strangers (though when they eventually understood and trusted our motives, they provided the information we needed).

Sampling and plot design - Plots can never cover the full range of sites found in nature. In our study, inaccessible sites are notably under-represented.

Our recording gave limited attention to shrubs, regeneration and treelets. This was a conscious choice, due to the difficulty of identifying them, but this potentially neglects community values. We also neglected fungi, epiphytes, lichens etc. as well as many classes of fauna, as this limited the crosschecking and taxonomic verification necessary. To some degree, this may not have been a problem given that the local population never included these in their lists of important products.

It should be noted that if there was only a single plant specimen, this was then taken as a herbarium collection sample and therefore there would be no sample to use in community triangulation exercises.

Language - Linguistic borrowing can make it difficult to determine from which ethnic group a name originates, and may lead one to mistakenly think that names that are currently in use should be substituted with older 'original' names. Underlying this problem is an assumption that there is a single correct name for each plant in each language. While triangulation is vital, researchers must accept that languages are dynamic and learn to be inclusive rather than exclusive in recording local names.

Incorrect attribution of uses of one group reported by another was a more serious concern in interviews with groups of mixed ethnicity.

The original series of value classes did not include a variety of reported uses. This is not a serious problem when sufficient data on each use is recorded, though some uses, such as ceremonial foods, seem to lie between classes. We carried out a series of exercises with the communities to assess what use belong to what class, and in most cases there is little disagreement.

There is some secrecy or embarrassment about certain uses/values. For example, to be seen as an 'eater of sago palm' is perceived by some local groups as embarrassing. In other cases some informants were hesitant to disclose medicinal uses. There might also be some 'secret information' that was not shared with us. Christianity has hindered discussion of some values of plants; one informant may dissuade another from talking about pre-Christian taboos, for example.

Reconciling local and scientific knowledge - Verification of the correlation between botanical and local plant names can be difficult as error or inconsistency can be ascribed to many different causes. When there is disagreement between local and botanical identification of an individual plant, special sensitivity is needed, as informants may feel uneasy about arguing their case and botanists may assume that there is no basis for argument. Variation in informant responses highlights the problematic nature of studying local knowledge. Similarly, the limited botanical collections and scientific expertise of many plant taxa highlights the difficulty of correlating knowledge systems.

Measuring Importance - A growing academic literature warns against the detailed interpretation of scoring-based studies of valuation. These studies serve as a rough gauge to identify patterns to be investigated further, not as a precise quantification of values. The more abstract exercises in particular are open to various interpretations that should be clarified by subsequent discussions with the informants.

We could have given more attention to 'negative' values – or the reasons why some taxa or land-types are avoided. While we do have some data on this, it seems clear, for example, that not all 'unvalued' plants are equal, some occur as weeds, some cause rashes, some harbour mosquitoes, etc. Similarly, living next to the forest has its own disadvantages (e.g. crop predation). Future evaluations could address these gaps.

Some non-animate objects, such as stones, minerals and water, were encountered that obviously do have value to local people, but are not fully included in our valuation exercises. Despite this we should be aware of their existence. The landscape is more than just the sum of its component species. For example salt springs are a significant draw for hunted animals.

Some items have multiple uses or occur in several value classes simultaneously. For instance, an item valued for hunting may produce food, which could be sold and could have ritual values. It is not always easy to assess the implications of such overlap.

The identification of species as having 'recreation value' and even 'value for the future' was hard to interpret both for informants and for interviewers. All species with high value presumably also have a future value, but perhaps others have a particular insurance value, as famine foods, for example. Some informants may see cultural values as having long-term significance. We recognised the difficulties this presented but decided to include the classes as exploratory and see what answers arose. Ultimately this proved more useful to the discussion than to the scoring results.

Since we have chosen to use a holistic definition of 'importance', our data cannot often distinguish what facets contribute to the importance of a species. There is no reason why this cannot be elicited also (as we did for local fish in a separate study where we asked which species were 1) most abundant in catches, 2) most eaten, and 3) most preferred). There is a profound difference between importance based on preference (in a theoretical world where everything is at hand) and availability (a more practical world that accounts for aspects of resource status, such as accessibility and the maturity of individuals).

Some informants may tend to dominate any group. Illiterate respondents were at a possible disadvantage when it came to reading the names on the cards, and we therefore made drawings on the cards as well.

General - We have identified species uses that cannot be replaced by other species but we have not asked if other forms of alternatives might substitute. Nor have we addressed the substitutability of sites or the reversibility of land use changes.

We have not found a totally satisfactory way of recording the 'accessibility' of resources/sites or assessing its importance in the valuation of the landscape. Efforts to collect resources vary a lot between people within a village, and depend on availability of transport, local conditions, product, and various rules and responsibilities.

In our study it was clear that the uncertainty regarding the future, and especially conflicts with powerful outside interests, made land preferences hard to gauge not only for us but also for community members themselves. Thus, we could argue the need for very clear hypothetical-future scenarios to try to elicit clearer values. Yet, as people are still making choices in the face of massive uncertainty, this context also needs to be addressed.

It would be useful to quantify and compare additional aspects that may play a role in landscape value. For instance history, culture, religion, and aesthetics. Heritage is very important in Western societies. What is the importance of heritage for forest communities?

Appendix III. Briefing note

It is important that all team members are able to provide consistent clear and honest answers to common questions. We drafted and circulated the following to ensure a common approach.

Catatan Mengenai Pertanyaan-Pertanyaan Umum tentang Hal yang Sedang Dikerjakan CIFOR.	**Some Notes on Commonly Asked Questions about What CIFOR is Doing.**
CIFOR merupakan sebuah organisasi penelitian yang tidak menghasilkan uang dengan membeli atau menjual apapun. Kami melakukan berbagai penelitian lain di banyak negara selain di sini. Kami tertarik tentang bagaimana masyarakat menggunakan hutan, dan bagaimana caranya agar arti penting hutan apapun selain menyediakan informasi yang lebih baik pada yang membutuhkan. Kami yakin bahwa beberapa dari yang kami lakukan suatu saat akan terbukti berguna dalam memberi informasi dan petunjuk tentang bagaimana seharusnya pemerintah dan organisasi lain melakukan perencanaan dan tindakan.	CIFOR is a research organisation, we do not make money by buying or selling anything. We do research in many countries, not just Indonesia. We are interested in how people use the forest, and how the values of the forest and the quality of the environment can be protected while also allowing local people to have improved living standards.
Uang yang digunakan CIFOR bukan milik kami. Aktifitas kami dibiayai oleh banyak negara seperti Jepang, USA, dan juga Indonesia, yang ingin untuk lebih mengetahui tentang wilayah Kalimantan khususnya bagian Malinau, Bulungan, serta ingin mendukung pembangunan yang lebih baik bagi masyarakat setempat dan lingkungan. Kami harus memberitahukan negara-negara dan pemerintahan tersebut tentang bagaimana kami menggunakan uangnya, dan mereka harus merasa puas dengan kegiatan yang dibiayainya atau mereka akan berhenti mendukung kita. Untuk alasan inilah CIFOR tidak dapat secara mudah memberikan uang saat diminta—meskipun alasannya bagus—mohon pengertian bahwa uang tersebut bukan uang kami yang dapat diberikan secara bebas.	Please do not expect too much from us. We do not have any power other than providing better information to those who require it. We believe that some of what we do may sometimes prove helpful in informing and guiding how the government and other organisations decide to plan and act. The money CIFOR spends is not ours. Our activities are paid for by many countries such as Japan and America as well as by Indonesia, that want to know more about this part of Kalimantan and want to promote development that is better for local people and the environment. We have to tell these countries and governments how we have spent their money, and they have to be satisfied that we are spending it for the agreed activities or they may stop supporting us. For this reason CIFOR cannot easily contribute when asked for money—even when the reason for request is clearly a good one—please understand that it is not our money to give freely.
Mungkin banyak pertanyaan dan aktifitas kami yang tampak aneh atau bahkan bodoh. Jika permintaan dan pertanyaan kami terasa terlalu berlebihan atau tidak beralasan, kami mohon maaf. Kami bersyukur terhadap toleransi dan pengertian anda.	Many of our questions and activities may appear strange or even foolish. When our demands and questions seem excessive or unreasonable, we ask for your forgiveness. We are grateful for your tolerance and understanding.
CIFOR berharap untuk dapat bekerja pada wilayah ini beberapa tahun lagi. Namun hal tersebut bergantung pada kemampuan kita untuk memperoleh dukungan dan dana yang berkelanjutan.	CIFOR hopes to work in this area for some years to come. But this will depend on our ability to gain support and continued funds.

Appendix IV. Datasheets used for community-based data collection

Appendix IV-a

Data Sheet 1: SETTLEMENT HISTORY & LAND USE *(SEJARAH PEMUKIMAN & PENGUNAAN LAHAN)*								
							Village Head/Traditional Leader	
Respondent			Date day\month\yr.				Inputted by	
Village			Booker				Checked by	
Checked by			Original or Copied?	O		C	File name	
Written on back	Y	N	This is page	1	of	1	Backups?	File copied?

Name *(Nama)*		**Gender *(Jenis kelamin)***	**M *(L)***	**F *(P)***
Age *(Umur)*		**Ethnic group *(Suku)***		

Question: Please tell us about the history of this village! If the village was moved from (an) earlier location(s), what was the reason to move and what was done with the old/abandoned settlement?

(Pertanyaan: *Tolong sebutkan sejarah pemukiman/desa ini! Alasan apa yang mendorong warga untuk pindah lokasi dan dipergunakan sebagai apa lokasi yang telah ditinggalkan tersebut?)*

No	**Name of place** *(Nama tempat)*	**Location** (*Lokasi*)	**Year of abandoning** *(Tahun ditinggalkan)*	**Reason for abandoning** *(Alasan ditinggalkan)*	**Present utilisation** *(Kegunaan sekarang)*

Appendix IV-b

Data Sheet 2: DISASTERS AND IMPORTANT EVENTS ***(BENCANA DAN KEJADIAN PENTING)*** ***Village Head/Traditional Leader***								
Respondent			Date day\month\yr.				Inputted by	
Village			Booker				Checked by	
Checked by			Original or Copied?	O		C	File name	
Written on back	Y	N	This is page	1	of	1	Backups?	File copied?

Name ***(Nama)***		**Gender** ***(Jenis kelamin)***	**M** ***(L)***	**F** ***(P)***
Age ***(Umur)***		**Ethnic group** ***(Suku)***		

Question: Please tell us when there have been important events for the village, causes thereof and special remarks if any! Tell us according to the sequence of the events.

(Pertanyaan: *Tolong sebutkan kejadian/peristiwa penting, penyebab dan tanda-tanda khusus bila ada! Sebutkan berdasarkan urutan waktu kejadiannya!)*

No	**Year** *(Tahun)*	**Disasters/important events** *(Bencana/kejadian penting)*	**Causes** *(Penyebab kejadian)*	**Special remarks** *(Tanda-tanda khusus)*

Appendix IV-c

Data Sheet 3: LAND AND FOREST TYPES *(JENIS LAHAN DAN HUTAN)*												*Community Meeting*
Participants		Group			Date day\month\yr.				Inputted by			
		Village (Language)			Checked by				Checked by			
		Facilitator			Original or Copied?	O		C	File name			
		Written on back	Y	N	This is page	1	of	1	Backups?		File copied?	

Question: Please tell us what land and forest types can be found in the village area, and where there are good examples of each of them!

(Pertanyaan: *Tolong sebutkan tipe-tipe lahan dan hutan yang terdapat di wilayah desa dan lokasi contoh yang baik dari masing-masing tipe!)*

No	Land and forest types (Local names) *Jənis lahan dan hutan (Nama Lokal)*	Location of example (Name of place and river) *Lokasi contohnya (Nama tempat dan sungai)*	No	Land and forest types (Local name) *Jenis lahan dan hutan (Nama lokal)*	Location of example (Name of place and river) *Lokasi contohnya (Nama tempat dan sungai)*

Appendix IV-d

Data Sheet 4: FOREST PRODUCTS ***(HASIL HUTAN)***											***Community Meeting***
Participants		Group			Date day\month\yr.					Inputted by	
		Village (Language)			Checked by					Checked by	
		Facilitator			Original or Copied?		O		C	File name	
		Written on back	Y	N	This is page	1	of	1		Backups?	File copied?

Question: Please tell us about forest products you know (local names), and the location(s) where they are collected!

(Pertanyaan: *Tolong sebutkan hasil-hasil hutan (nama lokal) yang Bapak/Ibu ketahui dan lokasi-lokasi pengambilannya!)*

No	**Forest products** (Local name) ***Jenis hasil hutan*** *(Nama lokal)*	**Location** (Place and river names) ***Lokasi pengambilan*** *(Nama tempat dan sungai)*	**No**	**Forest products** (Local name) ***Jenis hasil hutan*** *(Nama lokal)*	**Location** (Place and river names) ***Lokasi pengambilan*** *(Nama tempat dan sungai)*

Appendix IV-e

Data Sheet 5: DEMOGRAPHY ***(DEMOGRAFI)***								
							Household survey	
Respondent			Date day\month\yr.				Inputted by	
Village			Booker				Checked by	
Checked by			Original or Copied?	O		C	File name	
Written on back	Y	N	This is page	1	of	1	Backups?	File copied?

Household name ***(KK /nama)***		**Ethnic** ***(Suku)***		**Age of informant** ***(Umur)***	

Name *(Nama)*	**Family relationship** *(Hubungan keluarga)*	**Age** *(Umur)*	**Gender** *(Jenis kelamin)*	**Religion** *(Agama)*	**Ethnic group** *(Suku)*	**Education** *(Pendidikan terakhir)*	**Occupation/job** *(Pekerjaan)*	
							Primary *(Utama)*	**Secondary** *(Sampingan)*

Valuable goods/owned facilities *(Barang berharga/fasilitas yang dimiliki)*				**Remarks** *(Keterangan)*
Kind of goods *(Nama barang)*	**Number (unit)** *(Jumlah/satuan)*	**Year of buying** *(Tahun beli)*	**Price** *(Harga)*	
1. Electricity/generator *(Listrik/generator)*				
2. Television/parabola *(Televisi/parabola)*				
3. Tape/radio *(Kaset/radio)*				
4. Chainsaw *(Gergaji mesin)*				
5. Bicycle/motorbike *(Sepeda/motor)*				
6. Canoe engine *(Ketinting/tempel)*				
7. Canoe *(Perahu)*				
8. Sewing machine *(Mesin jahit)*				
9. Others *(Lainnya)*				
10.				
11.				
12.				
13.				
14.				
15.				

Appendix IV-f

Data Sheet 6: PDM LAND AND FOREST TYPES ***(PDM JENIS LAHAN DAN HUTAN)*** ***Key Informants-FGD/PDM***												
Respondent				Date day\month\yr.						Inputted by		
Village				Writer						Checked by		
Checked by				Interviewer						File name		
Written on back	Y	N	This is page	1	of	1	Original or copied?			O	C	Backups?	File copied?

Instruction *(Petunjuk)*:

(1) Among the following land/forest types on these cards, which one do you think is the most important? Please distribute 100 pebbles among the cards to express the importance! *(Di antara tipe-tipe lahan/hutan berikut mana yang paling penting menurut Bapak/Ibu? Silahkan bagikan 100 kerikil (biji-bijian) ke dalam kartu-kartu yang telah disediakan berdasarkan tingkat kepentingannya!)*

(2) For each of the use categories (food, medicine, …, the future) on the cards, which type of land/forest is the most important? Please distribute 100 pebbles among the cards based on importance of this category of use! *(Untuk setiap kategori guna berikut (makanan, obat-obatan, …, masa depan), tipe lahan/hutan mana yang paling penting menurut Bapak/Ibu? Silahkan bagikan 100 kerikil (biji-bijian) ke dalam kartu-kartu berdasarkan nilai kepentingan dari kategori guna ini!)*

	Overall *(Seluruh)*	**Food** *(Makanan)*	**Medicines** *(Obat-obatan)*	**Light construction** *(Konstruksi ringan)*	**Heavy construction** *(Konstruksi berat)*	**Boat construction** *(Konstruksi perahu)*	**Tools** *(Perkakas)*	**Firewood** *(Kayu bakar)*	**Basketry** *(Anyaman)*	**Ornament/tradit.** *(Hiasan/adat/ritual)*	**Marketable Items** *(Dijual)*	**Hunting function** *(Bahan berburu)*	**Hunting place** *(Tempat berburu)*	**Recreation** *(Rekreasi)*	**The future** *(Masa depan)*
Village *(Kampung)*															
Abandoned village *(Bekas kampung)*															
Garden *(Kebun)*															
River *(Sungai)*															
Swamp *(Rawa-rawa)*															
Current agriculture *(Ladang)*															
Young fallow *(Jekau muda)*															
Old Fallow *(Jekau tua)*															
Forest (*Hutan*)															
Total per use category *(Total per kategori guna)*= **100**															
Primary forest *(Hutan belum ditebang)*															
Logged over forest *(Hutan sudah ditebang)*															
Secondary forest *(Hutan bekas ladang)*															
Swamp forest *(Hutan rawa)*															
Mountain forest *(Hutan gunung)*															
Total per use category *(Total per guna)*= **100**															

Appendix IV-g

Data Sheet 7: PDM PAST-PRESENT-FUTURE ***(PDM MASA LAMPAU - MASA KINI - MASA DEPAN)*** ***Key Informants- FGD/PDM***											
Respondent			Date day\month\yr.				Inputted by				
Village			Writer				Checked by				
Checked by			Interviewer				File name				
Written on back	Y	N	This is page	1	of	1	Original or copied?	O	C	Backups?	File copied?

Instruction/*Petunjuk*:

(1) How important were/are/will be forest uses and values 30 years ago, at present, and in 20 years from now? Please distribute 100 pebbles among the cards based on the total importance of the forest at a particular time! *(Menurut pendapat Bapak/Ibu bagaimanakah kegunaan hutan pada saat 30 tahun yang lalu, sekarang, dan 20 tahun yang akan datang? Silahkan bagikan 100 kerikil (biji-bijian) yang ada ke dalam kartu-kartu yang tersedia berdasarkan kegunaan hutan pada waktu tertentu!)*

(2) How important were/are/will be forests at present, 30 years ago and in 20 years from now, per use category? Please distribute 100 pebbles among the use category cards, first for '30 years ago', then for 'present', and lastly for '20 years from now'! *(Seberapa penting hutan pada saat 30 tahun yang lalu, sekarang, dan 20 tahun yang akan datang untuk setiap kategori guna? Silahkan bagikan 100 kerikil (biji-bijian) yang ada pada kartu-kartu yang telah disediakan, pertama untuk '30 tahun yang lalu', kemudian untuk 'sekarang', dan yang terakhir untuk '20 tahun yang akan datang'!)*

	30 years ago *(30 tahun yang lalu)*	**Present** *(Sekarang)*	**20 years from now** *(20 tahun yang akan datang)*	**Total** *(Jumlah)* **=100**
Total importance *(Seluruh kegunaan)*				
Food *(Makanan)*				
Medicine *(Obat-obatan)*				
Light construction *(Konstruksi ringan)*				
Heavy construction *(Konstruksi berat)*				
Boat construction *(Konstruksi perahu)*				
Tools *(Perkakas/alat)*				
Firewood *(Kayu bakar)*				
Basketry *(Anyaman/tali)*				
Ornament/tradition/ritual *(Hiasan/adat/ritual)*				
Marketable products/ *(Dijual)*				
Hunting function/ *(Bahan berburu)*				
Hunting place *(Tempat berburu)*				
Recreation *(Rekreasi)*				
The future *(Masa depan)*				
Total per time *(Total per waktu)* **=100**				

Appendix IV-h

Data Sheet 8: PDM DISTANCE OF LAND & FOREST TYPES ***(PDM JARAK UNTUK JENIS LAHAN & HUTAN)*** ***Key Informants-FGD/PDM***												
Respondent			Date day\month\yr.						Inputted by			
Village			Writer						Checked by			
Checked by			Interviewer						File name			
Written on back	Y	N	This is page	1	of	1	Original or copied?		O	C	Backups?	File copied?

Instruction: Compare the importance of 'one unit of' the different land types on the cards (you can think of 'one unit of land' as the size of a football field)! Do this twice: the first time assume that the land can be reached from the village on foot in one hour, the second time in 4 hours. Please distribute 100 pebbles among the available cards for each type of land according to their importance!

(Petunjuk: *Untuk luasan yang sama (misalnya seluas lapangan sepakbola), bandingkan kegunaan dari masing-masing jenis lahan yang tercantum didalam kartu-kartu. Lakukan ini dua kali: pertama, bayangkan apabila lahan-lahan tersebut terletak 1 jam dari kampung; kedua, apabila terletak 4 jam dari kampung. Bagikan 100 biji di antara kartu-kartu yang tersedia untuk setiap jenis lahan. Lahan yang bernilai lebih tinggi mendapat biji yang lebih banyak.)*

Name of respondent *Nama Responden*																
Age *Umur*																
Ethnic group *Suku*																
Gender (M/F) *Jenis Kelamin (L/P)*																
1 Hour Walk *(1 Jam tempuh)*																
Abandoned village *Bekas kampung*																
Garden *Kebun*																
Swamp *Rawa-rawa*																
Current agriculture *Ladang*																
Young fallow *Jekau muda*																
Old fallow *Jekau tua*																
Forest *Hutan*																
Total per person =100 *Total perorang*																
4 Hours Walk *(4 Jam tempuh)*																
Abandoned village *Bekas kampung*																
Garden *Kebun*																
Swamp *Rawa-rawa*																
Current agriculture *Ladang*																
Young fallow *Jekau muda*																
Old Fallow *Jekau tua*																
Forest *Hutan*																
Total per person =100 *Total perorang*																

Appendix IV-i

Data Sheet 9: PDM SOURCES OF PRODUCTS ***(PDM SUMBER BARANG YANG DIGUNAKAN)*** ***Key Informants-FGD/PDM***												
Respondent			Date day\month\yr.							Inputted by		
Village			Writer							Checked by		
Checked by			Interviewer							File name		
Written on back	Y	N	This is page	1	of	1	Original or Copied?	O	C	Backups?	File Copied?	

Instruction: Compare the different sources of plant and animal products on the cards; wild from the forest or not from the forest, cultivated or purchased, which one is the most important to you? Please distribute 100 pebbles among the cards according to their importance!

(***Petunjuk:*** *Bandingkan berbagai sumber dari produk tumbuhan dan binatang yang ada pada kartu-kartu. Mana yang Bapak/Ibu anggap paling penting: yang liar dari hutan, liar bukan dari hutan, ditanam/dipelihara atau dibeli? Silahkan bagikan 100 kerikil (biji-bijian) yang ada ke dalam kartu-kartu yang telah disediakan menurut nilai kepentingannya!)*

Name of respondent *Nama responden*																		
Age *Umur*																		
Ethnic group *Suku*																		
Sex (M/F) *Jenis kelamin (L/P)*																		
Wild plant from forest *Tumbuhan liar dari hutan*																		
Wild plant, not from forest *Tumbuhan liar bukan dari hutan*																		
Cultivated plant *Tumbuhan ditanam*																		
Purchased plant *Tumbuhan dibeli*																		
Wild animal from forest *Hewan liar dari hutan*																		
Wild animal not from forest *Hewan liar bukan dari hutan*																		
Farmed (domestic) animal *Hewan dipelihara*																		
Purchased animal *Hewan dibeli*																		
Total per person =100 *Total perorang*																		

Appendix IV-j

Data sheet 10: PDM MOST IMPORTANT SPECIES PER USE CATEGORY ***(PDM SPESIES TERPENTING PER KATEGORI GUNA)*** ***Key Informants – FGD/PDM***											
Respondent			Date day\month\yr.						Inputted by		
Village			Writer						Checked by		
Checked by			Interviewer						File name		
Written on back	Y	N	This is page	1	of	4	Original or Copied?	O	C	Backups?	File copied?

Instruction:

(1) Compare the importance of the use categories on the cards (food, medicine, …., the future), and distribute 100 pebbles among them to express that importance!
(2) Secondly, list the forest products you think are the most important in each use category (agree on up to ten) and
(3) Distribute 100 pebbles again to express the relative importance of each of the products (separately for each use category)
(4) Lastly indicate in 'remaining' how important the remaining unlisted species are compared to the ones listed in this scale (sum of all those listed already = 100)

(Petunjuk:

(1) *Bandingkan kepentingan dari berbagai kategori guna yang tercantum di kartu-kartu (makanan, obat-obatan, …, masa depan), dan bagikan 100 kerikil (biji-bijian) di atas kartu-kartu tersebut menurut nilai kepentingannya.*
(2) *Selanjutnya, susun jenis hasil hutan yang paling penting dalam setiap kategori guna menurut Bapak/Ibu (paling banyak 10) dan*
(3) *Bagikan lagi 100 kerikil (biji-bijian) untuk menunjukkan kepentingan relatif dari masing-masing produk tersebut (terpisah untuk setiap kategori guna).*
(4) Terakhir, nyatakan di dalam "Tersisa" bagaimana pentingnya bagian yang tersisa dari species yang tidak terdaftar dibandingkan dengan yang terdaftar (yang jumlahnya 100).

This form has 4 pages

	Use category *(Kategori guna)*														
	Food *(Makanan)*	**Medicine** *(Obat-obatan)*	**Light construction** *(Kontruksi ringan)*	**Heavy construction** *(Konstruksi berat)*	**Boat construction** *(Konstruksi perahu)*	**Tools** *(Perkakas)*	**Firewood** *(Kayu bakar)*	**Basketry** *(Anyaman)*	**Ornament/trad/Ritual** *(Hiasan/adat/ritual)*	**Marketable items** *(Benda yang bisa dijual)*	**Hunting function** *(Sarana berburu)*	**Hunting place** *(Tempat berburu)*	**Recreation** *(Rekreasi)*	**The future** *(Masa depan)*	**Total PDM = 100** *(Total pdm)*
General PDM															

Data sheet 10: PDM MOST IMPORTANT SPECIES PER USE CATEGORY ***(PDM SPESIES TERPENTING PER KATEGORI GUNA)*** ***Key Informants – FGD/PDM***											
Respondent			Date day\month\yr.						Inputted by		
Village			Writer						Checked by		
Checked by			Interviewer						File name		
Written on back	Y	N	This is page	2	of	4	Original or Copied?	O	C	Backups?	File copied?

Instruction 2, 3 and 4 *(Petunjuk 2, 3 dan 4)*

	General pdm *(pdm umum)*			**Total pdm=100** *(Total pdm)*		**General pdm** *(pdm umum)*			**Total pdm=100** *(Total pdm)*		**General pdm** *(pdm umum)*		**General pdm** *(pdm umum)*		**Genaral pdm** *(pdm umum)*
Food *(makanan)*					**Medicine** *(obat-obatan)*					**Light construction** *(Konstruksi ringan)*		**Heavy construction** *(Konstruksi berat)*		**Boat construction** *(Konstruksi perahu)*	
Plants *(Tumbuhan)*		**Animals** *(Binatang)*			**Plants** *(Tumbuhan)*		**Animals** *(Binatang)*								
Plant names *(Nama tumbuhan)*	pdm	Animal names *(Nama binatang)*	pdm		Plant names *(Nama tumbuhan)*	pdm	Animal names *(Nama binatang)*	pdm		Plant names *(Nama tumbuhan)*	pdm	Plant names *(Nama tumbuhan)*	pdm	Plant names *(Nama tumbuhan)*	pdm
Total pdm =100?															
Remaining *(Tersisa)*		Remaining *(Tersisa)*			Remaining *(Tersisa)*		Remaining *(Tersisa)*			Remaining *(Tersisa)*		Remaining *(Tersisa)*		Remaining *(Tersisa)*	

Data sheet 10: PDM MOST IMPORTANT SPECIES PER USE CATEGORY ***(PDM SPESIES TERPENTING PER KATEGORI GUNA)*** ***Key Informants – FGD/PDM***												
Respondent				Date day\month\yr.							Inputted by	
Village				Writer							Checked by	
Checked by				Interviewer							File name	
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Instruction 2, 3 and 4 *(Petunjuk 2, 3 dan 4)*

	General pdm *(pdm umum)*			**Total pdm=100** *(Total pdm)*		**General pdm** *(pdm umum)*			**General pdm** *(pdm umum)*			**Total pdm=100** *(Total pdm)*		**General pdm** *(pdm umum)*			**Total pdm=100** *(Total pdm)*
Tools *(Perkakas)*					**Firewood** *(Kayu bakar)*			**Basketry** *(Anyaman)*					**Ornaments/ritual** *(Hiasan)*				
Plants *(Tumbuhan)*		**Animals** *(Binatang)*			**Plants** *(Tumbuhan)*			**Plants** *(Tumbuhan)*			**Animals** *(Binatang)*		**Plants** *(Tumbuhan)*		**Animals** *(Binatang)*		
Plant names *(Nama tumbuhan)*	pdm	Animal names *(Nama binatang)*	pdm		Plant names *(Nama tumbuhan)*	pdm		Plant names *(Nama tumbuhan)*	pdm		Animal names *(Nama binatang)*	pdm	Plant names *(Nama tumbuhan)*	pdm	Animal names *(Nama binatang)*	pdm	
Total pdm =100?																	
Remaining *(Tersisa)*		Remaining *(Tersisa)*			Remaining *(Tersisa)*			Remaining *(Tersisa)*			Remaining *(Tersisa)*		Remaining *(Tersisa)*		Remaining *(Tersisa)*		

Data sheet 10: PDM MOST IMPORTANT SPECIES PER USE CATEGORY ***(PDM SPESIES TERPENTING PER KATEGORI GUNA)*** ***Key Informants – FGD/PDM***											
Respondent				Date day\month\yr.						Inputted by	
Village				Writer						Checked by	
Checked by				Interviewer						File name	
Written on back	Y	N	This is page	4	of	4	Original or Copied?	O	C	Backups?	File copied?

Instruction 2, 3 and 4 *(Petunjuk 2, 3 dan 4)*

	General pdm *(pdm umum)*			**Total pdm=100** *(Total pdm)*		**General pdm** *(pdm umum)*			**Total pdm=100** *(Total pdm)*		**General pdm** *(pdm umum)*			**Total pdm=100** *(Total pdm)*		**General pdm** *(pdm umum)*		**General pdm** *(pdm umum)*	**sum=100**
Marketable prod. *(Benda yang bisa dijual)*					**Hunting function** *(Sarana berburu)*					**Hunting place** *(Tempat berburu)*					**Recreation** *(Rekreasi)*		**Future** *(Masa depan)*		
Plants *(Tumbuhan)*		**Animals** *(Binatang)*			**Plants** *(Tumbuhan)*		**Animals** *(Binatang)*			**Plants** *(Tumbuhan)*		**Animals** *(Binatang)*							
Plant names *(Nama tumbuhan)*	pdm	Animal names *(Nama binatang)*	pdm		Plant names *(Nama tumbuhan)*	pdm	Animal names *(Nama binatang)*	pdm		Plant names *(Nama tumbuhan)*	pdm	Animal names *(Nama binatang)*	pdm						
Total pdm =100?																			
Remaining *(Tersisa)*		Remaining *(Tersisa)*			Remaining *(Tersisa)*		Remaining *(Tersisa)*			Remaining *(Tersisa)*		Remaining *(Tersisa)*							

Appendix IV-k

Questionnaire 1.										***Interview-Village Head***	
VILLAGE DESCRIPTION/PERSPECTIVE OF LAND USE *(DESKRIPSI DESA / PERSPEKTIF PENGGUNAAN LAHAN)*											
Respondent				Date day\month\yr.						Inputted by	
Village				Writer						Checked by	
Checked by				Interviewer						File name	
Written on back	Y	N	This is page	1	of	2	Original or copied?	O	C	Backups?	File copied?

No.	Questions *(Pertanvaan)*	Answers *(Jawaban)*
	I. Village description *(Deskripsi desa)*	
1.	Since when has this village exist and when was it formally acknowledged by government? *Sejak kapan desa ini berdiri dan kapan disahkan pemerintah (definitif).*	
2.	What is the area of the village? What does it border on? *Berapakah luas wilayah desa? Sebutkan batas-batas wilayahnya!*	a. Area *(Luas)* ……..
		b. Borders *(Batas-batas)* -North *(Utara)* …… -East *(Timur)* ……..……..…… -South *(Selatan)* ……..……..…… -West *(Barat)* ……..……..……
3.	What is the area of forest land, garden, ladang (swidden), swamp, settlement, and others? *Berapa luas kawasan hutan, kebun, ladang, rawa, pemukiman dan lain-lain!*	a. Forest area *(Luas hutan)*: ……..……..….
		b. Swidden area *(Luas ladang)*: ……..…….
		c. Garden (*Luas kebun)*:…….
		d. Settlement *(Luas pemukiman)*:……..…….
		e. Others *(Luas lain-lain)*:……..……
4.	What is the population of the village? *Berapa jumlah penduduk desa?*	……people *(Jiwa)*
		……..…….. households *(KK)*
5.	What ethnic groups are living in the village? List from the most to the least numerous. *Sebutkan suku-suku yang terdapat di desa ini dan urutkan mulai dari yang banyak penduduknya.*	
	II. Land use *(Guna lahan)*	
1.	Where do the villagers usually go for swidden cultivation; forest product gathering, gardening, and recreation (attractive places)? *Sebutkan tempat-tempat yang biasa didatangi penduduk desa untuk berladang, mencari hasil hutan, berkebun, berekreasi (tempat-tempat yang menarik).*	a. Swidden cultivation *(Berladang):*
		b. Forest product gathering/hunting *(Mencari hasil hutan/berburu):*
		c. Gardening *(Berkebun):*
		d. Fishing *(Mencari ikan):*
		e. Recreation *(Rekreasi) :*

Questionnaire 1.											***Interview-Village Head***
VILLAGE DESCRIPTION/PERSPECTIVE OF LAND USE *(DESKRIPSI DESA / PERSPEKTIF PENGGUNAAN LAHAN)*											
Respondent				Date day\month\yr.						Inputted by	
Village				Writer						Checked by	
Checked by				Interviewer						File name	
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2.	Is there any plan of land conversion in the village? For example: for transmigration, mining, plantation or others? If yes, where is the location? *Apakah ada rencana-rencana untuk pengalihan fungsi lahan di desa? Misalnya untuk transmigrasi, pertambangan, perkebunan, dan lain-lain? Bila ya, dimana lokasinya?*	a. If no, what is the reason? *(Kalau tidak ada, apa alasannya?)* b. If yes, what is the land for? *(Ada, lahan untuk?):* 1. Mining (Where?) *(Pertambangan; dimana?):* 2. Plantation (Where?) *(Perkebunan; dimana?):* 3. Agriculture (Where?) *(Pertanian; dimana?):* 4. Settlement/transmigration (Where?): *(Pemukiman/transmigrasi; dimana?):* 5. Others (Where?): *Lainnya (sebutkan dimana?):*
3.	Are there any changes in the area of the forest utilized by the villagers from year to year? *Apakah ada perubahan luasan hutan yang dimanfaatkan oleh masyarakat desa dari tahun ke tahun?*	a. Increase (What for?) *(Bertambah digunakan; untuk?):* b. Decrease (What for?) *(Berkurang digunakan; untuk?):* c. No change *(Tidak berubah digunakan)*
4.	Are there any changes in village rules concerning forest utilisation? *Apakah ada perubahan aturan desa tentang pemanfaatan lahan hutan?*	a. No change, for…? *(Tidak berubah, untuk…?):* b. Getting stricter, for…? *(Menjadi lebih ketat, untuk…?):* c. More flexible, for…? (*Menjadi lebih longgar, untuk…?):*
5.	Is it getting more difficult to utilize/obtain a new forest area? *Apakah saat ini mulai/sudah sulit menggunakan/mendapatkan areal hutan yang baru?*	a. More difficult *(Menjadi lebih sulit):* b. Easier *(Lebih mudah):* c. No change *(Tidak berubah):*

Appendix IV-I

Questionnaire 2. ***Interview-Traditional Leader*** **CULTURAL BACKGROUND OF LAND USE *(LATAR BELAKANG KULTURAL PENGGUNAAN LAHAN)***												
Respondent				Date day\month\yr.						Inputted by		
Village				Writer						Checked by		
Checked by				Interviewer						File name		
Written on back	Y	N	This is page	1	of	2	Original or Copied?	O	C	Backups?	File copied?	

No.	Questions *(Pertanyaan)*	Answers *(Jawaban)*
	I. General description of traditional community *(Gambaran umum masyarakat adat)*	
1.	Describe briefly the history of the traditional community of this village! *Bagaimana asal usul masyarakat adat yang ada di desa ini? Uraikan!*	
2.	Are the traditional rules and institutions still functioning significantly here? *Apakah peraturan dan kelembagaan adat masih berfungsi tinggi di sini?*	No; reasons *(Tidak, alasan):* Yes; examples *(Ya, sebutkan contohnya):*
3.	How long will the traditional rules be valid and what are the reasons? *Sampai kapan aturan adat ini akan diberlakukan dan apa alasannya?*	
4.	To whom do the traditional rules apply and how are they maintained? *Kepada siapa aturan adat berlaku dan bagaimana upaya melestarikan aturan adat tersebut?*	a. Insiders *(Orang dalam):* b. Outsiders *(Orang luar):* c. Measures *(Upaya):*
	II. Traditional rules and regulations (*Norma dan peraturan adat)*	
1.	Are there any places traditionally protected from disturbance (e.g. sacred places or traditional land/forest)? If yes, please name them! *Apakah ada tempat-tempat yang secara adat dilindungi atau tidak boleh diganggu (misalnya tempat keramat atau tanah/hutan adat)? Bila ya, sebutkan!*	
2.	Why are those places protected? *Mengapa tempat-tempat tersebut dilindungi?*	
3.	Are there any traditional rules used for protecting the forest? *Apakah ada peraturan adat yang dipakai untuk melindungi hutan?*	

Questionnaire 2. ***Interview-Traditional Leader*** **CULTURAL BACKGROUND OF LAND USE *(LATAR BELAKANG KULTURAL PENGGUNAAN LAHAN)***												
Respondent				Date day\month\yr.						Inputted by		
Village				Writer						Checked by		
Checked by				Interviewer						File name		
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4.	What traditional sanctions are imposed on people who damage the forests? *Sanksi-sanksi adat apa yang dikenakan bila seseorang merusak hutan?*	
5.	Are there any changes in the area of the forest being utilized? *Apakah ada perubahan luasan hutan yang dimanfaatkan?*	*a.* Increase (What for?) (*Bertambah; digunakan untuk...?):* *b.* Decrease (What for?) (*Berkurang; digunakan untuk...?):* *c.* No change (What for?) (*Tidak berubah; digunakan untuk…?):*
6.	Are there any changes in the traditional rules concerning forest land–uses? *Apakah ada perubahan aturan adat dalam pemanfaatan lahan hutan?*	*a.* No change (What for?) *(Tidak berubah, untuk...?):* *b.* Becomes stricter (What for?) *(Menjadi lebih ketat, untuk...?):* *c.* Becomes more flexible (What for?) (*Menjadi lebih longgar, untuk...?)*
7.	Is it difficult to use/find new forest area? *Apakah sulit untuk menggunakan/ mendapatkan areal hutan yang baru?*	*a.* More difficult (Why?) (*Menjadi lebih sulit, karena... ?):* *b.* Easier (Why?) *(Lebih mudah, karena...?):* *c.* No change (Why?) *(Tidak berubah, karena...?):*

Appendix IV-m

Questionnaire 3. **PRICE OF TRADED GOODS *(HARGA JUAL BARANG)***										***Interview Informants – 3–5 shop keepers***	
Respondent				Date day\month\yr.						Inputted by	
Village				Writer						Checked by	
Checked by				Interviewer						File name	
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Questions *(Pertanyaan)*	**Answers** *(Jawaban)*		
What are the prices of following goods/products*? (Berapa harga jual barang/produk berikut?)*	**Unit** *(Satuan)*	**Price (Rp)** *(Harga)*	**Remarks** *(Keterangan)*
1) Rice *(Padi)*			
2) Flour *(Tepung)*			
3) Cooking oil *(Minyak sayur)*			
4) Kerosene *(Minyak tanah)*			
5) Sugar *(Gula)*			
6) Salty fish *(Ikan asin)*			
7) Cloth *(Kain)*			
8) Tea (*Teh)*			
9) Coffee *(Kopi)*			
10) Gasoline *(Bensin)*			
11) Diesel fuel *(Solar)*			
12) Instant noodle *(Mie instan)*			
13) Sardines *(Sarden)*			
14) Battery (size D – big) *(Batere ukuran D-besar)*			
15) Soap *(Sabun mandi)*			
16) Washing soap/Detergent *(Sabun cuci/deterjen)*			
17) Cigarettes *(Rokok)*			
18) Medicines *(Obat-obatan)*			
•			
•			
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Appendix IV-n

Questionnaire 4. **HOUSEHOLD SURVEY** ***(SURVEI RUMAH TANGGA)***												***HH Survey-minimum 30 households/village***
Respondent				Date day\month\yr.						Inputted by		
Village				Writer						Checked by		
Checked by				Interviewer						File name		
Written on back	Y	N	This is page	1	of	3	Original or Copied?	O	C	Backups?	File copied?	

HH no./name *(KK No./nama)*		**Ethnic group** *(Suku)*		**Age** *(Umur)*	

No.	**Questions** *(Pertanyaan)*	**Answers** *(Jawaban)*
A. Dangers/threats of human activities to forest *(Bahaya/ancaman kegiatan manusia bagi SDH lokal)*		
1.	According to Bapak/Ibu which human activities can disturb the sustainability of forest functions and benefits to local communities? Why? *Menurut Bapak/Ibu ancaman kegiatan manusia apa saja yang dapat mengganggu kelestarian dari fungsi dan manfaat hutan bagi masyarakat lokal? Mengapa?*	
2.	Could you please list them based on their degree of danger? *Tolong Bapak/Ibu urutkan berdasarkan tingkat bahayanya.*	
3.	Beside dangers and threats are there also some advantages/benefits from those human activities? Please explain. *Disamping bahaya/ancaman apakah ada pula keuntungan/manfaat dari aktivitas manusia yang Bapak/Ibu sebutkan tadi? (selain kerugian barangkali ada keuntungannya pula!)*	
B. Perceptions of local communities on dangers/threats *(Persepsi masyarakat tentang bahaya)*		
1.	What threats are very dangerous for human life in this village, according to Bapak/Ibu? (e.g. natural disasters, hunger, pests, always changing government regulations, etc.) *Ancaman apa saja yang menurut Bapak/Ibu membahayakan kehidupan di desa ini? (Misalnya bencana alam, kelaparan, banjir, penyakit menular, peraturan pemerintah yang berubah, dll.)*	
2.	Please, make a priority list of above threats based on their degree of danger, according to Bapak/Ibu. *Tolong diurutkan ancaman yang disebutkan diatas dari yang paling berbahaya menurut Bapak/Ibu.*	
3.	What do you (Bapak/Ibu) do to prevent or to reduce those dangers/threats? *Apa saja yang Bapak/Ibu lakukan untuk mencegah atau mengurangi bahaya tersebut?*	
4.	If you (Bapak/Ibu) are being informed that those dangers/threats will come soon, what do you do? *Jika Bapak/Ibu diberitahu bahwa bencana tersebut akan datang segera, apa yang Bapak/Ibu lakukan?*	

Questionnaire 4. **HOUSEHOLD SURVEY *(SURVEI RUMAH TANGGA)***												***HH Survey-minimum 30 households/village***
Respondent				Date day\month\yr.						Inputted by		
Village				Writer						Checked by		
Checked by				Interviewer						File name		
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C. Sources of income (*Sumber pendapatan*)		
1.	Where does your income come from, besides from forest and ladang? *Dari mana saja sumber penghasilan Bapak/Ibu selain dari hutan dan ladang?*	
2.	How big is your income? (Note: according to local unit/value, which will be converted later into Rp/month) *Berapa besar jumlahnya? (Catatan: Sesuai nilai lokal, kemudian dikonversikan nantinya ke Rp/bulan)*	
3.	Are there any other household members, who work and earn money? If 'yes', who, what job, how much do they earn? *Apakah ada anggota keluarga lainnya yang bekerja dan menghasilkan uang? Bila ya, siapa dan apa pekerjaannya, dan berapa besar penghasilannya sebulan?*	
D. Taboos and restrictions (*Tabu dan pantangan)*		
1.	Are there any restrictions, beliefs, or traditional norms used, especially concerning utilization of plants, animals, and other forest products? If 'yes', please explain. *Apakah di kalangan masyarakat di sini masih ada pantangan, kepercayaan, atau aturan adat khusus yang masih diberlakukan dalam menggunakan tumbuhan, binatang dan memanfaatkan hasil/hutan lainnya? Jika ya, jelaskan!*	
2.	Are there any restrictions, beliefs, or special traditional norms implemented concerning land and forest clearing? *Apakah ada pantangan, kepercayaan, atau aturan adat khusus yang masih diberlakukan dalam membuka atau menggunakan lahan ataupun lokasi hutan tertentu?*	
E. Aspiration of local community *(Aspirasi masyarakat lokal)*		
1.	Is your (Bapak/Ibu) life better than five/ten years ago? Why? *Apakah kehidupan Bapak/Ibu sekarang lebih baik dari pada lima/sepuluh tahun yang lalu? Mengapa?*	
2.	What future do you hope for your children/young generation? *Apa yang Bapak/Ibu harapkan terhadap anak-anak/ generasi muda di masa depan?*	

Questionnaire 4. **HOUSEHOLD SURVEY *(SURVEI RUMAH TANGGA)***												***HH Survey-minimum 30 households/village***
Respondent				Date day\month\yr.						Inputted by		
Village				Writer						Checked by		
Checked by				Interviewer						File name		
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3.	What do you expect/predict will happen in your village in the next few months/years? *Apa yang Bapak/Ibu harapkan dan perkirakan akan terjadi pada desa ini beberapa bulan/tahun mendatang?*	
4.	In case the forest is degraded or disappears, what are you (Bapak/Ibu) going to do? *Seandainya hutan ini berkurang atau habis, apa yang akan Bapak/Ibu lakukan? Bagaimana caranya agar hutan ini tidak musnah?*	
5.	Is there any species of plants or animal which may play an important role in protecting and maintaining forest functions and benefits? If there is, please explain! *Apakah ada jenis tanaman atau binatang yang dianggap penting untuk perlindungan dan pemeliharaan fungsi dari manfaat hutan? Jika ada, apa saja dan mengapa?*	
6.	If someone wants to know something about the forest (plants, animals, and specific areas), who among the villagers is able to explain it? (note: at least five persons) *Jika ingin belajar atau mengetahui 'tentang hutan' (tumbuhan, binatang dan lokasi-lokasi tertentu) siapa orang-orang di desa ini yang banyak memiliki pengetahuan tersebut? (Catatan: minimal lima orang)*	

Appendix IV-o

Questionnaire 5.											***Interview-Key Informants (3-5 persons)***	
TRADITIONAL KNOWLEDGE ON LAND USE *(PENGETAHUAN TRADISIONAL TENTANG PENGGUNAAN LAHAN)*												
Respondent				Date day\month\yr.							Inputted by	
Village				Writer							Checked by	
Checked by				Interviewer							File name	
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Land use/management (*penggunaan/ pengelolaan lahan)*		
1.	What names do you have for different soils/lands in wetland-paddy/tree-crop farming/ladang etc surrounding the village? What are these names based on? (location/soil texture/colour/forms/others) *Apa sebutan yang Bapak/Ibu berikan untuk macam-macam tanah/lahan di sawah/kebun/ ladang di sekitar desa ini? Berdasarkan apa penyebutan dan pengelompokan tersebut? (Lokasi/tekstur tanah/warna/bentuk/lainnya)*	a. b. c. d. e.
2.	According to you (Bapak/Ibu) what is the most suitable use of each land location? (e.g. farming, pasture, fish culture, etc.) *Menurut Bapak/Ibu penggunaan sebagai apakah yang paling cocok untuk masing-masing lokasi tersebut? (Bercocok tanam, beternak, memelihara ikan, lainnya …)*	a. b. c. d. e.
3.	What management is needed to use those lands? (burning, weeding, cutting, hoeing or ploughing, fertilizing, others...) *Bagaimana cara mengolah lahan tersebut? (Dibakar, ditebas, ditebang, dibajak, dipupuk, lainnya …)*	a. Burning *(Dibakar)*: b. Weeding *(Ditebas)*: c. Cutting *(Ditebang)*: d. Hoeing or ploughing *(Dibajak)*: e. Fertilizing *(Dipupuk):*
4.	According to you, is the management of your land easy or difficult? If difficult, how do you overcome the problems? *Menurut Bapak/Ibu berat atau ringankah pengolahan lahan yang harus dilakukan? Jika berat bagaimana cara mengatasinya?*	a. Fertilizing *(Dipupuk)*: b. Fallowing *(Diberakan)*: c. Other *(Lainnya)*:
5.	a. How fertile are your lands? b. What consideration was your statement based on? (soil colour, texture, slope, surrounding vegetation, compactness, others…) c. If not fertile, how do you overcome that problem? *a. Seberapa suburkah lahan Bapak/Ibu?* *b. Berdasar apakah pernyataan tersebut? (Warna, butiran tanah, lereng, vegetasi, kepadatan, lainnya …)* *c. Jika tidak, bagaimana mengatasinya?*	a. Very fertile Fertile Moderate Not fertile b. Colour *(Warna)* Texture (*Tekstur tanah)* Slope *(Lereng)* Vegetation *(Tumbuhan)* Compactness *(Kepadatan*) Other *(Lainnya):*..... c.
6.	Do you know where there are fertile soils near this village? Please give us the names of the location(s). A*pakah Bapak/Ibu mengetahui lokasi yang subur di wilayah desa ini? Jika ya, dimana tempatnya?*	a. b. c. d.

Appendix IV-p

Questionnaire 6. ***Interview-Key Informants (3-5 Persons/Ethnic)*** **FOREST PRODUCT COLLECTION AND SALE *(PENGUMPULAN DAN PENJUALAN HASIL HUTAN)***												
Respondent				Date day\month\yr.							Inputted by	
Village				Writer							Checked by	
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Name *(Nama)*		**Ethnic group** *(Suku)*		**Age** *(Umur)*	

No.	**Questions** *(Pertanyaan)*	**Answers** *(Jawaban)*
1.	What forest products do you mostly /usually get? *Hasil hutan apa yang paling sering/biasa Bapak/Ibu ambil dari hutan?*	
2.	When do you usually get the best forest products? *Kapan Bapak/Ibu biasanya mendapatkan hasil hutan yang terbaik?*	
3.	Where do you usually get the best forest products? *Di mana Bapak/Ibu biasanya mendapatkan hasil hutan tersebut?*	
4.	Are there any changes in a) location and b) quantity of forest products that you usually collect? *Apakah ada perubahan lokasi dan jumlah hasil hutan yang biasa Bapak/Ibu peroleh?*	a) Changing location, previously in *(Tempat/lokasi berubah, dulu di daerah):* ..... Now in *(sekarang di daerah)*..... Permanent place/location, in *(Tempat/lokasi tetap, di daerah)*:..... ..... b) Increased quantity *(Jumlah bertambah):* ..... Decreased quantity *(Jumlah berkurang)*:..... No change *(Tidak berubah)*:.....

Questionnaire 6. ***Interview- Key Informants (3-5 Persons/Ethnic)*** **FOREST PRODUCT COLLECTION AND SALE *(PENGUMPULAN DAN PENJUALAN HASIL HUTAN)***											
Respondent				Date day\month\yr.						Inputted by	
Village				Writer						Checked by	
Checked by				Interviewer						File name	
Written on back	Y	N	This is page	2	of	2	Original or Copied?	O	C	Backups?	File copied?

Continued from page 1

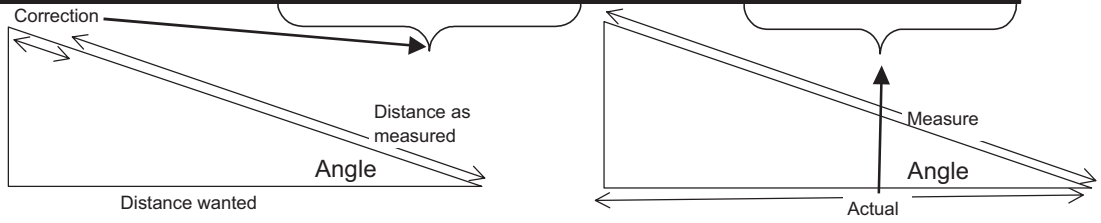
	Prices *(harga)*			
5.	What are the selling prices of the following products from ladang/ garden/forest? *Berapa harga jual dari hasil ladang/kebun/hutan?*	**Unit** *(Satuan)*	**Prices (Rp)** *(Harga (Rp))*	**Remarks** *(Keterangan)*
	Rattan *(Rotan)*			
	Aloe Wood *(Gaharu)*			
	Damar *(Damar)*			
	Hard construction timber *(Kayu konstruksi berat)*			
	Others (please name) Lain-lain *(sebutkan)*			
6.	Please list ten important products, which are easily sold! *Tolong diurutkan sepuluh barang/produk yang paling mudah dijual.*	(1)		
		(2)		
		(3)		
		(4)		
		(5)		
		(6)		
		(7)		
		(8)		
		(9)		
		(10)		

Appendix V. Slope correction table

Slope correction table for measures taken at a given angle.

Based on Cosine of slope % correction =100(1/Cos(slope) -1) Horizontal = distance x Cos (slope)

SLOPE		*Correction % on slope*	Add to 4m along slope	Add to 20m along slope	Add to 40m along slope	Slope is fraction of horizontal	sloping 4m	sloping 20m	sloping 40m
Degrees	**%**	**%**	**m**	**m**	**m**	Fraction = Cos [slope]	= horizontal m	= horizontal m	= horizontal m
5	*8.75*	**0.38**	0.02	0.08	**0.15**	0.996	3.98	19.92	39.85
10	*17.63*	**1.54**	0.06	0.31	**0.62**	0.985	3.94	19.70	39.39
15	*26.79*	**3.53**	0.14	0.71	**1.41**	0.966	3.86	19.32	38.64
17.5	*31.53*	**4.85**	0.19	0.97	**1.94**	0.954	3.81	19.07	38.15
20	*36.40*	**6.42**	0.26	1.28	**2.57**	0.940	3.76	18.79	37.59
21	*38.39*	**7.11**	0.28	1.42	**2.85**	0.934	3.73	18.67	37.34
22	*40.40*	**7.85**	0.31	1.57	**3.14**	0.927	3.71	18.54	37.09
23	*42.45*	**8.64**	0.35	1.73	**3.45**	0.921	3.68	18.41	36.82
24	*44.52*	**9.46**	0.38	1.89	**3.79**	0.914	3.65	18.27	36.54
25	*46.63*	**10.34**	0.41	2.07	**4.13**	0.906	3.63	18.13	36.25
26	*48.77*	**11.26**	0.45	2.25	**4.50**	0.899	3.60	17.98	35.95
27	*50.95*	**12.23**	0.49	2.45	**4.89**	0.891	3.56	17.82	35.64
28	*53.17*	**13.26**	0.53	2.65	**5.30**	0.883	3.53	17.66	35.32
29	*55.43*	**14.33**	0.57	2.87	**5.73**	0.875	3.50	17.49	34.98
30	*57.73*	**15.47**	0.62	3.09	**6.19**	0.866	3.46	17.32	34.64
31	*60.08*	**16.66**	0.67	3.33	**6.67**	0.857	3.43	17.14	34.29
32	*62.49*	**17.92**	0.72	3.58	**7.17**	0.848	3.39	16.96	33.92
33	*64.94*	**19.24**	0.77	3.85	**7.69**	0.839	3.35	16.77	33.55
34	*67.45*	**20.62**	0.82	4.12	**8.25**	0.829	3.32	16.58	33.16
35	*70.02*	**22.08**	0.88	4.42	**8.83**	0.819	3.28	16.38	32.77
36	*72.65*	**23.61**	0.94	4.72	**9.44**	0.809	3.24	16.18	32.36
37	*75.35*	**25.21**	1.01	5.04	**10.09**	0.799	3.19	15.97	31.95
38	*78.13*	**26.90**	1.08	5.38	**10.76**	0.788	3.15	15.76	31.52
39	*80.98*	**28.67**	1.15	5.73	**11.47**	0.777	3.11	15.54	31.09
40	*83.91*	**30.54**	1.22	6.11	**12.22**	0.766	3.06	15.32	30.64
41	*86.93*	**32.50**	1.30	6.50	**13.00**	0.755	3.02	15.09	30.19
42	*90.04*	**34.56**	1.38	6.91	**13.82**	0.743	2.97	14.86	29.73
43	*93.25*	**36.73**	1.47	7.35	**14.69**	0.731	2.93	14.63	29.25
44	*96.57*	**39.01**	1.56	7.80	**15.61**	0.719	2.88	14.39	28.77
45	*100.00*	**41.42**	1.66	8.28	**16.57**	0.707	2.83	14.14	28.28
46	*103.55*	**43.95**	1.76	8.79	**17.58**	0.695	2.78	13.89	27.79
47	*107.23*	**46.63**	1.87	9.33	**18.65**	0.682	2.73	13.64	27.28
48	*111.06*	**49.45**	1.98	9.89	**19.78**	0.669	2.68	13.38	26.77
49	*115.03*	**52.42**	2.10	10.48	**20.97**	0.656	2.62	13.12	26.24
50	*119.17*	**55.57**	2.22	11.11	**22.23**	0.643	2.57	12.86	25.71
51	*123.49*	**58.90**	2.36	11.78	**23.56**	0.629	2.52	12.59	25.17
52	*127.99*	**62.42**	2.50	12.48	**24.97**	0.616	2.46	12.31	24.63
53	*132.70*	**66.16**	2.65	13.23	**26.46**	0.602	2.41	12.04	24.07
54	*137.63*	**70.13**	2.81	14.03	**28.05**	0.588	2.35	11.76	23.51
55	*142.81*	**74.34**	2.97	14.87	**29.74**	0.574	2.29	11.47	22.94
56	*148.25*	**78.82**	3.15	15.76	**31.53**	0.559	2.24	11.18	22.37
57	*153.98*	**83.60**	3.34	16.72	**33.44**	0.545	2.18	10.89	21.79
58	*160.03*	**88.70**	3.55	17.74	**35.48**	0.530	2.12	10.60	21.20
59	*166.42*	**94.15**	3.77	18.83	**37.66**	0.515	2.06	10.30	20.60
60	*173.20*	**99.99**	4.00	20.00	**40.00**	0.500	2.00	10.00	20.00
62.5	*192.09*	**116.56**	4.66	23.31	**46.62**	0.462	1.85	9.24	18.47
65	*214.44*	**136.61**	5.46	27.32	**54.64**	0.423	1.69	8.45	16.91
70	*274.73*	**192.36**	7.69	38.47	**76.95**	0.342	1.37	6.84	13.68
75	*373.17*	**286.34**	11.45	57.27	**114.54**	0.259	1.04	5.18	10.35
80	*567.05*	**475.80**	19.03	95.16	**190.32**	0.174	0.69	3.47	6.95
85	*1142.68*	**1047.05**	41.88	209.41	**418.82**	0.087	0.35	1.74	3.49



Appendix VI. Sample description sheet

Sample description sheet								
Sample[1]		**Date** day\month\yr.				**Inputted by**[8]		
Location & Type[2]		**Writer**[3]				**Checked by**		
Checked by[4]		**Original**[5] **or Copied**	O		C	**File name**		
Written on back[6]	Y	N	**Any data sheets omitted**[7]			**Backups?**	**File copied?**	

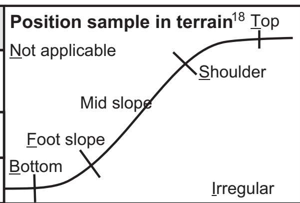
Concise description of 'how site was reached'[9] **How long did it take?**[10]

Local name(s) for area[11]	**Type vegetation and site**[12]

GPS reading (UTM50, WGS84)[13]	**E**								**N**							

Altitude[14]	**Why/how site selected**[15]	**Typical**[16]		
mtr		Typical	Restricted	Special

Artefacts and feature[17]		**Position sample in terrain**[18]
Cigarette ends & litter	Cut stems /stumps	
Old fire	Old camp	
Old swidden	Trail	



Surrounding habitats/extent of formation[19]									
Slope Aspect[20]									**Slope Degrees**[21]
N	NE	E	SE	S	SW	W	NW	*na*	

Others	Leaches	**Still (ponds, polls, lakes)**[22]			**Moving (stream, river)**[23]			**Marsh**[24]		
	Distance[25]	m			m			m		
	Extent[26]	m^2			m wide			m^2		
	Depth[27]	m			m			m		
Permanent/Seasonal/Ephemeral[28]		***P***	***S***	***E***	***P***	***S***	***E***	***P***	***S***	***E***

Stemmed rattans[29]			**Other lianas**[30]			**Epiphytes**[31]			**Moss%**[32]			**Tree seedlings**[33]				**Saplings**[34]			
<3	3-10	>10	<3	3-10	>10	<3	3-10	>10	<3	3-10	>10	<3	3-10	>10	>100	<3	3-10	>10	>100

Most abundant tree seedling (<1.5 m)[35]	Ref Coll. **No**[36]	**Distinctive giant monocots (palms, etc. in vicinity)**[37]	Ref Coll. **No**[36]
Most abundant saplings (≥1.5 m)[38]	Ref Coll. **No**[36]	**Most abundant shurbs/treelets (≥1.5 m)**[39]	Ref Coll. **No**[36]

Explanation of numbers in 'Sample description sheet'

1	Sample	Sequential, unique number for the sample
2	Location & type	Local name of area (as 11) and type of vegetation (as 12 e.g. x yr old ladang, primary forest, bamboo, etc.)
3	Writer	Who is writing the datasheet?
4	Checked by	Before leaving the site, the datasheets should always be checked. Who checked?
5	Original or copied?	Is this the original sheet (o) or a (hand)copied version of it (c)? Tick right answer
6	Written on back?	Is there any information written on the back? (useful when photocopying…)
7	Any data sheets omitted?	In case some data were not collected: e.g. if no trees, the (>10 cm drh) tree sheet is not used, maybe sometimes no soil data is collected, etc.
8	Inputted by, etc.	*To be filled out later, when data input in the computer takes place.*
9	Description of 'how site was reached'	Briefly describe how you got to the site; helps to remember later which place it was and, together with no.10, an indication of how accessibility to the site is.
10	How long did it take?	Roughly indicate travel time from a given point (usually 'camp' or the last sample site). Mention if (long) rest was taken on the way.
11	Local name for area	Ask the local guide how people refer to the area
12	Type of vegetation and site	A brief note on the type of vegetation and the landscape position – this can be asked from local informants also.
13	GPS reading	Always using UTM50 and the WGS84 datum. Let the GPS calculate an average position with less than 10 m if possible. In the GPS: mark the position with sample number and write down the Eastings (top nr.) and Northings (nr. below) on sheet.
14	Altitude	Ideally from an altimeter or a good map position – note GPS altitude reading is often unreliable. If this cannot be filled in it is not a problem.
15	Why/how was site selected?	Indicate whether randomly chosen, or selected for a specific quality/feature, or out of convenience, etc. Were we led by guides or did we we choose the spot to stop?
16	Typical?	Tick/circle whether *typical* =unexceptional example of a widespread kind of vegetation cover, *restricted* =a limited type of cover or with unusual features, or *special* =the sample is located to contain some very local feature or characteristics.
17	Artifacts and features	Tick/circle if any of the signs mentioned can be observed in the site no matter how old.
18	Position in the terrain	Tick/circle the relative position of the site on sloping terrain. Level plains means slope position is 'not applicable'.
19	Surrounding habitats/extent of formation	What is in the direct surroundings of the site in terms of vegetation and features and how far does the formation of the site extend?
20	Slope aspect	For <u>overall</u> slope direction at the site (NOT the direction of the transect line, which is supposed to be roughly at an angle 45 degrees from the slope direction!) read *aspect;* the compass bearing of the slope when you stand on it facing *downslope*.
21	Slope degrees	Measure slope steepness with a clinometer and read the scale in degrees
22	Still (ponds, etc.)	Distinct area of standing water
23	Moving (stream, etc.)	Distinctly linear water course, with (slow-fast) moving water
24	Marsh	Often muddy, marshy, with special vegetation adapted to wet conditions
25	Distance	Rough distance to the closest point of the transect line
26	Extent	Estimation of size of pond or marsh (or width of the stream)
27	Depth	Estimation of depth of pond/stream
28	Permanent, etc.	Ask local guide how permanent the water source is *P*=permanent, *S*=seasonal, *E*=ephemeral (only after heavy rain e.g.)
29	Stemmed rattans	Estimate nr. of stemmed rattans over 1.5 m high, within the 5 x 40 m
30	Other lianas	Estimate nr. of (living) lianas (woody and herbaceous), within the 5 x 40 m
31	Epiphytes	Estimate nr. of epiphytes, within the 5 x 40 m
32	Moss %	Estimate % of moss covering the ground, within the 5 x 40 m
33	Tree seedlings	Estimate nr. of tree seedlings, within the 5 x 40 m
34	Saplings	Estimate nr. of saplings, within the 5 x 40 m
35	Most abundant tree seedlings	List the species names of the 3 most abundant tree seedlings (< 1.5 m in height) – include tree species only.
36	Ref. Coll. No.	If species was collected for identification/confirmation, write the collection number
37	Distinctive giant monocots, etc.	List the species names of the giant monocots (e.g. palms, large ginger species, bamboo, pandanus, banana, Marantaceae) in the vicinity of the transect
38	Most abundant saplings	List the species names of the 5 most abundant saplings over 1.5 m high but less than 10 cm drh. Tree species only.
39	Most abundant shrubs/treelets	List the species names of the 5 most abundant shrubs/treelets over 1.5 m high. These are species which rarely achieve 10 cm drh.

Appendix VII. Non-tree data sheet

NON-TREE DATA SHEET: herbs, palms, climbers > 1.5 m, epiphytes below 2 m, pandans, etc.										
Sample[1]			Date day\month\yr.				Inputted by[8]			
Location & Type[2]			Writer[3]				Checked by			
Checked by[4]			Original or Copied?[5]	O		C	File name			
Written on back[6]	Y	N	This is page[7]		of		Backups?	File copied?		

No.[9]	Genus/Species[10]	Ref Coll.no[11]	Life form[12]	Section (4 m x 5 m)[13]										Planted?[14]	Notes[15]
				1	2	3	4	5	6	7	8	9	10		

Instructions for 'Non-tree data sheet'

This sheet records herbs, climbers ≥ 1.5 m, epiphytes below 2 m, and all monocots except for short lianas (no trees, shrubs or treelets)

[1] Sample number (each new plot is numbered in sequence, old numbers are not reused)

[2] A useful name of location.

[3] Who is writing the data sheet?

[4] Who has checked the data sheet and believes it is clear (initials)?

[5] Is this an original data sheet? (Great care must be given in copying any spoilt sheets – best that these are not thrown away but attached with the new sheet).

[6] Notes and explanation may be written on the back of sheets and may become lost during copying, etc.

[7] This tells us the number of this sheet of the total for THIS TYPE of data sheet at THIS sample site.

[8] This whole box is not filled in until the data has been entered on computer.

[9] Numbers are useful for referring to the individual plant entries. If more than one sheet is used the numbers continue from the previous sheet.

[10] This is used for giving the scientific name – or best guess at the current time. This will be verified later.

[11] When identification is not 100% confident, or is of botanical interest, a voucher specimen will be collected and the reference to this should be inserted here.

[12] The 'life form' is recorded as follows:

Plant	Code	When recorded*
Liana (**W**oody climber)	**WL**	**Transect sheet** when any part ≥ 1.5 m long
Climber (non woody **L**iana)	**L**	**Transect sheet** when any part ≥ 1.5 m long
Pal**m**s family/**T**ree **Pa**l**m**s	**Pl / TPl**	**Transect sheet** when ≥ 1.5 m tall, or adult plant
Pandanus/tree	**Pa / TPa**	**Transect sheet** - any
Epiphytes	**E**	**Transect sheet** when apparently established within 2 m of ground
Fern/**T**ree **F**ern	**F / TF**	**Transect sheet** - any
Epiphytic **F**erns	**EF**	**Transect sheet** - when within 2 m of ground
Climbing **F**erns	**CF**	**Transect sheet**
Strangler **F**igs/**L**iana **F**ig	**SFig / LFig**	**Transect sheet** - any /**Tree sheet** if ≥ 10 cm drh
Other **H**erbs (even large)	**H**	**Transect sheet** (if more than cotyledons only)
Aquatic	**A**	**Transect sheet** (if more than cotyledons only)

All have to be alive and rooted in the sample unit area. The sample unit area is corrected for slope.

[13] Presence in each of the transect's ten consecutive 4 m x 5 m units is recorded by a tick.

[14] A tick is used to note when a tree is understood to have been planted. Note such plants *should* be fully recorded.

[15] Any notes about the plant or difficulties in recording.

Appendix VIII. Tree data sheet

TREE DATA SHEET: woody stems over 10 cm drh [– 15 m - empty transect maximum]									
Sample[1]			Date day\month\yr.				Inputted by[8]		
Location & Type[2]			Writer[3]				Checked by		
Checked by[4]			Original or Copied?[5]	O		C	File name		
Written on back[6]	Y	N	This is page[7]		of		Backups?	File copied?	

No[9]	Genus/Species[10]	Ref. Coll. No[11]	drh Cm[12]	Ht. (m)[13]	Distance (m)[14]	F Index[15]	Planted[16]	Notes[17]
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Instructions for 'Tree data sheet'

1 Sample number (each new plot is numbered in sequence, old numbers are not reused)

2 A useful name of location

3 Who is writing the data sheet?

4 Who has checked the data sheet and believes it is clear (initials)?

5 Is this an original data sheet? (Great care must be given in copying any spoilt sheets – best that these are not thrown away but attached with the new sheet).

6 Notes and explanations may be written on the back of sheets and may become lost during copying, etc.

7 The number of THIS TYPE of data sheet at THIS sample site (generally 2).

8 This whole box is not filled in until the data has been entered on computer.

9 Numbers are useful for referring to the individual tree entries.

10 This is used for giving the scientific name – or best guess at the current time to be verified later in an herbarium.

11 When identification is not 100% confident, or of botanical interest, a voucher specimen will be collected and the reference to this should be inserted here.

12 Diameter at Reference Height. Usually recorded with a forester's diameter tape at 1.3 m above the ground. If the stem is deformed the point of measurement can be adjusted. For large buttressed trees an estimate of the higher diameter is acceptable. We adopt an unorthodox convention for multi-stemmed plants. These qualify where one stem is ≥ 10 cm at 1.3 m, the diameter is recorded below the fork (at ground level if needed – n.b. we are less interested in multiple stems than in individuals).

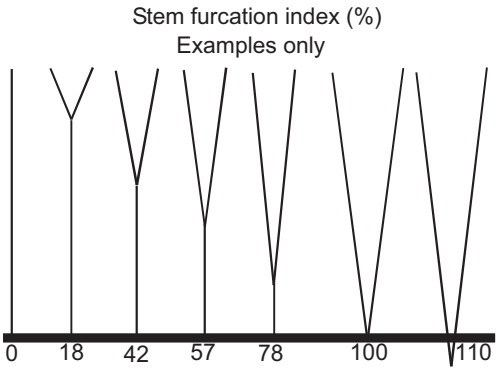
13 Estimated total height from the ground to the top of the plant. Good to compare and test estimates.

14 The shortest horizontal distance from the centerline of the transect to the center (at 1.3 m) of the 5th most distant stem in each of the four 10 m wide 5-tree transects (d_1 to d_8 in the Figure 6).

15 Furcation index – an estimate of the % of plant height where apical dominance is no longer a property of a single clearly defined stem. It is recorded on a continuous scale of 0 to 110 % (see figure for some examples).

16 A tick is used to note when a tree is understood to have been planted. Note such trees *should* be fully recorded.

17 Any notes about the tree or difficulties in recording (such as buttressed or inaccessible stems). Record **slope** here (degrees) if the distance measure is not slope corrected.



Appendix IX. Local site description data sheet

Plot: data sheet for local site description												
Sample			Date day\month\yr.					Inputted by				
Location			Booker					Checked by				
Checked by			Original/Copied?					File name				
Written on back	Y	N	This is page		1	of	4	Backups?		File copied?		
Informant :			M	or	F	Age :		Ethnicity :			Language :	

Description of the site/local names *(Deskripsi lokasi/nama lokal)*

1. Name of location (*Nama tempat):*

   _____

   Specific name? *(Nama khusus)*:

   _____

2. Description of the location *(Deskripsi lokasi)*:
   (a) Local term for physical landscape (*Sebutan tempat yang memiliki keadaan lapangan seperti ini*):

   _____

   (b) Local term for vegetation cover *(Sebutan tempat yang ditumbuhi tumbuh-tumbuhan seperti ini):*

   _____

   (c) Age of the vegetation *(Umur tanaman/tumbuhan)*:

   _____

   (d) What does the community use this area for? *(Tempat ini dimanfaatkan oleh masyarakat dengan cara):*

   _____

   (e) Can one find many sites like this around? *(Apakah tempat seperti ini banyak terdapat di desa ini?)*

   _____

3. Has this area ever been disturbed? If so, how and when and what was the effect? *(Apakah pernah terjadi kerusakan alam ditempat ini, kapan dan apa pengaruhnya?):* _____

   _____

   _____

   _____

   _____ _____

4. How quickly can this site be reached? *(Lokasi ini dari pusat desa dapat dicapai dengan)*:
   (a) By foot (*Jalan kaki saja selama*)_____hours *(jam)* or *(atau)* (b)
   (b) By outboard boat *(Ketinting/boat selama)* ____ hours *(jam)* and by foot *(dan jalan kaki)* ____ hours *(jam)*

5. Are there any taboos or traditional rules applying here? Why? *(Apakah tempat ini termasuk tempat yang tabu/larangan? mengapa?)*_____ _____

   _____

   _____

   _____ _____

   _____

6. Who comes here most regularly, and why/for what? (Siapa yang paling sering mendatangi tempat ini dan mengapa?) _____

   _____

   _____

   _____

Plot: data sheet for local site description											
Sample			Date day\month\yr.					Inputted by			
Location			Booker					Checked by			
Checked by			Original/Copied?					File name			
Written on back	Y	N	This is page		2	of	4	Backups?		File copied?	
Informant :			M	or	F	Age :		Ethnicity :		Language :	

The site as a wildlife habitat (*Kesesuaian tempat hidup satwa)*

1. Is this area often used for hunting? *(Apakah ditempat ini sering dilakukan perburuan?)*
   (4) Very often *(Sering sekali)* (3) Often *(Sering)* (2) Seldom *(Jarang)* (1) Never *(Tidak pernah)*,
   When do people hunt here (season)? *(Kapan? Musim, bersamaan dengan kegiatan lain dll.)*

   _____
   _____
   _____
   _____

   What tools do people use for hunting here?*(Dengan peralatan apa?)* _____
   _____
   _____
   _____

2. How easy is it to encounter the following animals here? *(Apakah di tempat ini mudah untuk melihat/menemukan binatang/satwa?)*

No.	**Name of the wildlife** *(Nama satwa)*	**Ease/difficulty to encounter** *(Kemudahan untuk menemukan)*			
		Very easy (*Sangat mudah)*	**Easy** *(Mudah)*	**Hard** *(Sulit)*	**Not there** *(Tidak ada)*
1	Bearded pig *(Babi hutan)*				
2	Sambar deer *(Rusa (payo, temang, payau))*				
3	Barking deer *(Kijang (telo raw, telao pawen, telau rauwe))*				
4	Gibbon *(Lutung (aci', kelasi, pangsih, hacei))*				
5	Macaques *(Kera ekor panjang (koyat, kura', kara'))*				
6	Rhinoceros hornbill *(Ungko klampian, Wak-wak (klowat, klabet, klavet))*				
7	Helmeted hornbill (*Rangkong papan/gading (pecaku, teva'un, tebun))*				

Plot: data sheet for local site description												
Sample			Date day\month\yr.					Inputted by				
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Usefulness of site per value category (*Kesesuaian tempat tumbuh dan penggunaan lain)*

1. How useful is this site for the respective use categories? (*Apa manfaat tempat ini bagi masyarakat?)*

Value category *(Jenis manfaat)*	**Use value *(Nilai manfaat)***			
	Very useful *(Sangat Bermanfaat)*	**Useful** *(Bermanfaat)*	**Less useful** *(Kurang Bermanfaat)*	**Useless** *(Tidak Bermanfaat)*
Food (*Makanan)*				
Medicine (*Obat-obatan)*				
Light construction (*Konstruksi ringan)*				
Heavy construction (*Konstruksi berat)*				
Boat construction (*Konstruksi perahu)*				
Tools (*Perkakas)*				
Fire wood *(Kayu bakar)*				
Basketry/cordage (A*nyaman keranjang /tali)*				
Ornaments/tradition (*Hiasan/upacara adat)*				
Marketable products (*Barang yang mudah dijual)*				
Hunting function (*Bahan-bahan untuk berburu)*				
Hunting place (*Makanan binatang/tempat berburu)*				
Recreation (*Rekreasi)*				
Future security *(Pencadangan areal untuk masa depan)*				
Special use: (*Kegunaan khusus:)*				
a.				
b.				
c.				
d.				
e.				
f.				
g.				
h.				
i.				
j.				
k.				
l.				
m.				
n.				

Plot: data sheet for local site description								
Sample		Date day\month\yr.				Inputted by		
Location		Booker				Checked by		
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Informant :	M	or	F	Age :	Ethnicity :		Language :	

History of land use and natural events at the site *(Sejarah penggunaan lahan dan kejadian alam)*

1. List the changes in land use and natural events that have taken place at this site used period *(Perubahan apa saja yang pernah terjadi pada tempat ini?)*

Period *(Jangka waktu)*	**Land use changes** *(Penggunaan/kejadian)*	**Impacts on land** *(Dampak)*

Appendix X. Plant uses data sheet

Plot: Plant uses data sheet																
Sample				Date day\month\yr.				Inputted by		Informant						
Location				Booker				Checked by		Age		Gender	M	or	F	
Checked by				Original/Copied?	O	or	C	File name		Ethnicity						
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Local name *(Nama lokal)*	**Language** *(Bahasa)*	**Ref no.**	**Description of use** *(Kegunaan Tanaman)*	**Used part of plant** *(Bagian tanaman yg dipakai)*											**Preference**	**Frequency of use** *(Frekuensi)*					**Exclusivity**
				A	K	D	Bu	Bng	Klt	B/S/C/Bh	Pc	G/R	Semua	Lain		1 Th	2 Th	2^+ - 5 Th	5^+-10 Th	> 10 Th	

Appendix XI. Soil data sheet

SOIL DATA SHEET									
Sample			Date day\month\yr				Inputted by		
Location			Booker				Checked by		
Checked by			Original/Copied				File name		
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Parent Material:	**Drainage:**	**BAF :**			**Land Use:**	**Site Name:**		**Surface pH:**	**Erosion:**		
	Groundwater table:	**1**	**2**	**3**		**Map Number:**					
Horizon Symbol	Depth (cm)	Colour			Texture	Structure	Consistency	Matrix Node	Soil Pores		Root
									Micro	Macro	

No.	Land characteristics	No.	Land characteristics
1.	Soil Surface Condition:	2.	Landform:
3.	Temperature Regime:	4.	Moisture Regime:
5.	Classification:	6.	Suitable for:

No.	**Question** *(pertanyaan)*	**Answer** *(jawaban)*
1.	What is the former use of this land? (Forest/Garden/Fallow/Sawah/Others...) *Sebelumnya lahan ini digunakan untuk apa saja ? (Hutan/Kebun/Ladang/Sawah/Lainnya...)*	
2.	What is this soil's name? (location/colour/Texture/Others…) *Apa nama dari jenis tanah ini?(Lokasi/Warna/Tekstur/Lainnya…)*	
3.	What are the characteristics of this soil? *Apa ciri-ciri dari jenis tanah ini?*	
4.	What kind of use is this land suitable for? Why? Forest/Garden/Fallow/Sawah/Others… *Cocok untuk apa tanah ini digunakan? Mengapa? (Hutan/Kebun/Ladang/Sawah/Lainnya...)*	
5.	How do you prepare this kind of land for cultivation? Burn/slash/Others... *Bagaimana cara mengelola tanah ini (bila digunakan untuk berkebun/ ladang/sawah)? (Dibakar/Dibabat/Dibajak/Lainnya…)*	
6.	How fertile is this land? Based on what indicator? What will you do if it is unfertile? *Seberapa suburkah tanah ini? (Sangat/subur/lumayan/tidak) Berdasar apakah (Warna/Tekstur/Lereng/Vegetasi/Konsis-tensi/Lainnya...)? Jika tidak, bagaimana cara mengatasinya? (Pupuk/Bera/Lainnya...)*	
7.	Is it easy or difficult to cultivate this land? What will you do if it is difficult to cultivate? *Apakah tanah ini mudah/sulit diolah?Jika sulit, bagaimana cara mengatasinya?*	

The characteristics of forested landscapes are usually critical to their inhabitants, but the significance of these relationships is largely hidden from the outsider. The challenge is to understand what aspects of the landscape local people care about, why they matter and how much.

The groundbreaking approach reported in this book was developed during a study of seven communities in the forest-rich upper portion of the Malinau watershed in East Kalimantan, Indonesian Borneo. A village-based survey collected a wide range of qualitative and quantitative information about the judgments, needs, culture, institutions and aspirations of the communities, and examined general perceptions of the local landscape. A parallel field survey assessed sample sites and recorded soil, vegetation and other site characteristics through both 'scientific' and indigenous approaches. These field methods emphasized landscape-scale characterization through high replication of small data-rich samples, and assessments of community territories based on these samples. Two hundred research plots were established and about 2000 plant species recorded, representing a 'baseline', 'exploratory' or 'diagnostic' phase within a longer-term research strategy.

Decision makers require guidance on how to deal with the needs of local communities and biodiversity in landscapes. This book for the first time brings together a suite of effective methods to address this. The techniques provide conventional biophysical descriptions of the landscape and explicitly relate this information to local needs, preferences and value systems. These methods can be used to guide future research and to make recommendations on options about land use and policy. The methods described in this report also provide a foundation for deeper dialogue with the forest communities.

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