Final Technical Report of Project R6352: A field manual on participatory inventory of non-timber forest products, with special reference to Indonesia

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Executive Summary

The direct participation of local communities in forest management is increasingly seen as desirable, and perhaps necessary, to ensure sustainability. At the same time, there is recognition of the need for a greater role for non-timber forest products in forest management, due to their economic importance at the local, national and international levels. There is therefore a need for the well-established inventory or survey methodologies used as management tools by professional foresters or park managers to be adapted to involve the participation of local people, and to include the assessment of locally important forest resources, most of which are non-timber forest products. The purpose of this project therefore was to determine scientifically sound and locally acceptable methods for participatory inventory of locally important forest resources, and make the results available to target institutions in the form of a field manual, written in English and Indonesian, and training workshops. This purpose was achieved through the following activities:

- Initial development of a participatory inventory method,
- Evaluation and revision of the method following two trial inventories conducted in villages in East Kalimantan and Jambi, Indonesia,
- Initial development of a field manual,
- Evaluation and revision of both the participatory inventory method and field manual during two training workshops (one for government organisations, one for non-government organisations) conducted in East Kalimantan, Indonesia, and
- Final review and publication of the English version of the field manual.

The main part of the Output of this project was the development of a scientifically sound and locally acceptable method for participatory inventory of locally important forest resources. This method was evaluated in terms of its precision, cost efficiency, accuracy, simplicity and acceptability to local people. In order to work towards DFID's developmental goals of sustainable management of tropical forests, however, many activities were focused on making this method available to Indonesian target institutions involved in forest management at the community level (from government, timber companies, and NGOs). These activities included: training 103 individuals (24 women, 79 men) during 2 trial inventories and 2 training workshops, making 5 presentations in Indonesia, giving 2 lectures in the UK, writing 6 internal reports for Indonesian collaborating organisations, and publishing 1 paper and 1 field manual. Follow-up activities will be focused on publishing the Indonesian version of the field manual and in promoting and distributing both versions of the field manual.

Background

The direct participation of local communities in forest management is increasingly seen as desirable, and perhaps necessary, to ensure sustainability (BAPPENAS/Ministry of Forestry/World Bank, 1994). At the same time, there is recognition of the need for a greater role for non-timber forest products in forest management, due to their economic importance at the local, national and international levels (de Beer and McDermott, 1996). There is therefore a need for the well-established inventory or survey methodologies used as management tools by professional foresters or park managers to be adapted in several ways. Firstly, they need to involve the participation of local people, and secondly, they need to include the assessment of locally important forest resources, most of which are non-timber forest products (Williams, 1991; INBAR, 1994; Perez, 1995; Stockdale and Ambrose, 1996). There is also a need to make these new methods, once they are developed, available to people working with communities that are in or near forests.

A number of recent development projects have attempted to involve communities in forest survey and inventory. Many of these projects have been reviewed in Carter's (1996) book: *Recent approaches to participatory forest resource assessment.* Of the projects mentioned in this book, four assess both timber and non-timber forest resources, although three assess timber resources only.

A variety of participatory tools are used to assess forest resources, including: a. social surveys of resource use; b. mapping of resource distribution, and; c. inventory of resource quality and quantity.

a) Social survey techniques for assessing forest resource use (particularly Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA), amongst others) have received more attention than participatory mapping and inventory. These techniques, used for a number of community development purposes, are reviewed in Chambers (1992) and Chambers and Guijt (1995). A number of manuals have also been produced to assist community workers with social survey techniques in the field, including FAO (1990), Nichols (1991) and Pratt and Loizos (1992).

b) Participatory mapping of forest resource distribution began as one of many PRA techniques. However, considerable interest has been focused on this technique, as it can be a useful tool for discussing forest resource ownership, access and management issues (see review by Poole, 1995). The accuracy of the sketch maps produced using this technique have been upgraded in recent years by the inclusion of ground surveying techniques and the use of Global Positioning Systems (GPS) (Momberg *et al.*, 1994). There are several field manuals on participatory mapping techniques (Jackson *et al.*, 1994; Flavelle, 1996; Momberg *et al.*, 1996).

c) Participatory inventory of forest resources, involving some form of sampling, has been conducted recently in a number of development projects, although most of these projects were primarily concerned with the participatory inventory of timber species (Carter, 1996). No field manuals yet exist that are specifically concerned with participatory inventory, whether of timber or non-timber forest resources.

One of the chapters in Carter (1996) was written by M. Stockdale, the principal investigator on this project. The chapter (Stockdale and Ambrose, 1996) describes M. Stockdale's preliminary research, in which participatory inventory methods for non-timber forest products were tested and evaluated during a one-week workshop attended by local people and NGO extension workers in East Kalimantan, Indonesia. The procedure that was developed used specific social survey techniques, participatory mapping techniques as well as sampling techniques, in order to plan and conduct an inventory. The participants in the workshop indicated that East Kalimantan communities would be very interested in receiving further training as well as training materials on participatory inventory. These participants identified a number of possible uses for the inventory results, including to:

- Negotiate over local peoples' tenure or access to forest lands,
- Show the impact of external development projects on locally important forest resources, and
- Develop a plan for the management of locally important forest resources.

Project Purpose

The project described in this Final Technical Report proposed to develop further the method described in the preliminary research of Stockdale and Ambrose (1996). The purpose of this project therefore was to determine scientifically sound and locally acceptable methods for participatory inventory of locally important forest resources[1], and make the results available to target institutions in the form of a field manual written in English and Indonesian and training workshops. Such a project would address two general developmental constraints: a) the lack of involvement of local people in forest management, and b) the limited role of non-timber forest resources in forest management. This project also would address the specific developmental constraint of the unavailability of references and training opportunities in methods for participatory inventory of locally important forest resources, particularly non-timber forest resources.

Research Activities

Activity 1.1. (In the UK) Consult the literature and the relevant experts (one and a half months).
During this time the researcher, M. Stockdale, in weekly consultation with the project manager N. Brown:

- Wrote a project summary and distributed it along with comments and questions to relevant individuals and organisations (a total of 42 letters were written),
- Conducted a literature review on topics including: inventory (general theory, multi-resource, rattan/bamboo), participatory methodologies (especially participatory mapping and inventory), community forestry in the Indonesian context (especially UK-Indonesia Tropical Forest Management Project and WWF-Indonesia internal reports).
- Consulted with 17 experts in the fields of inventory, mapping, ethnobotany, participatory methodologies, and community forestry in the Indonesian context.
- Wrote a first draft of an internal report for the purpose providing subject matter for a day and a half of consultation with Dr. M. Philip (inventory expert).

Activity 1.2. (In the UK) Select inventory techniques for testing in the field and plan trial inventories (one month).
During this time the researcher M. Stockdale, in weekly consultation with the project manager N. Brown:

- Developed a participatory inventory method to test in the field during the trial inventories.
- Planned the trip to Indonesia.
- Bought equipment for the project. A Toshiba T2130CS laptop, Hewlett Packard Deskjet 340 printer and other computing accessories were purchased, as well as equipment and supplies for inventory.

Activity 2.1. (In Indonesia) Coordinate research with larger ODA and WWF-Indonesia projects, arrange logistics of fieldwork, take Indonesian language classes, obtain research visa (four months).
The above activities were conducted as planned by the two project researchers, M. Stockdale and J. Corbett. Discussions with people from the two larger collaborating projects meant that this project's trial inventories were conducted in a way that could contribute to the goals of the larger projects and be of benefit to the participating villages. In the case of the ODA-Indonesia bilateral programme, the inventory results had input into the scheduled redefining of concession boundaries. In the case of the WWF-Indonesia programme, the inventory results were used during later discussions of the zonation of the Kayan Mentarang National Park.

Activity 2.2. and Activity 2.3. (In Indonesia) Conduct trial inventories in East Kalimantan (as part of WWF-Indonesia project) and Jambi (as part of ODA-Indonesia bilateral project) (four months).
Participatory inventory teams conducted two trial inventories. One team was composed of the 2 researchers, 2 NGO community workers, villagers, and supporting staff from the WWF-Indonesia project. The second team was composed of the 2 researchers, 2 NGO community workers, villagers, and representatives from DINAS Kehutanan, the provincial level Forestry Department, and PT IFA, the logging concessionaire of the area where the trial inventory was held. Input to the second trial inventory also came from Dr. Gordon Storey, an expert in training and PRA from the Centre for Rural Development and Training at the University of Wolverhampton, who helped plan and conduct the training of the villagers.

[1] Initially, the proposal was focused on the participatory inventory of 'non-timber forest products' alone, but the importance attached to timber by both villages involved in the trial inventories caused the researchers to change this term to 'locally important forest resources'. However, as most of the locally important forest resources chosen by the villagers were NTFPs, determining suitable methods for assessing them remained the main focus of this project.

In addition to completing two trial inventories, members of the teams and villagers also evaluated the participatory inventory method. This evaluation was made using a number of techniques including: formal interviews of villagers after the community meetings, formal observations made during all meetings, informal feedback from villagers and PIP team members, analysis of precision and analysis of the check data.

Activity 3.1. (In the UK) Analyse results of trial inventories (2 months).
The two researchers returned to the UK to consult with the project manager N. Brown, assess the field teams' evaluation of the participatory inventory method and analyse the inventory data. This work is summarised in a publication (Stockdale and Corbett, 1998a), attached in Appendix A.

Activity 3.2. (In the UK) Finish first English draft of the manual, send to reviewers (4 months).
The two researchers incorporated the results of the trial inventory evaluation into the participatory inventory method and wrote a first draft of a field manual describing how to use this method. They later revised this draft in Indonesia before giving it to two reviewers, G. Storey (expert in training and RRA/PRA) and A. Flavelle (expert in training, participatory mapping and participatory forest management).

Activity 3.3. (In the UK and Indonesia) Prepare training materials for workshops, revise manual (3 months).
The two researchers, together with collaborating organisers of the planned Government and NGO workshops, prepared training materials and a training schedule. The Government collaborators were from the EEC-Government of Indonesia Berau Forest Management Project (BFMP) and the NGO collaborators were from the Indonesian NGO Network for Participatory Mapping (JKPP) and the local NGO hosting the workshop called the Institute for the Environment and Peoples' Empowerment (PLASMA). Other donor organisations covered most of the workshop costs.

Activity 4.1. (In Indonesia) Work with Indonesian translator to translate the manual (2 months).
Two translators, N. Kasyanto and S. Cooke, translated the first draft of the manual for use in the training workshops. N. Kasyanto, the editor of an extension newsletter for forest dwelling communities in East Kalimantan, also reviewed the manual draft.

Activity 4.2. (In Indonesia) Government training workshop in East Kalimantan (1.5 months).
The Government training workshop took place in Berau, East Kalimantan, and included the conducting of a full participatory inventory with a participating village. The participants were from five local villages, the government-owned Pt. Inhutani I timber company, as well as a number of local, provincial and national level government departments. The participatory inventory method and the field manual describing it were evaluated during this workshop. This evaluation is described in Stockdale and Corbett (1998b).

Activity 4.3. (In Indonesia) NGO training workshop in East Kalimantan (1.5 months).
The NGO training workshop took place in Samarinda, East Kalimantan, and did not include a full participatory inventory as it would have been difficult to obtain the necessary permits for work in a village. The NGO participants were from Sumatra, Java, West, Central and East Kalimantan, Sulawesi and Irian Jaya. The participatory inventory method and the field manual describing it were evaluated during this workshop. This evaluation is described in PLASMA (1997).[2]

Activity 5.1. (In Canada and Indonesia) Revise, publish and promote manual (1 month).
The feedback from the reviewers, translators and training workshop participants all contributed to substantial revision of the manual. Once revised, and once the figures were added to the text, the manual was too large in size to be completed using word processing software. The project therefore hired experts in desktop publishing to put together the final layout of the manual, the table of contents and the index. This took six months.

2 After the NGO workshop, three participatory inventories were successfully conducted in villages in East Kalimantan, West Kalimantan and Sulawesi, as planned follow up to the workshop (funding and coordination for these inventories was provided by CIDA). A fourth was organised independently by one of the NGOs that attended the workshop. The teams that conducted these inventories also sent evaluations to the researchers.

Then the manual was submitted to two reviewers (inventory experts H. Wright and M. Philip), as required by the publishers (the Oxford Forestry Institute's Tropical Forestry Papers). The reviewers gave the manual a very favorable rating, as can be seen from their reviews, attached in Appendix B, but recommended some minor revisions. The researchers had by now begun new work in Indonesia and had to make the revisions in their spare time. Once revised, the manual had to be returned to the desktop publishers in Canada. This process took almost another year.

The English version of the manual is now at the printers, and will be distributed through the Oxford Forestry Institute library from mid-September onwards. It can presently be downloaded from the pdf file: **ftp://geography.geog.uvic.ca/pub/incoming/Stockdale**

The Indonesian version is now being translated, and will be published and printed by the end of the year. It will be distributed through a national non-governmental organisation (NGO) called the Indonesian Tropical Institute (LATIN), from early 2000 onwards.

This final list of activities has taken considerably more than the one month that remained of the time contracted for completion of the project.

Outputs

The Output for this project, as stated in the logical framework, was to:

Determine scientifically sound and locally acceptable methods for participatory inventory of locally important forest resources, and publish the results as a field manual in English and Indonesian.

A key part of this was the:

- Successful development of a scientifically sound and locally acceptable method for participatory inventory of locally important forest resources.

Evaluation of the method was made throughout the course of the activities of this project; some key findings from the trial inventories are summarised in Box 1.

Box 1. Key findings from the trial inventories (adapted from Stockdale and Corbett, 1998a: to be found in Appendix A of this report)

In addition to completing two trial inventories in Long Tebulo and Semembu, members of the PIP team and villagers also evaluated the participatory mapping and inventory method. This evaluation was made using a number of techniques including: formal interviews of villagers after the community meetings, formal observations made during all meetings, informal feedback from villagers and PIP team members, analysis of precision, and analysis of the check data.

From this the following general observations have been made:

Precision

If all forest resources which were considered extremely variable are excluded (i.e. those with a coefficient of variation (CV%) of greater than 700%), then a plot number of 2,500 (10 m x 50 m plots) is sufficient to bring the remaining nine resources in the Long Tebulo inventory and the remaining fifteen resources in the Semambu inventory to sampling errors of 20% or lower (at 90% probability). A plot number of 10,000 is sufficient to bring the same resources to sampling errors of 10% or lower.

Cost efficiency

The cost of achieving a desired sampling error is higher in Long Tebulo than in Semambu. In Long Tebulo, the steeper terrain only allows an average of 20 plots to be finished by one team in one day. Thus a sampling error of 10% or less for all but the most variable resources (which would require 10,000 plots to be established) would cost 500 team days, and a sampling error of 20% or less for the same resources (which would require 2,500 plots to be established) would cost 125 team days. In Semambu, an average of 30 plots could be finished per team per day. Here, a sampling error of 10% would cost 333 team days

and a sampling error of 20% would cost 83 team days. The cost of achieving 10% sampling error is unreasonably high for villagers, a 20% sampling error is more realistic.

Accuracy

Accuracy could not be measured directly as the "true" data values were not known, however, it was approximated by comparing the data gathered from the same plots by two different teams. The differences between original and check data were particularly large for some forest resources. These differences can be divided into three major types of errors. The teams found that some of these types of errors could be improved once discovered, whereas others continued to be a problem.

1. Small plants were often missed. This error occurred for all small herbs, shrubs, saplings and seedlings, such as the <10 cm d.b.h. *sekau*, *bekai lanya*, *bekai lan* and *temaha* in the Long Tebulo inventory and *pasak bumi* in the Semambu inventory. The checks in Long Tebulo also showed that women focused on small plants because these often included resources of particular importance to them, such as the cooking herbs *bekai lan* and *bekai lanya*, whereas men tended to enumerate the trees only, therefore teams with no women often missed the smaller plants. There was no such gender difference in Semambu, where it seemed that this error occurred more often when individuals were tired, preoccupied with other tasks or simply less meticulous than their colleagues. This problem was difficult to rectify by discussion; one solution is to count small plants in smaller subplots, although this makes work in the field and later calculations more complex.

2. It was difficult to determine how to count clumped plants. This difficulty was experienced for the rattans, the other palms and the bamboo enumerated in the two inventories. There were two types of error for these plants. One error was in determining whether all the size classes of plants should be included in the data. For example, in Semambu some people were counting the rattan clumps down to seedlings, at which stage it becomes very difficult to distinguish species, whereas other people were only counting rattan clumps that had already developed stems. This problem led to vast errors between teams in the first check, but was soon improved after discussion, following which the approach of the latter group of people was adopted. The other error was in determining whether a group of clumps in close proximity were all individual clumps or all one big clump. For example, in Semambu, *rotan udang* produces long underground stolons that lead to a much more spreading clump structure than those of *rotan sego* or *rotan jerenang*. Thus people differed much more in their judgement of what constitutes a clump when counting this species. This problem was difficult to rectify with discussion.

3. There were some differences of opinion about taxonomy. Older villagers were extremely good at identifying species, especially those included in the inventories since these species were of particular importance to them. However, checks revealed some differences of opinion. In Semambu there was confusion over whether or not to include two types of *kulim*, a timber tree with an edible fruit. Although the two types of tree were from different genera the fruit tasted similar and both were referred to as *kulim*. These types of problems could be resolved before beginning the inventory work by conducting a first day of training in the forest with all members of the inventory team.

Simplicity

Levels of understanding: It was clear that not everyone in the villages understood all of the concepts underlying the mapping and inventory method to the same level. However, it was decided that this was not so important as long as the concepts that are important for community decision-making (such as the potential purposes and objectives of mapping and inventory) are understood by all and as long as the other concepts, such as the technical aspects (including how to use a map or how to sample in order to estimate total quantities), are understood by at least some people, so that they can continue to use the method and explain its products long after the PIP team has gone.

Who understands the concepts: Understanding all concepts, particularly the technical ones, was easier for the younger, formally educated people in the village. However, the older, less educated people contributed a specialised knowledge of the area and the resources that was particularly useful when making the sketch maps, planning the objectives, finding the starting points of inventory lines, identifying the plants in the plots etc. Thus the knowledge and skills of the two groups together made for a formidable team, and meant that the maps and inventory data were produced more efficiently and were of a higher quality than if outsiders such as the PIP team had tried to produce them by themselves.

Acceptability to villagers

The ideals of ensuring full participation from all groups in the community at times clashed with culturally accepted norms. For example, in one of the villages the men did not see the need for the participation of women in the meetings and fieldwork. This is a difficult and value-laden issue.

In general, however, the method met the approval of the villagers, although with some suspicion of ulterior motives on the part of members of the PIP team. The involvement of villagers in the method from start to finish had the effect of decreasing suspicion and raising enthusiasm as time progressed. The feedback from both villages at the end was positive, with villagers commenting that they felt more confident to discuss issues with outsiders or within the village, now that they were armed with written documents to illustrate their statements.

The remainder of this output was focused on making this method available to Indonesian target institutions involved in forest management at the community level (from government, timber companies, and NGOs). This was done by:

- Training people in Indonesia
- Making presentations in Indonesia
- Giving lectures in the UK
- Writing internal reports for Indonesian collaborating organisations, and
- Producing publications.

The results or products of each of these activities are described in turn below:

Training people in Indonesia

- At the trial inventory in Long Tebulo, East Kalimantan, 2 NGO community workers (1 woman, 1 man), 2 WWF field staff (1 woman, 1 man) and 20 villagers (7 women, 13 men) were trained in most aspects of participatory inventory.

- At the trial inventory in Semambu, Jambi, 2 NGO workers (2 men), 1 representative from DINAS Kehutanan (1 man), 1 representative from the provincial level Forestry Department (1 man), 1 representative from PT IFA (logging company) (1 man) and 18 villagers (6 women, 12 men) were trained in most aspects of participatory inventory.

- At the government training workshop in Punan Malinau, East Kalimantan:
  - 4 staff (2 men, 2 women) from the district office of Pt. Inhutani I (parastatal logging company) were trained to act as trainers during the workshop and to complete the remainder of the inventory with the villagers once the workshop was over.
  - 5 representatives (all men) from national, provincial and district offices of Pt. Inhutani I, 1 (1 man) from the Forestry Research Institute (BPK) in Samarinda, 1 (1 man) from the district office of the Development Planning Department (BAPPENAS), and 10 villagers (4 women, 6 men) from 5 villages (including the host village for the workshop) in the Pt. Inhutani I concession were trained in the participatory inventory method during the course of the 11 day workshop.
  - A team of 15 villagers (all men) from the host village for the workshop were trained in some of the technical aspects of participatory inventory.

- At the NGO workshop in Samarinda, East Kalimantan, 20 NGO participants (3 women, 17 men) from the Indonesian provinces of Sumatra, Java, West, South and East Kalimantan, Sulawesi and Irian Jaya were trained in the participatory inventory method during the course of the 10 day workshop.[3]

Making presentations in Indonesia

Following the trial inventories, presentations on participatory inventory were given to:

[3] After the NGO workshop, three participatory inventories were successfully conducted in villages in East Kalimantan, West Kalimantan and Sulawesi, as planned follow up to the workshop (funding and coordination for these inventories was provided by another donor organisation (CIDA). At least one further inventory has since been conducted spontaneously by one of the NGOs trained at the workshop. It is not known how many people were trained in the process of these subsequent inventories.

- WWF staff in Samarinda, East Kalimantan province (approx. 15 participants),
- Representatives of NGOs, the timber company Pt. IFA and local government in Jambi City, Jambi province (approx. 25 participants)
- Representatives from relevant branches of the Ministry of Forestry in Jakarta (facilitated by the UK-Indonesia bilateral project) (approx. 20 participants)

Following the training workshops, presentations on participatory inventory were given to:
- Representatives of the parastatal timber company Pt Inhutani I and the local Forestry Dept in Berau, East Kalimantan province (approx. 10 participants)
- Representatives of the parastatal timber company Pt Inhutani I and the relevant branches of the Ministry of Forestry in Jakarta (facilitated by the EEC Berau Forest Management Project) (approx. 20 participants, including Deputy Minister)

Giving lectures in the UK

Lectures on participatory inventory have also been given to:
- The M.Sc. class at the University of Reading, and
- The M.Sc. class at the Oxford Forestry Institute, University of Oxford.

Writing internal reports for Indonesian collaborating organisations

Following the trial inventories, four reports were written in Indonesian (two translated to English) and distributed to collaborating organisations and other interested bodies:

1. Stockdale, M. C., Corbett, J. M. and Adjang, T., 1996. An evaluation of the participatory mapping and inventory method (written in Indonesian and English). Unpublished report submitted to the World Wide Fund for Nature (WWF-Indonesia), Jakarta, Indonesia.

2. WWF-PIP Team and the people of Long Tebulo Village, 1996. Participatory mapping and inventory in Long Tebulo village, East Kalimantan, Indonesia (written in Indonesian and English). Unpublished report submitted to the World Wide Fund for Nature (WWF-Indonesia), Jakarta, Indonesia.

3. Sijabat, M., Stockdale, M.C., Shakti, M., Corbett, J.M.S., Gultom, H.E., 1996. Evaluasi pemetaan dan inventarisasi partisipatif di desa Semambu (An evaluation of the participatory mapping and inventory method in Semambu village) Unpublished report submitted to the Department of Forestry - Overseas Development Agency (ODA) Tropical Forest Management Project, Jakarta, Indonesia.

4. PIP Team and the people of Semambu Village, 1996. Pemetaan dan inventarisasi partisipatif di desa Semambu, Jambi, Indonesia (Participatory mapping and inventory in Semambu village, Jambi province). Unpublished report submitted to the Department of Forestry - Overseas Development Agency (ODA) Tropical Forest Management Project, Jakarta, Indonesia.

Following the training workshops, two reports were written and distributed to interested organisations:

5. Stockdale, M.C. and Corbett, J.M.S., 1998b. Report on a consultancy to the Berau Forest Management Project: Participatory inventory workshop. Unpublished report submitted to the EEC Berau Forest Management Project, Jakarta, Indonesia.

6. PLASMA (the Institute for the Environment and Peoples' Empowerment), 1997. Prosiding lokakarya dan pelatihan Inventarisasi partisipatif, Indigenous Ecological Knowledge dan Ethnobotany (Proceedings of the workshop and training in participatory inventory, Indigenous Ecological Knowledge and Ethnobotany), 1-13 December, 1997, Samarinda, East Kalimantan, Indonesia.

As well, at least 2 reports have been written by Indonesian participants about the participatory inventory training workshops.

1. Tim Inventarisasi Partisipatif (Tim IP), 1997. Laporan hasil inventarisasi partisipatif (IP) di desa Punan Malinau, Kecamatan Segah, Kabupaten Berau, Kalimantan Timur (Report of the results of

participatory inventory (IP) in Punan Malinau village, Segah subdistrict, Berau district, East Kalimantan). Unpublished report written for Pt. Inhutnai I and the EEC Berau Forest Management Project (BFMP), East Kalimantan, Indonesia.

2. Nasir and Nurita, 1998. Laporan proses Inventarisasi Simpukng Partisipatif di desa Tepulang (Report on the progress of participatory inventory in traditional fruit gardens in Tepulang village). Unpublished report written for Konsorsium Sistem Hutan Kerakyatan Kalimantan Timur (Consortium on Traditional Forest Management Systems, East Kalimantan branch), East Kalimantan, Indonesia.

Producing publications

Evaluation of the trial inventories resulted in this publication:

1. Stockdale, M. C. and Corbett, J. M., 1998a. Participatory mapping and inventory in two villages in Indonesia. In: G. Lund (editor), International Union of Forestry Research Organizations (IUFRO) Guidelines for Designing Multipurpose Resource Inventories. A project of IUFRO 4.02.02. **IUFRO World Series Vol. 8.**, Vienna, Austria. 216 p.

The final publication is the field manual itself:

2. Stockdale, M.C. and Corbett, J.M.S. 1999. Participatory inventory, a field manual written with special reference to Indonesia. **Tropical Forestry Papers 38,** Oxford Forestry Institute, University of Oxford, UK. 383 p.

3. Stockdale, M.C. and Corbett, J.M.S. in prep. Pedoman inventarisasi partisipatif. Lembaga Alam Tropika Indonesia (LATIN) or the Indonesian Tropical Institute, Bogor, Indonesia.

Contribution of Outputs

The outputs mentioned above will contribute towards DFID's developmental goal:

Tropical forests sustainably managed

by ensuring that the people who work with forest dwelling communities on forest management issues (in Indonesia but also in other countries with tropical forest) have the capacity to conduct participatory inventory of locally important forest resources, particularly non-timber forest resources.

However, some follow up activities are necessary to promote the findings of this work in order to achieve these development benefits. These include:

- Making arrangements for distribution of the manual
- Promoting the manual to target institutions

and are described in turn below.

Distribution of manual

The printed English versions of the manual (500 copies have been made) will be distributed by the Oxford Forestry Institute library.

The printed Indonesian versions of the manual (the number of copies yet to be determined) will be distributed by an Indonesian NGO called Lembaga Alam Tropika Indonesia (Indonesian Tropical Institute) or LATIN. This is a centrally located Indonesian NGO concerned with community forest management. It has experience in producing publications and has a publications list, newsletter and website that will be useful for promoting the manual in Indonesia.

The co-authors plan to set up a website in which a full version of the manual, in both languages, will be available. The manual will be downloadable in PDF format, which can be printed in exactly the same format as the final published copy. A counter will be put on this website in order to determine how much traffic passes through and downloads the manual.

Promotion of manual

As stated in the project's proposal, the mechanisms to be used for promotion of the manual will include personal professional contact, conferences, training workshops, publications, and advertising in the relevant bulletins and newsletters and on the relevant conferences on the internet. Some of the planned promotion activities for the next four months are as follows:

Emails will be sent to list-servers dealing with participatory research, inventory and forestry management. Among these list servers are the:

- FOREST list,
- IUFRO working group lists,
- ID21NEWS (the online Newsletter of the ID21 Development Research Reporting Service) at the IDS at the University of Sussex, and
- Indonesian Community Forestry Communication Forum (FKKM) list, etc.

Contact will be made with the following organisations:

- Community forestry networks such as the Rural Development Forestry Network at ODI, People and Plants Programme at UNESCO, Forestry and Agriculture Organisation (FAO) Community Forestry Group, Community Ecoforestry Network based out of the University of Victoria, Canada, Indonesian Community Forestry Communication Forum (FKKM), in Jokjakarta, Indonesia, etc.

- Research organisations such as CIFOR, IUFRO, ICRAF, IDRC, IIED, INBAR (the International Network for Bamboo and Rattan)

- Training organisations such as RECOFTC, University of Wolverhampton, etc.

- Donor organisations such as DFID, USAID, EEC, JICA, GTZ, ASEAN, SIDA, CIDA, etc.

- International NGOs such as FSC, IUCN, WWF, Oxfam, Conservation International, the Rainforest Action Network, etc.

- Indonesian NGOs such as Walhi, Latin, Skephi, JKPP, KSHK, Bina Swadaya, etc.

- Botanical herbariums such as Leiden, New York, Kew, Bogor, etc.

- Relevant university programmes such as those at OFI, Yale, Oregon, Guelph, Bangor, UEA, Montpellier, IDS, etc.

- Relevant projects such as BSP's Peoples, Forests, and Reefs Project, etc.

- Indonesian Government bodies including Pt. Inhutani and the Dept. of Forestry research, training and management branches

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APPENDIX A. Evaluation of trial inventories

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3.5. Participatory Mapping And Inventory In Two Villages In Indonesia

Case Study Synopsis

Area of Concern: East Kalimantan Province and Jambi Province, Indonesia

Problem: Data on non-timber forest products are lacking. Local villagers do not have the technologies to measure and monitor their resource base. The problem is the development of a system for the inventory of non-timber forest products that is simple to use and statistically appropriate.

Organization/Infrastructure Created: A participatory mapping and inventory team including researchers from the UK, the Indonesia Department of Forestry, a local timber concession company, and a local non-governmental organization, with input from the villagers.

Methods: Series of meetings to identify information requirements, development of an inventory plan, followed by training and implementation.

Results: The inventories were complete and results discussed with the villagers. In general, the inventories met with the approval of the villagers.

3.5.1 Review of the Issues

Participatory forestry, in which local communities that are dependent upon the forests are involved in managing them, is increasingly seen as a desirable and feasible option in many parts of the world, particularly in the tropics. One reason for this trend is the realisation of the negative impacts of ignoring local people's forest interests, especially in areas where there are high population densities and/or which are remote and poorly serviced by government. Another reason is the increased recognition of local people's rights to own and manage their traditional lands. A final reason is the current tendency of many national governments to decentralise and reduce management costs borne by the state (Carter 1996).

Participation by local people in forest management requires a number of changes to the existing management methods used by forestry or related professionals. One important change is in the way in which information about forest resources is collected compiled and analysed; participatory approaches to this are for the most part very new and/or still under development, and are reviewed in Carter (1996). Broad themes arising from this review are discussed below (Stockdale and Corbett 1996).

3.5.1.1 Reasons for the Assessment

Although local knowledge may have been sufficient in the past for controlling and managing forest land and resources, in present day circumstances the need for systematic, quantified information has arisen for a variety of reasons. Communities may map the location of, or inventory the quantities and types of forest resources important to them in order to claim tenure to forested land, or at least claim rights to harvest certain forest resources on that land. They may wish to manage specific resources in a more rigorous manner according to agreed objectives. Or they may wish to claim compensation for the loss of important resources.

3.5.1.2 Methods Used

Techniques such as remote sensing imagery, electronic data handling, and advanced statistical analyses are largely inappropriate to communities not used to such complex technology and with limited resources for gathering and handling information. Appropriate methods in conducting forest resource assessment include:

- *RRA/PRA techniques:* Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA) techniques include semi-structured interviews, group discussions, seasonal calendars, transect walks and sketch mapping with community members in order to obtain information about forest resources (a wide range of information not concerned with forest resources may also be obtained using these

techniques) (Chambers and Guijt 1995).

- *Modified RRA/PRA sketch mapping with an emphasis on geographical accuracy*: The aim of RRA/PRA sketch mapping is to investigate the perceptions and knowledge of different forest users rather than to produce an accurate map of forest resources. However the geographical accuracy of the sketch maps produced by local people can be improved by consulting, and incorporating information from conventional maps and aerial photographs, by mapping using conventional land survey methods, or by the use of Global Positioning Systems (GPS) and Geographic Information Systems (GIS) (Poole 1995).

- *Participatory surveys and inventories*: Carter (1996) has defined both surveys and inventories as quantitative assessments of resources; however, inventories can be distinguished from surveys by their greater statistical accuracy. The challenge for participatory inventories is to develop a system that is both simple to implement and statistically appropriate.

3.5.1.3 Resources Assessed

In the tropics local people's interest in multiple resource assessment often focuses on non-timber forest products (NTFPs) such as game, fodder for livestock, fuel, charcoal, fruits, medicines, dyes, rattans and bamboo, although timber products too may play an important role at the local level. Problems in estimating NTFP include (Temu 1995):

- Poorly defined products in terms of parameters to be measured;
- Highly variable product distribution over space, time, and culture;
- Uncertainty over the present and future value of non-timber products; and
- Shortage of expertise and resources committed to inventory and monitoring as a whole.

3.5.1.4 Social and Institutional Aspects

Some important social and institutional aspects that impact upon participatory forest resource assessment include:

- *Attitudes of the outsider, project, or government official working within the community:* Any individual outsider must develop a relationship of trust and respect with the local people if he or she is to establish a working relationship.
- *Institutions that exist within a community through which the work can be organised*: Strong local organizations with a common commitment are key in developing a participatory approach to resource assessments.
- *Local people's perception of their ownership of the forest or resource base:* Local people's willingness to commit resources such as time and money to conducting the assessment is likely to depend on a strong sense of ownership of the forest, whether in fact it is legally recognised or not.

3.5.1.5 Practical Aspects

Practical lessons learned from experiences of resource assessment in the projects described in Carter (1996) include recognition of the importance of:

- *Building upon local knowledge and experience:* Where there is a particular focus on non-timber forest products, there seems to be more likelihood of local peoples' knowledge being actively sought, as foresters' knowledge of these species tends to be less than their knowledge of timber species. Of particular interest is local peoples' knowledge of plant taxonomy, ecology, uses, and management.

- *Appropriate training:* Forestry Department members may require training in participatory forestry. Local people may require training in a number of completely new techniques. Training should be discussed at the outset, and a flexible program set up.

- *Proper species identification:* Local people, and certain individuals in particular, may have an excellent knowledge of local plant taxonomy. However, if only local names are used, this reduces the reliability and value of the assessment. Thus plant collection and the determination of scientific species names should be done in conjunction with the use of local systems of species identification.

- *Systematic, planned data collection:* Determining the information that is required, and discussing and trying out the different possible assessment techniques, should be done in as participatory a manner as possible. All parties concerned should consider carefully how the data should be recorded, stored, and processed in order to maximise local peoples' involvement and ownership of the information. A

system of accuracy checking should be ensured, and attention given to data security and storage.

3.5.1.6 Economic Viability

The economic viability of forest resource assessment is an important issue, especially for villagers with very limited resources, whether labour, equipment or money. At times it may be economically worthwhile for villagers to invest in an inventory, for example, for a commercial forest operation, particularly if it is aimed at a specialist, premium market. At other times it may be more appropriate for outsiders to cover some of the expenses, for example if the assessment includes long-term monitoring for forest growth modelling where the results are of interest to a wider audience than the villagers alone.

3.5.2 Two Case Studies from Indonesia

From February until August, 1996, a trial of a new methodology for participatory forest resource assessment called participatory mapping and inventory (*pemetaan dan inventarisasi partisipatif*, or PIP), was conducted in two villages in Indonesia. The so-called PIP team of researchers and trainers that arrived in the villages to work together with the villagers consisted of Mary Stockdale and Jonathan Corbett of the Oxford Forestry Institute and Indonesian counterparts from collaborating projects. The objectives of this work were:

- To test and evaluate the method with a view to writing a field manual on its use.
- To complete the method in both villages so that the villagers, and the larger ongoing projects that they were involved with, also received some benefit from the PIP team's work.

3.5.2.1 Background

1. *Indonesian legislation with respect to forest tenure and management.* In Indonesia, land and resource tenure is one of the aspects of community life covered by traditional law, or *adat*, and has formed the basis of traditional forest management systems for many generations. However, although traditional law is recognised in the Basic Agrarian Law (1960) as the basis of national land law, it is often overruled in day-to-day government land-use decision-making by other more modern Indonesian laws such as the Basic Forestry Law (1966). One reason why traditional law is easy to ignore is that it is largely oral, whereas modern Indonesian laws pertaining to forest tenure and management are documented on paper, and implemented through such media as maps and inventory results.

In response, many communities in Indonesia are attempting to claim rights to control and manage what they have traditionally considered to be their own forests. An important first step is expressing their traditional law in the same language as that of government (for example, in the form of reports, maps and inventory results).

2. *Long Tebulo village, East Kalimantan Province*. Long Tebulo village is a community of 25 households located in the upper reaches of the Bahau River, in East Kalimantan province, Borneo, as shown in Figure 3-9. The village is partly situated in the Kayan Mentarang Nature Reserve close to the WWF-Indonesia Field Studies Centre. The mapping and inventory work conducted in this village linked in with WWF's community forest mapping project, which is being done in anticipation of a change of status of the area from nature reserve to national park. This change will permit the development of different types of forest use zones within the park, including traditional community forest use zones. Members of the PIP team included WWF staff and representatives from a local non-governmental organization.

The villagers are *Dayak* (a generic term used to describe indigenous peoples of Borneo) and predominantly from the ethnic group called the Kenya Lepo Ke'. They founded Long Tebulo village in 1970, moving from a village called Long Lio which was situated further up the Bahau River. The villagers clear the forest on a rotational basis to plant *ladang* (swidden rice fields) and *sawah* (irrigated rice fields); in addition to this they grow vegetable and fruit crops. However, the village relies heavily on resources from the surrounding primary lowland to hill dipterocarp forest to supplement their daily needs.

3. *Semambu village, Jambi Province*. Semambu village is a community of 130 households, located on both sides of the Sumai River in Jambi province, Sumatra, as shown in Figure 3-9. The village is situated in a KPHP concession management area which is part of a pilot project co-managed by the governments of Indonesia (Department of Forestry) and United Kingdom's Department for International Development (DFID) – formerly the Overseas Development Administration (ODA). The KPHP system is a new system of timber concession management which attempts to achieve higher ecological sustainability and to ensure that the needs of local communities are more adequately addressed. The mapping and inventory work conducted in Semambu village fitted in with the community mapping being done in the area in anticipation of boundary re-negotiation between communities, timber companies and government. Thus

members of the PIP team included representatives from the Department of Forestry (BIPHUT), the local timber concession company (PT. IFA) and a local non-governmental organization.

The Semambu villagers are predominantly from the Malay ethnic group, a term used to describe Malay language speaking peoples, most of whom live in Sumatra and Peninsular Malaysia. They founded Semambu village in 1915, moving to this more central location from smaller villages in the immediate area. The predominant land use over the past 20 years has been for groups of villagers to clear small areas of forest (1-5 hectares) every two or three years to plant *ladang* (swidden rice fields); usually after two seasons of rice they convert this land to *kebun karet* (rubber plantation). The people rely on the surrounding forests to harvest resources which they use to meet subsistence and cash income needs. The forested area around Semambu consists of *belukar tua,* or previously cultivated land, linked to abandoned village sites, and *rimbo,* or natural forest, much of which has been logged over the past 20 years.

3.5.2.2 Purpose of Inventory

The villagers in Long Tebulo determined some of the broad purposes of the method, or the most important potential uses for the maps and inventory data to them as to:

- Strengthen traditional claims to forest areas which are most important to the village. This is especially relevant when determining the future zonation of the National Park with outside parties such as the Department of Forest Protection and Nature Conservation and WWF-Indonesia.
- Manage forest resources for the present and future needs of the village. For example, the villagers decided that smaller *sekau* saplings should be counted in the inventory as well as the larger harvestable ones. This is because this highly valuable forest resource had been so intensively harvested over the past years that the villagers were worried about the sustainability of their current practices.

The purposes or uses for the maps and inventory data, determined to be most important by the villagers of Semambu were to:

- Use them as a tool for discussion to prevent outsiders (for example, timber companies) from taking or destroying the forest resources most important to the village.
- Prevent rare (possibly over-harvested) forest resources from going extinct.
- Discuss traditional regulations about forest resource management.

3.5.2.3 Methods Used

The participatory mapping and inventory method can be broken down into a series of steps:

1. *First community meeting*: Introduction to participatory mapping and inventory. The purpose of the first meeting was for members of the PIP team to introduce the participatory mapping and inventory method, explain what a forest resource map and inventory table are, their uses, and how they are made. Permission was also requested from the village for the PIP team to conduct this method together with the villagers.

2. *Gather preliminary information*. During this stage of the method preliminary information about the village, its forest area and its forest resources was gathered using a variety of PRA techniques. This helped the PIP team to gain a better understanding of the village, its forest area and its forest resources and so enable them to be more effective in facilitating subsequent meetings.

3. *Second community meeting*: Determining the purpose of the maps and inventory data. During the second community meeting the villagers identified and ranked the present and potential problems associated with the forest area and forest resources, and then discussed possible ways in which the maps and inventory data could be used to assist in solving these problems. They then determined the broad purpose for which they would like to conduct the method. This meeting was held in Long Tebulo only; in Semambu the subject matter of the second community meeting was discussed in the small group meetings of step 4 (below) instead.

4. *Small group meetings*: Making sketch maps and planning the inventory. During the small group meetings, the villagers divided into small groups (in Long Tebulo there were three, a women's group, an older men's group and a younger men's group; in Semambu there were four, a women's group and a men's group for each half of the village, on both sides of the Sumai River) in order to provide an easier atmosphere for discussion, this division into small groups was especially important for drawing out the different information and opinions of the less vocal groups. The small groups drew a sketch map showing

the location of rivers, ridges, cultivated lands, forests, the traditional boundaries of the village land and any other natural or man-made features. Following this they listed the forest areas and resources they considered to be most important to them. From these lists they determined short lists of those forest areas and resources they would like to include in the inventory, and what type of information (for example age, size or condition) they would like to collect about each of these resources. All decision-making was done keeping in mind the broad purposes for the final map and inventory data that had previously been discussed in the second community meeting in Long Tebulo or at the beginning of the small group meeting in Semambu.

5. *Third community meeting:* Reaching consensus in planning the inventory. During the third community meeting representatives from each of the small groups presented the sketch maps and the decisions made by their group to the rest of the community. The village, as a whole, then reached a consensus concerning which forest areas and resources would be in the inventory and what information they wanted to collect about each resource.

6. Training. Before beginning work in the forest, the villagers that had been chosen by community leaders to join the inventory team, together with other interested villagers, received two days of training from members of the PIP team. The inventory team consisted of men and women, young and old. In Long Tebulo the total number of villagers on the team was 15, in Semambu it was 18.

The first day of training was spent conveying the most important concepts needed for planning an inventory followed by the actual planning of the work in the forest. These concepts included how to use the scale of a map to calculate areas and distances, how to determine compass orientation in the field from orientation on the map and how to plan the logistics of an inventory. The second day of training was spent explaining the concepts behind and techniques involved in doing the work in the field. These techniques included how to use a compass, how to determine the boundaries of a plot, how to enumerate the forest resources within the plot and how to record the data.

7. *Planning the inventory.* The main steps used to plan the inventory are to:

- Produce a planning map by combining information from available scale maps brought in by the PIP team the sketch maps of the small groups (step 4) and the villagers directly.

- Calculate the total area of the forest areas chosen to be included in the inventory using a transparent grid paper overlaid on the sketch map.

- Calculate the total area of 10 m by 10 m inventory plots that could be established given the constraints of available time and labour. This calculation was made using the assumption that one team of six people could cover1.5 hectares per day in flat areas and 1.0 hectare per day in steep areas.

- Calculate the sampling intensity by dividing the total area of plots by the total area of forest chosen to be included in the inventory. In both inventories the sampling intensity was approximately 0.5% and this was considered to be sufficient for the purposes of the data that had been determined by the villagers (this assumption was a rough guess only due to lack of information on the variance of the forest resource populations at the time that the inventory was planned).

- Draw the inventory plots on the planning map:
  - The sampling design consisted of systematic lines of 10 m wide by 50 m long plots laid end to end.
  - The location of the first line of plots in each of the forest areas chosen by the villagers was selected randomly.
  - The total number of plots allotted to each forest area was proportional to the relative size of each forest area.
  - The compass direction of the lines was selected in each forest area such that the lines crossed the general direction of the main river at right angles. This was done to ensure that the variation in vegetation due to topography was covered most efficiently.

- Plan the logistics of the inventory (such as the location of the camps, the work schedule, the supplies needed for the camps, etc.).

8. Conducting the inventory

- *Team tasks*. In the forest the inventory team was divided into smaller teams, usually of six people. Each person within the small team had a specific task: One person cuts the trail to ensure a clear path

for the compass and stick people to follow; one compass person and one stick person set the direction of the central line and use a 10 meter nylon rope to measure the correct horizontal length of each plot. Two enumerators count the forest resources to the left and the right of the central line, measuring whether plants are inside or out of the plot using a 5 m nylon rope measured from the plot's central line. One recorder records the information called out by the enumerators and numbers the plots.

- *Checks.* During the inventory work 10% (in Long Tebulo) to 15% (in Semambu) of the inventory plots were checked by a small team different from the team that had originally gathered the data. The results of these checks were then compared with the information gathered by the original team and discrepancies between the teams were discussed amongst the small teams in order to standardise the information being collected.

- *Collect botanical samples*. Samples of the forest resources chosen for the inventory were collected in order to identify the botanical name of the species. Members of the PIP team took the samples to the National Herbarium in Bogor to have them identified by experts, and the list of names were sent back to the villages.

9. *Make the final maps and reports.* On completion of the work in the forest, the inventory team compiled all data from the field in order to produce an inventory map, a forest resource map, and a mapping and inventory report.

- *Final maps.* The map used to plan the inventory was further modified by adding to it all information about the location of ridges and rivers that had been collected along the inventory lines. One copy of this final base map, called the inventory map, presents information about the location of the inventory lines and the boundaries of the forest areas chosen for each inventory. The other copy, called the forest resources map, shows the location of concentrations of forest resources, using data gathered from the inventory plots combined with information from the villagers' sketch maps.

- *Final report.* All the data from the inventory plots were compiled in order to estimate the total number and average number per hectare of each resource in each forest area. These calculations were done by villagers from the inventory team using simple hand-held calculators. The results of these calculations were presented in tables. The final report, describing the purposes specific objectives, method and results of the participatory mapping and inventory method, was written after the maps and tables had been completed.

10. *Final community meeting:* Presentation of final maps and report. During the final community meeting the final maps and report, and an explanation to how they were produced, were presented to the village by the villagers from the inventory team. There followed some informal discussion on how the maps and data that they now possessed could be of benefit to the village.

3.5.2.3 Results

Results from Long Tebulo Village. In Long Tebulo, the inventory work was conducted in four forest areas identified as being of the greatest importance by the village, namely the Bua Alat, Tebulo, Enggeng I'ut, and Perinda watershed areas. The location of these areas, plus the location of the inventory lines in each area can be seen in Figure 3-10. Thirteen resources were counted in the inventory. Table 3-6 provides a summary of their local and scientific names, their uses, and the information abut them that the villagers had decided to collect in the inventory.

Some of the major results included:

- Evidence that the densities of important forest resources were much higher in the Bua Alat and Tebulo areas than in the other two areas. This evidence helped to strengthen their existing status in Long Tebulo traditional law (these two watersheds are already designated as "protected forest" which cannot be cleared for agriculture and emphasise to outsiders the particular importance of these areas for the villagers.
- Evidence that the densities of young *sekau* saplings is still high, despite heavy harvesting pressures. The villagers resolved to continue to adhere to their traditional law which states that *sekau* trees are not to be felled unless there is evidence of infection by the fungus that causes the aromatic wood.

Figure 3-10: Inventory map of the Long Tebulo Village area, East Kalimantan Province, Borneo.

Results from Semambu village. Inventory work was conducted in three forest areas in the Semambu village's traditional lands, namely the Ngayau, Tikar-tikar, and Mendalang watersheds. The location of these areas, plus the location of the inventory lines can be seen on the inventory map in Figure 3-11. Sixteen resources were counted in the inventory. Table 3-7 provides a summary of their local and scientific names, either uses, and the information about them that was requested by the villagers. Some of the major results included:

- Evidence that Ngayau is the richest of the areas in most of the forest resources included in the inventory, such as timber trees, fruit trees, honey trees, *kemenyan* trees and bamboo. For this reason it is considered the area most important to the villagers. However, other areas in the inventory are also important because other resources are more common there; for example Tikar-tikar had the highest concentrations of *salak* and rattans and Mendalang had more *lipai*.
- Evidence that very few *durian* trees are regenerating. Unlike all other timber and fruit trees, there were more *durian* in the larger >31 cm d.b.h. class than in the 5-30 cm d.b.h. class. This spurred a discussion amongst the villagers about how their ancestors had originally planted the trees and resulted in a resolve to plant more trees in the near future to ensure a supply for future generations.

Figure 3-11: Inventory map of the Semambu Village area, Jambi Province, Sumatra.

3.5.2.4 Lessons learned from fieldwork

In addition to completing two trial inventories, members of the PIP team and villagers also evaluated the participatory mapping and inventory method. This evaluation was made using a number of techniques including: formal interviews of villagers after the community meetings, formal observations made during all meetings, informal feedback from villagers and PIP team members, analysis of precision, and analysis of the check data.

From this the following general observations have been made:

1. *Were the inventory estimates precise?* Tables 3-8 and 3-9 show, for Long Tebulo and Semembu villages respectively, the estimated overall mean number of plants per hectare for all of the chosen forest area together, the 90% confidence limits for this mean and the sampling error (the 90% confidence limits expressed as a percentage of the mean) for each of the chosen forest resources. The sampling errors were on the whole higher (or less precise) in Long Tebulo compared to Semambu. This is no doubt due to the lower number of plots established in Long Tebulo, where 347 plots were established, compared to Semambu, where 998 plots were established.

Tables 3-8 and 3-9 also show, for Long Tebulo and Semambu respectively, the sampling errors that can be achieved when the number of plots in the inventory are 2,500 and 10,000. If all forest resources which were considered extremely variable are excluded (i.e. those with a coefficient of variation (CV%) of greater than 700%), then a plot number of 2,500 is sufficient to bring the remaining nine resources in the Long Tebulo inventory and the remaining fifteen resources in the Semambu inventory to sampling errors of 20% or lower (at 90% probability). A plot number of 10,000 is sufficient to bring the same resources to sampling errors of 10% or lower.

The cost of achieving a desired sampling error is higher in Long Tebulo than in Semambu. In Long Tebulo, the steeper terrain only allows an average of 20 plots to be finished by one team in one day. Thus a sampling error of 10% or less for all but the most variable resources (which would require 10,000 plots to be established) would cost 500 team days, and a sampling error of 20% or less for the same resources (which would require 2,500 plots to be established) would cost 125 team days. In Semambu, an average of 30 plots could be finished per team per day. Here, a sampling error of 10% would cost 333 team days and a sampling error of 20% would cost 83 team days.

2. *Were the inventory data accurate?* Accuracy could not be measured directly as the "true" data values were not known, however, it was approximated by comparing the data gathered from the same plots by two different teams. Tables 3-8 and 3-9 show the results of three checks for Long Tebulo and Semambu, respectively. In Long Tebulo, there is no discernible trend over time in the differences between the original and the check data, perhaps a trend would have been observed had there been a

larger number of plots revisited in each check. In Semambu the trend over time is a decrease in the differences between the original data and the check data. This improvement in accuracy is largely due to the information feedback to the teams from the check data. For this reason checks should be done at a higher intensity at the beginning of the field work, and lowered as the work progresses and fewer discrepancies between the original data and the check data can be seen.

The differences between original and check data were particularly large for some forest resources. These differences can be divided into four major types of errors. The teams found that some of these types of errors could be improved once discovered, whereas others continued to be a problem.

- *Small plants were often missed.* This error occurred for all small herbs, shrubs, saplings and seedlings, such as the <10 cm d.b.h. *sekau*, *bekai lanya*, *bekai lan* and *temaha* in the Long Tebulo inventory and *pasak bumi* in the Semambu inventory. The checks in Long Tebulo also showed that women focused on small plants because these often included resources of particular importance to them, such as the cooking herbs *bekai lan* and *bekai lanya*, whereas men tended to enumerate the trees only, therefore teams with no women often missed the smaller plants. There was no such gender difference in Semambu, where it seemed that this error occurred more often when individuals were tired, preoccupied with other tasks or simply less meticulous than their colleagues. This problem was difficult to rectify by discussion; perhaps one solution is to count small plants in smaller subplots, although this makes work in the field and later calculations more complex.

- *It was difficult to determine how to count clumped plants.* This difficulty was experienced for the rattans, the other palms and the bamboo enumerated in the two inventories. There were two types of error for these plants. One error was in determining whether all the size classes of plants should be included in the data. For example, in Semambu some people were counting the rattan clumps down to seedlings, at which stage it becomes very difficult to distinguish species, whereas other people were only counting rattan clumps that had already developed stems. This problem led to vast errors between teams in the first check, but was soon improved after discussion, following which the approach of the latter group of people was adopted. The other error was in determining whether a group of clumps in close proximity were all individual clumps or all one big clump. For example, in Semambu, *rotan udang* produces long underground stolons which lead to a much more spreading clump structure than those of *rotan sego* or *rotan jerenang*. Thus people differed much more in their judgement of what constitutes a clump when counting this species. This problem was difficult to rectify with discussion.

- *There were some differences of opinion about taxonomy.* Most older villagers were extremely good at identifying species, especially those included in the inventories since they were of particular importance to them. However, checks revealed some differences of opinion. In Semambu there was confusion over whether or not to include two types of *kulim*, a timber tree with an edible fruit. Although the two types of tree were from different genera the fruit tasted similar and both were referred to as *kulim.*

3. *Were the important concepts underlying this method understood by the villagers?*

- *Levels of understanding:* It was clear that not everyone in the villages understood all of the concepts underlying the mapping and inventory method to the same level. However, this was not so important as long as the concepts that are important for community decision-making (such as the potential purposes and objectives of mapping and inventory) are understood by all and as long as the other concepts, such as the technical aspects (including how to use a map or how to sample in order to estimate total quantities), are understood by at least some people, so that they continue to use the method and explain its products long after the PIP team has gone.

- *Who understands the concepts:* Understanding all concepts, particularly the technical ones, was easier for the younger, formally educated people in the village. However, the older, less educated people contributed a specialised knowledge of the area and the resources that was particularly useful when making the sketch maps, planning the objectives finding the starting points of inventory lines, identifying the plants in the plots etc. Thus the knowledge and skillsof the two groups together made for a formidable teamand meant that the maps and inventory data were produced efficiently and were of a higher quality than if outsiders such as the PIP team had tried to

produce them by themselves.

4. Was this method participatory?

- *Within the village:* It is important to have participation from all sectors of the village community, as otherwise the decision-making, if made by a small group of villagers only, may be biased by their values and opinions alone. In this project, participation could be said to have been achieved in terms of actual numbers of villagers at meetings and representation of important sectors of society (such as men, women, youths) in all steps of the method; however participation in terms of equal involvement by all in decision-making was not achieved, as the older men tended to dominate the community discussions. This situation could not have been changed without major challenges to traditional institutions; at least this method provided an opportunity for the views of the less vocal groups to be brought forward.

- *Between villagers and outsiders:* The mapping and inventory activities in this project were initiated and directed by outsiders (notably two researchers from the Oxford Forestry Institute), as part of a research project for testing and evaluating a new method. The focus of this project was on developing ways of involving the participation of the villagers in the mapping and inventory activities; the other stakeholders from the region who provided representatives to the PIP team (notably from WWF-Indonesia the local timber concession and government) were not involved as equal participants.

It should be possible for villagers to initiate and direct the mapping and inventory process themselves. However, some assistance before and/or during the process may be needed from outsiders, in the form of thorough practical training with training materials that can be taken away to use as a basic reference, and equipment such as a base map, compasses and d.b.h. tapes.

The villagers are likely to be able to cover much of the inventory costs (such as labour, food supplies, etc.) if they feel that the products of the activities are of sufficient importance to be worth the expense. However, in most cases it might be unrealistic to expect that the village alone could obtain or pay for the training or equipment mentioned above.

It should also be possible for villagers to conduct this mapping and inventory work as part of a larger team of stakeholders, which might include members from government, non-government or commercial organizations. Mechanisms for involving these other stakeholders as full participants still need to be sought. For various reasons, there is often a high degree of mistrust by villagers of the motivations of outsiders; for this reason an emphasis on transparency in the involvement of all stakeholders is very important. Furthermore, to ensure that the participation of the villagers does not become restricted to a token presence on the team, it is important to try to maintain the villagers' full involvement in the planning of the mapping and inventory activities, in the collecting, compiling and analysis of data and in the implementation of results.

5. *Was this method acceptable to the villagers?* The ideals of ensuring full participation from all groups in the community at times clashed with culturally accepted norms. For example, in one of the villages the men did not see the need for the participation of women in the meetings and field work. This is a difficult and value-laden issue.

In general, however, the method met the approval of the villagers, although not without some suspicion of ulterior motives on the part of members of the PIP team. The involvement of villagers in the method from start to finish had the effect of decreasing suspicion and raising enthusiasm as time progressed. The feedback from both villages at the end was positive, with villagers commenting that they felt more confident to discuss issues with outsiders or within the village, now that they were armed with written documents to illustrate their statements.

Table 3-6: Forest resources chosen for the Long Tebulo inventory

Lepo Ke' name	Latin name	Uses	Information required
Sekau	*Aquilaria malaccensis (Thymelaceae)*	Aromatic incense with international market value	1. Trees <10 cm trees 2. Trees ≥10 cm trees
Bekai Lanya	*Coscinium miosepalum (Menispermaceae)*	Cooking herb with local market value	All shrubs
Bekai Lan	*Pycnarrhena cauliflora (Menispermaceae)*	Cooking herb with local market value	All shrubs
Sang	*Licuala sp. (Palmae)*	Leaves for roofing and hat making	All clumps
Da'a	*Pandanus sp. (Pandanaceae)*	Leaves for hat and basket making	All clumps with at least one stem
Wai Seka	*Calamus caesius (Palmae)*	Cane for construction and basket making	All clumps with at least one stem
Temaha	*Memecylon garcinddes (Melastomataceae)*	Stem for hunting spears and boat poles	Trees 3-10 cm d.b.h.
Kayu Merang	*(Rubiaceae)*	Timber for house foundations	1. Trees 30-59cm d.b.h. 2. Trees 60-89cm d.b.h. 3. Trees ≥90cm d.b.h.
Kayu Tenak	*Shorea spp. (Dipterocarpaceae)*	Timber for boards and boat building	1. Trees 30-59cm d.b.h. 2. Trees 60-89cm d.b.h. 3. Trees ≥90cm d.b.h.
Kayu Tumu	*Agathis borneensis (Araucariaceae)*	Timber for boards and furniture	1. Trees 30-59cm d.b.h. 2. Trees 60-89cm d.b.h. 3. Trees ≥90cm d.b.h.
Kayu Pung Ubi	*Ochanostachys amentacea (Olacaceae)*	Timber for house foundations	1. Trees 30-59cm d.b.h. 2. Trees 60-89cm d.b.h. 3. Trees ≥90cm d.b.h.
Kayu Kapun	*Dryobalanops lanceolata (Dipterocarpaceae).*	Timber for boards and joints in house construction	1. Trees 30-59cm d.b.h. 2. Trees 60-89cm d.b.h. 3. Trees ≥90cm d.b.h.
Kayu Nyeliwai	*Quercus argentea (Fagaceae)*	Timber for shingles	All trees ≥30 cm d.b.h.

Table 3-7: Forest resources chosen for the Semambu inventory

Jambi Dialect name	Latin name	Uses	Information required
Sialang	Canopy emergents (many species)	Honey from hives	All trees ≥50 cm d.b.h.
Kayu Kulim	*Scorodocarpus borneensis* and *Ochanostachys amentaceae (Olacaceae)*	Timber for construction and fruit for food	1. Trees 10-49 cm d.b.h. 2. Trees ≥50 cm d.b.h.
Kayu Tembesu	*Plectronia dydima (Rubiaceae)*	Timber for construction	1. Trees 10-49 cm d.b.h. 2. Trees ≥50 cm d.b.h.
Kemenyan	*Styrax benzoin (Styracaceae)*	Resin for smoking	Trees ≥5 cm d.b.h.
Durian	*Durio spp. (Bombacaceae*)	Fruit for food	1. Trees 5-29 cm d.b.h. 2. Trees ≥30 cm d.b.h.
Bedaro	*Nephelium eriopetalum* and *Paranephelium nitidum (Sapindaceae)*	Fruit for food	1. Trees 5-29 cm d.b.h. 2. Trees ≥30 cm d.b.h.
Petai	*Parkia spp. (Fabaceae)*	Seed for food	1. Trees 5-29 cm d.b.h. 2. Trees ≥30 cm d.b.h.
Cempedak	*Artocarpus spp. (Moraceae)*	Fruit for food	1. Trees 5-29 cm d.b.h. 2. Trees ≥30 cm d.b.h.
Salak	*Salacca spp. (Palmae)*	Fruit for food	All clumps
Lipai	*Licuala spp. (Palmae)*	Leaves for hat and basket making	All clump
Bambu Mayan	*(Graminae)*	Stems for fence, tool and, raft building and construction	All clumps with stems
Bambu Mumpo	*(Graminae)*	Stems for fence, tool and, raft building and construction	All clumps with stems
Rotan Sego	*Calamus caesius (Palmae)*	Cane for construction and household items	All clumps with stems
Rotan Udang	*Korthalsia echinometra (Palmae)*	Cane for household items	All clumps with stems
Rotan Jerenang	*Daemonorops propinqua and D. didymophylla (Palmae)*	Seed skin gives red dye with international market value	All clumps with stems
Pasak Bumi	*Eurycoma longifolia (Simarubaceae)*	Root for medicinal tonic	Shrubs

TABLE 3-8: PRECISION AND ACCURACY OF THE DATA FROM THE LONG TEBULO INVENTORY														
Resource Name	**Precision**					**Accuracy**								
	Mean Plants per Ha	*Conf Limits Plants per Ha*	*CL/Mean %*	*CL/Mean % if n = 2500*	*CL/Mean % if n = 10000*	*1st Check*			*2nd Check*			*3rd Check*		
						Orig	*Check*	*Diff*	*Orig*	*Check*	*Diff*	*Orig*	*Check*	*Diff*
Sekau	20.63	±4.01	19.5%	7.3%	3.6%	8	5	**3**	65	13	**52**	0	16	**16**
Bekai Lanya	0.06	±0.09	164.5%	61.3%	30.6%	0	0	**0**	1	0	**1**	0	0	**0**
Bekai Lan	3.98	±1.74	43.9%	16.3%	8.2%	7	10	**3**	0	0	**0**	0	0	**0**
Sang	12.68	±4.31	34.0%	12.7%	6.3%	8	22	**14**	0	0	**0**	22	75	**53**
Da'a	2.07	±2.78	133.9%	49.9%	24.9%	51	2	**49**	0	1	**1**	0	0	**0**
Wai Seka	1.84	±0.98	53.3%	19.8%	9.9%	0	0	**0**	0	0	**0**	0	1	**1**
Temaha	12.05	±3.73	30.9%	11.5%	5.8%	15	3	**12**	0	0	**0**	4	11	**7**
Merang	0.06	±0.09	164.5%	61.3%	30.6%	0	0	**0**	0	0	**0**	0	0	**0**
Tenak	6.86	±1.23	18.0%	6.7%	3.3%	8	3	**5**	9	14	**5**	8	3	**5**
Kapun	2.36	±1.25	53.0%	19.8%	9.9%	0	0	**0**	0	0	**0**	4	4	**0**
Tumu	0.12	±0.13	116.2%	43.3%	21.6%	0	0	**0**	0	0	**0**	0	0	**0**
Pung Ubi	0.69	±0.35	50.6%	18.9%	9.4%	0	2	**2**	0	0	**0**	2	0	**2**
Nyeliwai	7.49	±1.47	19.7%	7.3%	3.7%	21	4	**17**	0	3	**3**	5	2	**3**

TABLE 3-9: PRECISION AND ACCURACY OF THE DATA FROM THE SEMAMBU INVENTORY														
Resource Name	**Precision**					**Accuracy**								
	Mean: Plants per Ha	*Conf Limits: Plants per Ha*	*CL/Mean %*	*CL/Mean %* **if n = 2500**	*CL/Mean %* **if n = 10000**	*1st Check*			*2nd Check*			*3rd Check*		
						Orig	*Check*	*Diff*	*Orig*	*Check*	*Diff*	*Orig*	*Check*	*Diff*
Sialang	2.38	±0.43	18.0%	11.4%	5.7%	19	9	**10**	2	6	**4**	4	4	**0**
Kemenyan	4.55	±0.86	18.9%	11.9%	6.0%	8	4	**4**	25	0	**25**	0	1	**1**
Kulim	12.38	±1.33	10.7%	6.8%	3.4%	22	0	**22**	20	0	**20**	19	5	**14**
Tembesu	3.85	±0.72	18.6%	11.8%	5.9%	24	2	**22**	17	3	**14**	1	0	**1**
Durian	5.29	±0.86	16.3%	10.3%	5.1%	12	14	**2**	31	0	**31**	2	1	**1**
Bedaro	9.10	±1.47	16.2%	10.2%	5.1%	34	132	**98**	14	3	**11**	0	0	**0**
Petai	3.69	±0.58	15.8%	10.0%	5.0%	3	5	**2**	10	1	**9**	15	5	**10**
Cempedak	1.56	±0.34	21.9%	13.9%	6.9%	1	0	**1**	2	0	**2**	0	1	**1**
Pasak Bumi	18.82	±1.63	8.7%	5.5%	2.7%	36	24	**12**	20	24	**4**	60	86	**26**
Lipai	94.63	±11.77	12.4%	7.9%	3.9%	7	11	**4**	27	43	**16**	370	440	**70**
Salak	3.79	±1.12	29.6%	18.7%	9.3%	4	3	**1**	0	0	**0**	3	2	**1**
Bambu Mayan	1.28	±0.60	47.1%	29.8%	14.9%	31	30	**1**	0	0	**0**	1	1	**0**
Bambu Mumpu	7.82	±2.51	32.2%	20.3%	10.1%	153	164	**11**	0	0	**0**	0	0	**0**
Rotan Sego	2.77	±0.81	29.1%	18.4%	9.2%	248	3	**245**	0	3	**3**	3	2	**1**
Rotan Udang	10.70	±2.31	21.6%	13.6%	6.8%	178	3	**175**	1	2	**1**	42	17	**25**
Rotan Jerenang	10.68	±1.95	18.2%	11.5%	5.8%	174	30	**144**	1	189	**188**	2	10	**8**

APPENDIX B. Reviewers' comments on field manual

Review by M. Philip

17 July 1998

Dear Mary

Many, many thanks for letting me see your masterpiece. I do think that it is both excellent and just what is needed. I thought the layout excellent and the whole was easy to read, though there is (intentional) repetition in many parts. I particularly liked the excellent illustrations and examples that lightened the text. I enclose my rather niggly comments for your consideration; their extent reflects my interest in what I read.
I have only three major comments. They are:-
Think again about confidence limits, the definition of a plot and the number of transects you recommend.

Consider a little more on volume tables - if you visualise that villages may be selling timber.

Try to give some guidance on precision. If the area data are unreliable, then total quantity is bound to be unreliable - but quantity per ha can be reliable. This carries the corollary that villagers should be wary of reaching conclusions and making decisions based on total quantity.

It is large and I know only too well how difficult it is, for one who is close, to change it. Apart from checking on repetition and considering cutting out the survey part in Ch 6, I would leave it alone and concentrate on getting it published and jumping into something new.

I shall be delighted to put an invoice in to Sandie Hardaker for 1.5 days work - I'm becoming very mercenery in my old age as my Talisker consumption increases. Many thanks.

Yours aye,

Michael S. Philip

PARTICIPATORY INVENTORY

Iconography excellent 'plus or minus' not in type script.
p2 2nd para up: sampling not a key innovation - it dates from Brandis
App, A very good
Box l.l could be improved by indenting 2 and 4 and changing their numbers to la, and 2a, etc. The verbs - negotiate, predict, describe, plan might be high-lit.

I rate **Chapter 1** excellent in content, layout and presentation.
Repetition of Box 1.1. and 2.1, otherwise **Chapter 2** excellent.

Check list in App B l.l very good. Surprised you don't use 'gate' booking in Fig B5. Suggest that the boxes in Fig. B6 are square to match the text - not rectangles - (not important).

Appendix C good.

Chapter 3

App D Oh. Mary, Mary, Mary. You cannot maximise A and at the same time minimise B (i.e precision and cost) when they are antagonistic. You have avoided this pit trap up to this point. You yourself see this in the third succeeding line! I suggest that you are unwise to set an impossible aim. I do not agree that you need a balance. One has to be the aim and the other a constraint; this is usually the maximum cost or resource use -often time. If you haven't got a constraint then you may consider 100% inventory.

Example D.2 I think you should high light the pieces of information you need for the calculation:

number of working days available number of teams working each day
number of plots a team completes per day.

Table D.l. When I read this I hadn't seen any explanation of the Coefficient of Variation. Give a reference to Step 3 and form Dl. The use of underlining of some integers is misleading, I think (p 255-7). I would prefer the use of 'sum of squared deviations from the mean' to just 'sum-of-squares'.

Example D.4. Should you add the conclusion from the calculation that the planned 900 plots would be completed within the set period.

App E. Productivity Study - is missing in my copy

App F. and or H. You make no mention of the system of dividing a right angle into 100 grades. Some compasses that I have used (Scandinavian ones) use grades rather than degrees.

App G No comment

App J. I believe Student was the pen name of W.S. Gosset - a statistician - and should have a capital initial letter.

App L. Regeneration and CFI not in my copy.

App N. For purpose 1, I should rate the delineation and mapping of boundaries a very high priority.

P311 3rd heading 'Analyses needed" 2nd & 3rd bullets - I don't think that it is a question of 'drawing a larger or smaller inventory area on the map". Better phrasing might be' a larger (or smaller) area of forest will be needed to supply the average annual needs,.. No mention is made for changing demands due to population or social changes.

This section did not have a favourable impact on me. In your attempt to be inclusive you have become repetitious and over simple. By the time readers have reached or jumped into this appendix, I feel that they are more competent than you give credit. Is it worth looking at its structure again?

Chapter 4.

No comment

Chapter 5.

Why do you have N/A against Materials required on p 52? NB your protractor and compass must be in the same units (degrees or grades). Fig. 5.1 does not show the strings for tightening Fig 15.5 is better. I should have though that to be consistent Ch 15 should be an appendix, just as map making, surveying and measuring techniques are.

Chapter 6.

I do not think that the dimensions of the map necessarily reflect its accuracy. Maps as large as l m x l.5 m will be quite difficult to spread out in the field. Maps can be sub-divided into more easily handled sheets.

Do you need to mention map copyrights? You do not mention changes of scale and distortion when copying aerial photographs; is it important? How can you trace the scale, latitude and longitude grid and the North symbol from an AP? Is your section

6.2.2 on enlarging maps necessary? Is it right to have this in the main text, or should it be added to App. F? Though you mention distortion, do you give it sufficient emphasis? What is a large scale map? Is it one with a relatively large scale fraction. i.e. a small number to the right of the colon?

I do not get a clear picture about how accurate you feel planning maps need to be. Obviously the more accurate the better, but what are the minimal requirements? I suggest that they enable you to find your way about the inventory area easily; locate sampling units in the population to be sampled.

The requirement to estimate the area of the population is another question. If you cannot do this then any estimate of the size and confidence limits for the whole population is unthinkable.

6.3 You really are inventing the wheel and doing it no better than the Egyptians. Your plea to have all the necessary, simple information in one book does not convince me. I think that you would be wiser (I am sure that you will take no notice!) to leave out the surveying lessons. Surveying is a very useful tool for so much of resource management that it should not be part of your manual on inventory. Unskilled persons could go so very wrong You say nothing of what to do if the forward and back bearings do not agree; nothing on advisable lengths of open and closed traverses, or on cross-ties in traverses, or on acceptable closing errors.

The optional information on p 78 repeats that given on p 71. Before reading Chapter 7 it occurs to me that if you are advocating a systematic grid, then most of the surveying needed will be gathered during the lay-out of the grid. The most important technique will be laying out compass lines on known bearings.

Chapter 7,

7.1 I can visualise doing 100% inventory of doing and a 5% inventory of other trees in the same area - so are your comments in lines 18 & 19 correct?

Is the random start for the first line very important. What does it mean in practice?

page 84 I suggest you delete the final part of the first sentence, ending the sentence with the words 'working units'. Your diagrams make the meaning clearer than the deleted words.

7.2.2 At this stage the boundaries may not be known precisely - so stress that this area estimate may not be precise but is needed to help you plan the distance between lines, etc. I am still a little uncertain about plot size (You give it in 13 and D2.l, but have you a clear reference to it in Ch. 7?). If you have standardised on 10 m. width then the whole of 7.2.3 concerns transect length, either in metres or in multiples of 50 m. I would suggest that it might be easier to calculate for each working unit:-

the total area of the sample that you can afford,A
the area of the unit,a

the sampling fraction,a/A
the distance between transects = 10 m/sampling fraction.
The number of inventory lines is the total length of the base line divided by the distance between transects.

What happens if the calculation is less than 1 transect? Presumably you have the wrong orientation for the baseline? Your sketches seem to indicate you desire at least 4 transects. I do not like your reference to plots. The plot is the transect that is sub-divided into sub-plots for checking, booking, etc. I do hope that you are not using the number of sub-plots as 'n' in a calculation of the S.E. In Section 7.2.3 I would divide the area of the sample in proportion to the area of the working unit; I would not use 'number'.

Chapter 8

I see you use cm and m in defining tree sizes; is it better to translate these into head height, less than finger thickness, etc? Bamboo can also be aged with reference to the presence and freshness of the bracts, can't they?

p 106 Are not you being excessively pedantic in defining tree diameter as passing through the pith - especially as App K shows you deriving it from a girth measurement. I do not like your definition of height to crown; it is usually defined as the height to some degree of live branching - not in terms of visibility. Fig 8.6 You should stress that these can usually only be measured from the ground on open grown trees. Your comments on diameter growth of different plants led me to try to remember my plant anatomy. As I recall, palms can increase in both diameter and height. I think, but am not certain, that the diameter of a bamboo culm is governed by the diameter of the bud on the rhizome and doesn't increase. Do any bamboos extend in length (height) for more than one growing season? They certainly have secondary, etc. branching.

p 113 Slope position: I have always found eluvial, colluvial and alluvial useful.

Chapter 9

In Table 9.1 why have you changed from WU = working unit to A = area? I am a little confused between line number, plot and subplot. You have not, to my mind, very clearly given the lay out. I deduce from various sources that you are closing booking in a 50 m plot every 10 m and calling it a sub-plot a, b, etc. This is shown in Fig.13.l. Do you really need slope aspect etc every 10 m? what will you use this information for? (I agree that closing booking every lO m is a good idea and helps enormously with checking.)

Chapter 10

Mary, you really are dotting the Is, crossing the Ts and adding the tail to the Qs! If you are talking about soap - what about towels? You can wash dishes with sand and ashes.' More seriously, why aren't the coloured tape, metre tape, etc in Box
10.2 also in 10.1?

p 131 I suggest you explain the purpose of checks or give a reference to Ch 14; my experience is that checks should be done in the presence of the original team- even by the original team but under the guidance of an independent leader. I am not so keen on one team checking another's work as it can be disruptive - but what is your own experience? I prefer random checks in sub-plots rather than complete re-enumerations of longer stretches. I do suggest that teams should re-check their own work at intervals as a routine operation. Again my experience is that one needs to take botanical specimens when one comes across an unknown species. It may not be easy to return and find the specimen again. How likely is botanical collection to be needed in this type of inventory by villagers?

Chapter 11

You do not stress the use of three sticks to align a transect; personally I have found that many people are frightened of compasses and few are confident; however once two sticks have been aligned, almost all are good at setting a third in line and so on. To my mind this is quicker and better than using a compass along

the line. Occasionally, when one meets an obstruction, the compass has to be used to restart the line. I advocate 'step measuring' on slopes up to 50%.

I feel you should stress the need to ensure good visibility along the transect centre line.

Chapter 12

Fig. 12.2 Why do you have two starting points marked on the 3rd transect from the bottom of the picture? Similarly on the 2nd transect of Fig. 12.4?

Chapter 13

Trying to put myself in the position of a novice, I think that I would have liked some of the detail about plot demarcation earlier. It is worth considering this. See my remarks in Ch 11 above. One advantage of a narrower plot - say 5 m.- is that the outer boundary can be checked with a 2.5 m stick carried by the enumerator. There are pros and cons.

Chapter 14

I feel that the result of checking should be apparent immediately - so that the reason for errors can be sought. I do not really like you scheme of doing it in the evening. As you well, know the idea is not to discover bad workers, but to reward, train and maintain standards, It is terribly easy to destroy camaraderie and substitute resentment.

Chapter 15

Fig. 15.1 if you label c compound palmate, also label b compound pinnate. You should stress the need to change and dry the paper in presses at least once a day. I use to kill fleshy parts by dipping them in boiling water - unfortunately it destroys their colour.

Chapter 16

No comment

Chapter 17

17.1 You should make it clear that your example had 50 plots; is it wise to use a round figure? similarly the total for the area or forest type may not be on every page - but only at the end of that area or type.

The whole question of precision gives me cause for concern. So far you have made no mention of the number of transects. I would suggest that there is a minimum required - say 3 per working unit. If the allocated number of plots does not permit this minimum, then I feel either their length or width should be reduced.

I feel precision should not be calculated in situations where the area calculation is very approximate (i.e. where there is no accurate base map on which to work.) I am deeply suspicious of your cavalier approach to degrees of freedom within the data. Should you think again about bringing in **y2** on the compilation form? - At least make it optional like the calculation itself. Then the calculation must have warning notices - it is very likely to mislead because your plots are not independent and your degrees of freedom for 't' are too high. Your design is really a cluster; you are calculating the precision from the pooled within cluster variance and ignoring the, probably, larger between cluster variance. What is your justification for your approach? So I went to App I to see what you say there.

App I

I accept the arguments for using systematic sampling, though I do not see why in Fig 1.1 you have eliminated all but strip sampling when, in fact, you have used a cluster design. Nor have you justified enumerating 100% of the transect; you could sub-sample every other plot, etc. This appendix does not allay my fears about the confidence limits. Surely others have brought this point to your attention.

Basically I am saying - don't calculate confidence limits but ensure that you have a reasonable number of transects (whatever this means, perhaps at least 10?).

Chapter 18

I think that you have again gone over the top here - especially in 18.1.2 B. Who on earth is interested in the food eaten during the inventory!! You are encouraging reports that will be too long and unread.

Chapter 19

No comment.

App H As I have mentioned above, I think many people will have difficulty reading compasses. I would put in more on aligning sticks. On the whole this appendix is useful - more useful than the surveying in Chapter 6. Measuring on slopes is fine P. 280 I think that there is an error in the paragraph above the example H.l. P.281 Do all compasses have a red end? - certainly not the military ones with which I am familiar.

App K NB 'The point on the body is only bh if the operator is standing with her/his feet level with the base of the tree. Give a warning that the 0 mark on tapes may or may not be at the end. Make sure 20 and a bit is not read as 19 and a bit. I think that you might mention what to do with fluted trees or trees with irregular X-section. Give warnings about trying to measure tree heights when you cannot see the top of the tree. On the whole I would warn against trying to measure tree height in closed canopy forest.

App N I was a little surprised that nowhere do you mention volume tables as being necessary when doing economic valuations of timber. I agree that they are beyond the scope of the book, but I think they should be mentioned.

Review by H. Wright

PARTICIPATORY INVENTORY

A Field Manual Written with Special Reference to Indonesia

MC Stockdale and JMS Corbett

Draft Tropical Forestry Paper 38 - Comments by HLW

General
Overall I found this an excellent manual. I particularly liked the format and structure in which much of the more technical detail is contained in Appendices and each Chapter begins with information as to where you are in the participatory inventory process, the objectives, skills, *etc*. The amount of detail is comprehensive with good illustrations, resulting in a lengthy manual; however, I think that this is justified. I would rather see more detail in a manual of this type than less. It would make sense for the final TFP to be ring bound to enable it to open flat for photocopying.

I have only a limited number of 'serious comments' but a considerable number of minor typographical errors. I give these below in order from the beginning.

Acknowledgements
You need to include the standard DFID disclaimer as the last para
"This publication is an output from a project funded through the Forestry Research Programme of the UK Department For International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID. Project code R6352 Forestry Research Programme."

Introduction
p2 bottom 'reliable estimates of *total* quantity with'; next sentence ' techniques *to be* recommended'
p3 para 4 last sentence '*may lose* credibility'
p3 bottom (and elsewhere in manual) the plus or minus sign is better given as a symbol (∀) than an underlined plus
p4 rephrase second para
'*The most important practice in increasing the precision of an estimate, as opposed to increasing accuracy, involves:'*

Chapter 1
p18 Box 1.2 *under-represent* not underrepresent in 1. and *inventory* not inventoery in 2.

Chapter 2
p27 2.2.2 rather than 'products' the word '*outputs*' might be better to reduce any confusion with forest products (used overleaf).

Chapter 3
p36 'recurrent inventory' should be in the glossary
p37 Objective 3 you could add *Sacred groves* as an example of an area which should be excluded.
p41 Objective 6 delete 'there' in third bullet point; Objective 7 Precision also depends on the inherent variation and if this is very large then it may not be possible to obtain the level that you want. I suggest that the sentence 'It is always possible . . . ' be rewritten as '*It is usually possible . . '*
p42 Box 3.1 plus/minus sign and last sentence '*describes'* not described.

Chapter 4
p46 Skills Appendix E last word '*and'* not nad

Chapter 5
p53 Box 5.1 third item in list, 'At least 1 metre tape' - delete metre as confusing

Chapter 6
p68 6.2.2 delete '*they'* in '. . . areas they are long . . '

p72 Fig 6.4 increase size of legend and add words '*along a river'* after linear traverse in caption
p73 6.3.2 point 4 delete '*from that the tape'* in third sentence; Footnote 16 delete ??????
p75 6.3.3 Fig 6.6 It is difficult to relate notes in notebook to sketch; it would be clearer to give at least a complete station traverse
p76 Choosing a scale: second para applies only if the traverse is reasonably straight

Chapter 7
p89 3. better to use 'square metres' rather than 'metres squared'
p90 7.2.4 I did not find this section the most straightforward and I am sure that it can be made easier to understand. Figures 7.10 and 7.11 should use the same example and it could be useful to include a final version as 7.12. they also need to be positioned better in the text. Would it make more sense to put the calculation of length of line for the allotted numbers of plots earlier in the section?

Chapter 8
p99 8.1.1 fifth bullet point; word omitted 'clumped or and . . '
p100 Table 8.1 bracket together Diameter at breast height and Height - it looks as if you measure dbh on seedlings and height on saplings.
Either in this Chapter or in Appendix K it might be useful to mention that many forest departments have standard mensuration techniques described, often in local languages.
p106 give a footnote reference for the last sentence?
p105 Rattan size para 2 'difficult5' - the 5 should be superscript.
p112 Example 8.1 para 2 delete '*to limit their inventory to'* or substitute '*in their inventory'*
p114 Fig 8.9 The numbers on the diagram are the wrong way round (or the text in the caption!)

Chapter 13
p164 Fig 13.5 the figure implies that the side-stepped plot should be assessed, however, doing so would introduce bias; in the case illustrated only the left hand part of the plot should be measured. This needs to be made clear.
p167 Figure 13.7 You could put a tick and a cross against the two lines to reinforce which is correct.

Chapter 14
p170 Introduction: perhaps you could stress that it is important to get over the idea of checking to everyone and that it is for the benefit of the inventory as a whole rather than a 'spying' exercise on individual teams or members of a team.
p171 14.1.1 Are the check objectives set by each team or for the inventory as a whole if there is more than one team? This seems to imply that <u>each</u> team can set its own objectives.
p173 14.3 no footnote 2

Chapter 17
p206 Introduction; delete *is* in second bullet point last sentence; plus/minus sign in last para.
p207 17.1 third bullet *filling* not filing
Figure 17.1 first column the underlining of the page numbers needs correcting
p209 17.1.2 No of plants squared; there is a 32 instead of 3^2
p211 17.2.2 step 3. second sentence the symbol is wrong - it should be y bar
p212 17.2.3 step 7 symbol for SS missing; step 9 underlining of 0.1
step 10 the lower confidence limit is different from the reliable minimum estimate in that a different value of *t* is used to reflect that it is essentially a one-tailed test you are interested in. I would delete the phrase '*also known as . . . '*
step 17 last para symbol missing after i.e.

Chapter 18
p217 18.1.1 first point 2. inventory1 instead of inventory[1]
p219 III Results A remove 'or reliable minimum estimates'

Appendix D
p248 Introduction plus/minus sign
Box D.1 the Dawkins paper is not in the reference list
p250 D.1 under step 3. It might be worth emphasising that if the estimated precision is greater than the desired this implies that fewer plots would be needed by inserting '. . . result means that *fewer plots are*

needed and hence the cost could be lowered *to achieve* the desired precision.' In a similar way I think that for the next point you should spell out that more plots are needed.
p252 D2.2 Table D.1 Box D.1 does not explain CV%. I think the caption for this table should specify that it is for a CV% of 600 '. . . levels of precision *for a CV% of 600'*. It could be useful to add two lines to the bottom of the note saying
'If CV% is < 600 then less plots are needed
If CV% is > 600 then more plots are needed.'
p256 step 11 603% needs underlining to be consistent.
p257 Cal form D.1 step 1 symbol needs a 3 not an S

Appendix F
p260 Example F.2 perhaps the river should be shown slightly smaller - it appears to be about 100m wide!

Appendix G
p267 G.1.2 one disadvantage of aerial photos is that they may well be out of date
p268 G.2.1 begin with '*In Indonesia* a large number . . . .'
p269 G.2.2 last sentence rephrase as 'It might be worth trying to ask a local office to lend or give you a map.'

Appendix H
p275 H.2 Perhaps you should define 'bearing' again
p278 Fig H.12 mirror not miorror

Appendix I
p286 I.1 para 2 resource not resopurce. Caption for Fig I.1 needs the word *steps* after 'decision-making'.
p288 I.1.2 bullet 2 delete 'the' after remaining. Fig I.4 add the word distribution after 'pattern of plot' in the caption.

Appendix J
p293 J.1 plus/minus in third para. In para 4 you give 1.6 as the value of *t* for 90% although in the table it is 1.697. Should you round it? It should be *Table J.1* not *Figure J.1*

Appendix K
p299 K.2 I find the first sentence misleading. What use is the height a given in Fig K.6? It might be better if the example did not show such a lean. I would suggest something like:
'When estimating tree height it is usual to assume that the tree is vertical. In some cases, however, the tree might be leaning which can lead to an over- or under-estimate of height especially if using a heighting instrument.' and perhaps omit the Figure.
p302 K.2.2 Estimating height with a clinometer. Fig K.9 in caption, from not form. It might be worth adding that to minimise error they should choose a position at right angles to the direction of any lean if possible. Also that some clinometers have a percentage scale which makes calculation of height so much easier. In fact if ordering a clinometer they should specify percentage and angle scales.

Appendix N
p313 footnotes 7 and 8 are the same.
p315 there is no footnote 12 and footnote 11 should be Appendix L not E

Appendix P
p321 Objectives P.2. insert 'form' after '. . a full data'