

Criteria and Indicators for Sustainable Plantation Forestry in Indonesia

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List of Abbreviations

C&I	Criteria and Indicators
CFI	Continuous Forest Inventory
CIFOR	Center for International Forestry Research
FMU	Forest Management Unit
HTI	Hutan Tanaman Industri (Timber Estate Enterprise)
IFGM	Iterative Filtering and Generation Method
IPF	Intergovernmental Panel on Forest
ITTO	International Tropical Timber Organization
IUCN	International Union for the Conservation of Nature
LEI	Lembaga Ekolabel Indonesia (the Indonesian Ecolabelling Institute)
MAI	mean annual increment
NGOs	Non-governmental organisations
PSP	permanent sample plots
SFM	Sustainable Forest Management
UMR	Upah Minimum Regional (regional minimum wage, under the Ministry of Manpower Indonesia)
WWF	World Wide Fund for Nature

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Executive Summary

Background

Industrial plantations of fast-growing species are being established on a large scale to meet increasing demands for wood in Indonesia. There is a growing concern over the long-term sustainability of wood production and the environmental and social impacts of the development of this resource with a government target of 4.5 million hectares of plantations.

In recent years the Center for International Forestry Research (CIFOR) has developed a system for testing criteria and indicators (C&I) to assess the sustainability of management of natural forests at the level of a forest management unit (FMU). This system was used to develop and test C&I for industrial plantations of predominantly *Acacia mangium* at three concession areas in Indonesia. The companies collaborating in this project included PT Arara Abadi, located at Riau, Sumatra (field test 1); PT Musi Hutan Persada, at Subanjeriji, South Sumatra (field test 2); and PT INHUTANI II, at Pulau Laut, South Kalimantan (field test 3).

Field testing was conducted in 1997 and 1998 to determine minimum sets of C&I at the FMU level for each concession area. It was carried out by interdisciplinary teams with expertise in socio-economics, forest management and ecology. Several members of each team were also familiar with the CIFOR process of testing C&I and with forest certification.

Field Tests

The CIFOR process for developing, testing and selecting C&I for sustainable forest management is based on an iterative filtering and generation method (IFGM) comprising three stages of evaluation or filters (Prahbu *et al.* 1999).

The first stage (Filter No. 1) identifies an appropriate set of C&I from various sources based mainly on professional judgement by the expert team.

The second stage (Filter No. 2) evaluates the candidate set on-site, based on discussions and

interviews with stakeholders, field surveys and documented information. Regular team discussions are held during this stage to review and revise proposed C&I and to address overlap and discrepancies.

The third stage (Filter No. 3) is a post-field workshop to review and revise the proposed C&I with input from the team as well as invited participants with expertise in the various disciplines. Following this workshop the team prepares a final report on C&I selected for each site, with comments on the IFGM process.

Synthesis of C&I for Plantations

The C&I selected by the teams for each site were compared systematically based on keywords and comments recorded by the teams to determine commonality. Based on this synthesis a core set of C&I applicable to all three sites was formulated. This set was reviewed by the primary stakeholders and future users of C&I at a final workshop for the project.

Results and Discussion

Candidate sets were selected from international published sources of C&I developed by CIFOR, ITTO, LEI, WWF-IUCN and SmartWood. The average number of C&I selected for field testing by the teams during this first stage of the IFGM process showed an emphasis on socio-economic (56 indicators) and management (58 indicators) issues compared with ecological and environmental issues (29 indicators).

The C&I selected by the teams after completion of field testing at each site (stage 2) showed some common trends. The majority of indicators (46% to 60%) addressed issues related to forest management. This compares with indicators for socio-economic (20% to 24%) and ecological issues (18% to 30%).

Examination of C&I showed a higher percentage of indicators common to all three sites for management (65%) and ecological issues (65%) compared with socio-economic issues (46%). The

level of semi-common indicators, i.e. common to two out of three sites, was similar ranging from 30% to 35%. In contrast, a relatively high percentage of socio-economic indicators (24%) were unique for each site.

The high degree of commonality in indicators related to forest management is a reflection of the similarity in management systems adopted by the companies developing the *A. mangium* plantation resources in Sumatra and Kalimantan. Likewise, good agreement between ecological indicators was not unusual, as the environmental issues were often similar at each site. In contrast, a comparatively high percentage of socio-economic indicators were unique (24%) addressing issues specific to the local and indigenous communities at each concession area.

Content of C&I

The C&I reported for each site were compared in order to identify a minimum set applicable to all sites. A comparison of C&I selected by each team for the principles of socio-economics (see Table 6), forest management (see Table 7) and ecology (see Table 8) formed the basis for the formulation of a core set of C&I for industrial plantations in Indonesia (see Table 9).

Principle: 'Human well-being is enhanced'

The principle 'Human well-being is enhanced' reflects the intention that sustainable development of plantations must improve the socio-economic condition and well-being of local communities. The C&I proposed for this principle address the following issues:

- security of land tenure and land use (4 indicators);
- participation in forest management (4 indicators);
- sharing of social and economic benefits (7 indicators); and
- industrial relations and responsibilities of primary stakeholders (6 indicators).

Principle: 'A management system is in place to enhance sustainability'

This principle is based on the assumption that the system of forest management should maintain or improve long-term site productivity. The emphasis at all sites was on forest management plans and their implementation, resource inventory, research and

development, and the availability of funds for the management of plantations as well as conservation forests within the concession area. Other issues identified include the implementation and monitoring of silvicultural practices, forest health and protection, and the development of human resources. The core set of C&I address:

- management plans (9 indicators);
- resource management strategy (4 indicators);
- research and development (2 indicators);
- financial support (1 indicator);
- forest protection (3 indicators);
- monitoring of activities (3 indicators); and
- human resources (5 indicators).

Principle: 'Ecosystem function is maintained or improved'

This principle assumes that sustainable management of plantations can only be achieved if the ecological functioning of the FMU is either maintained or improved. It is also assumed that ecological issues are relevant to the entire FMU comprising plantations as well as conservation areas for the protection of biodiversity and to meet the needs of local communities. The C&I proposed address the maintenance of ecosystem function including potentially adverse environmental impacts of plantation development and the protection of land and water resources. The core set includes:

- structure and function of the ecosystem (5 indicators);
- soil and water resources (2 indicators); and
- environmental impacts (2 indicators).

Consultation Process

Workshops were conducted during the latter stage of the project to present and discuss the proposed core set of C&I with the primary stakeholders and future users of C&I. The main concerns raised during discussions with the participants, including LEI and companies that participated in the field testing, were related to:

- security of forest resources and protection against illegal logging;
- land use rights of local communities;

- competing economic activities by local communities;
- confidentiality of financial information; and
- monitoring of environmental impacts.

Conclusions

The CIFOR process for developing, testing and selecting C&I at the FMU level was used to formulate site-specific C&I for plantation concession areas on Sumatra and Kalimantan. Once expert teams were familiar with the IFGM method, the process of evaluating, testing and reviewing C&I was found to be efficient and effective.

The time allowed for field testing (15 days) was generally adequate for the evaluation of C&I dealing with forest management and ecology. However, this time was considered insufficient to fully evaluate C&I dealing with socio-economic issues because of a greater requirement for interviews and consultations with local communities.

The proposed core set of C&I comprises a mixture of process- and output-oriented indicators. It is essential to have both types of indicators to provide not only an assessment of the mechanisms or management procedures that are in place but also to evaluate the effectiveness of the management system in delivering the results conducive to long-term SFM.

Compared with the CIFOR generic set of C&I for natural forests, the proposed core set of C&I for industrial plantations places less emphasis on the conservation of biodiversity. The C&I for plantations have a strong focus on forest management and environmental impacts, but it is of interest to note that the main concern of primary stakeholders for long-term sustainability of plantation forestry was related to social rather than management or environmental issues.

The initial brief for the project was to evaluate C&I at the FMU level and therefore issues related to legal and institutional arrangements at regional and national levels were not included in the process. However, these arrangements can have a significant impact on SFM at the FMU level and therefore cannot be ignored. For example, the initial allocation of land for plantation development by government agencies without due consideration of the traditional rights of local communities was often stated as the primary source of conflict and land demarcation disputes between stakeholders at the FMU level. Likewise the issue of responsibility for forest protection against illegal logging requires resolution between stakeholders at least at FMU and regional levels. It is therefore important to include C&I on legal and institutional arrangements and for government agencies responsible for plantation development to be involved as stakeholders in the process.

1. Introduction

It is widely accepted that forest resources should be managed to meet the economic, ecological and cultural needs of present and future generations. Therefore forest management must respond to environmental, social and economic issues. This requires feedback of relevant information between planning, implementation, control and impacts of forest management. An hierarchical system of principles, criteria and indicators can be used to organise this information in a manner useful to conceptualise, evaluate and implement sustainable management of forests (Lammerts van Bueren and Blom 1997; Prabhu *et al.* 1999).

The concept of criteria and indicators (C&I), which was designed to be used in assessing the sustainability of forest management, has been evolving since 1995 when this issue gained recognition by the Intergovernmental Panel on Forests (IPF). Several international institutions have developed guidelines and C&I for sustainable management of forests. For example, ITTO launched criteria for assessment of sustainable tropical forest management/SFM (ITTO 1993); WWF and IUCN developed guidelines for timber plantations, environmental, social and cultural issues relating to commercial afforestation (WWF and IUCN 1997); FSC introduced general principles and criteria for forest management (Forest Stewardship Council 1999); SmartWood Program of Rainforest Alliance released generic guidelines for SFM assessment (SmartWood 1998); and LEI (Lembaga Ekolabel Indonesia 1999) also developed C&I for SFM of natural and plantation forests in Indonesia. CIFOR has developed a generic process for the development and evaluation of C&I for natural forests (Prabhu *et al.* 1999).

Forest resources in Indonesia comprise about 112.3 million ha of which 29.3 million ha are reserved for protection forest, 19 million ha are conservation

forest and 64 million ha are production forest (Kartodihardjo 1999). At present the domestic supply of log and chip wood from natural and plantation forests has reached 45.8 million m³/year while the demand for wood products is estimated at 57.1 million m³/year (Kartodihardjo 1999). To meet future demand, the government encourages the establishment of industrial timber plantations (HTI). In October 1998, 98 HTI units totalling a land area of 4.6 million ha had been approved by Ministry of Forestry and Estate Crops (MoFEC 1998). The Reforestation Fund (Dana Reboisasi) is the mechanism by which the Government of Indonesia provides financial support to HTI development.

This government strategy aims to meet increasing demand for wood from industrial plantations rather than natural forests. Plantations of fast-growing species such as *Acacia mangium* are being established on a large scale mainly in Sumatra and Kalimantan. This rapid development of a large plantation resource with a prime focus on wood production has raised issues related to long-term sustainability of production as well as environmental and socio-economic aspects. For example, economic problems resulting in conflict between local communities and forest concession holders are common. Also the productivity of second rotation plantations has been less than expected on some soils with low inherent fertility such as Oxisols and Ultisols. Furthermore, there is increasing concern about the long-term ecological impact of the large-scale introduction of exotic species such as *A. mangium*.

Plantations are managed with widely varying intensity for the primary purpose of commercial wood production. In many cases the management of plantations pays little attention to other environmental and socio-economic issues important for the long-term sustainability of the resource. Consequently the rapid

expansion of plantations has led to increasing opposition from NGOs for several reasons including:

- conversion of natural forests to plantations and associated loss of biodiversity; and
- displacement of local and indigenous communities.

Clearly a more holistic approach to plantation development and management is required with due consideration to not just wood production but also environmental, social and economic factors. Long-term sustainability will only be achieved by taking into account: the ecological capability of the site; intensity of management; soil, water and other environmental values; economic benefits; and social goals (Nambiar and Brown 1997).

In general, C&I can be formulated to serve at various levels of scale, namely global, regional (ecoregional), national and subnational or at Forest

Management Unit (FMU) level. CIFOR, through the international project of “Testing Criteria and Indicators for Sustainable Forest Management”, has developed a basic set of C&I applicable at the FMU level (Prabhu *et al.* 1999).

The CIFOR set of C&I together with other sets prepared by organisations such as ITTO, WWF, SmartWood and LEI formed the basis for the present evaluation of C&I for the sustainable management of *A. mangium* plantations. Field testing of C&I was conducted at two sites in Sumatra (Riau and Subanjeriji) and one site in Kalimantan (Pulau Laut) during 1997 and 1998.

The C&I identified for each site are summarised in this report. The three sets of site-specific C&I were examined for commonality in order to define a core or basic set of C&I that are objective, cost-effective and relevant to sustainable management of *A. mangium* plantations in Indonesia.

2. Methods

The guidelines and iterative process for the development and evaluation of C&I developed by CIFOR for natural forests were adopted for the present project. The methods and procedures used by three different expert teams in the field tests and the compilation and analysis of the results from these tests are described below.

2.1 Conceptual Framework

At the commencement of the project, the conceptual framework of Principles, Criteria and Indicators for sustainable forest management, as outlined by Prabhu *et al.* (1996) was discussed with the expert teams. It is important that team members with different expertise understand the conceptual framework so that the team functions within a common frame of reference. Therefore it was ensured that all team members were familiar with the CIFOR process, the IFGM procedures and that they had access to background information. Some valuable references provided by CIFOR included:

1. ITTO Guidelines for the Establishment and Sustainable Management of Planted Tropical Forests, 1993.
2. Hierarchical Framework for the Formulation of Sustainable Forest Management Standards - Principles, Criteria, Indicators, 1997.
3. Guidelines for Developing, Testing and Selecting Criteria and Indicators for Sustainable Forest Management, 1999.
4. Guidelines for Timber Plantations - Environmental, Social and Cultural Issues Relating to Commercial Afforestation, (draft) 1997.

5. Testing Criteria and Indicators for the Sustainable Management of Forests: Phase 1, Final Report, 1996.
6. C&I developed by Forest Stewardship Council and SmartWood Program of the Rainforest Alliance.

The conceptual framework reported by Prabhu *et al.* (1996) formed the basis for the initial workshop to educate the teams and achieve a common understanding. The step-by-step procedure included:

- definition of the main terms, such as principles, criteria and indicators;
- establishing relevance to sustainable forest management;
- identification of the constraints under which assessment of sustainability takes place;
- identification of the hierarchical links and relationships among the elements;
- identification of a strategy for developing an operational and cost-effective assessment system; and
- identification of a minimum number of reliable criteria and indicators for each test site.

The elements of the hierarchical framework are defined according to Prabhu *et al.* (1999).

A **principle** is defined as fundamental truth or law as the basis of reasoning or action. In the context of sustainable forest management, principles are viewed as providing the primary framework for managing forests in a sustainable fashion. Principles provide the justification for criteria, indicators and verifiers.

A **criterion** is defined as a principle or standard that a thing is judged by. A criterion can therefore be viewed as a second-order principle, one that adds meaning and operationality to a principle without itself being a direct measure of performance. Criteria are the intermediate points to which the information provided by indicators can be integrated and where an interpretable assessment forms. Principles form the final point of integration. In addition to considering criteria as the second-order principles, they should also be viewed as a reflection of knowledge. Knowledge is the accumulation of related information over a long period of time. It can be viewed as a large-scale selective combination or union of related pieces of information. Examples of such criteria are: 'Primary functions of the forest ecosystem are maintained'; 'Processes that maintain genetic diversity are conserved'; and 'Just access to benefits is assured'.

An **indicator** is any variable or component of the forest ecosystem or the relevant management systems used to infer the status of a particular criterion. Indicators should convey a 'single meaningful message'. This 'single message' is termed information. It represents an aggregate of one or more data elements with certain established relationships. For example: 'Seed sources are secure'; and 'Conflict levels are low and not rising'.

A **verifier** is defined as data or information that enhances the specificity or the ease of assessment of an indicator. Verifiers provide specific details that indicate or reflect a desired condition of an indicator. They add meaning, precision and usually also site specificity to an indicator. They may define the limits of a hypothetical zone from which recovery can still safely take place (performance threshold/target). On the other hand, they may also be defined as procedures needed to determine satisfaction of the conditions postulated in the indicator concerned (means of verification).

2.2 Team Composition

The project commenced in May 1997 with the establishment of a steering committee with representatives from the following organisations: Faculty of Forestry, Bogor Agricultural University; CIFOR; Ministry of Forestry; Association of Indonesian Forestry Companies; Lembaga Ekolabel Indonesia; Dewan Standardisasi Nasional (National

Standardization Board); and a Country Co-ordinator appointed by CIFOR.

Selection of the scientists for the teams was conducted with the cooperative assistance of the Dean of Faculty of Forestry, Bogor Agricultural University; Dean of Faculty of Forestry, Gadjah Mada University, Yogyakarta; and the Head of the Forest Research and Development Agency, Jakarta. An open invitation was also posted electronically through "forestry-indonesia" mailing list on the Internet. A special invitation was sent to Mr Tan Kee Chong (Malaysia), a former employee of PT Arara Abadi and a specialist in forest plantations, on the suggestion of Mr Christian Cossalter (CIFOR).

Field testing of C&I was conducted by three teams, each with expertise in forestry, ecology, sociology and economics. The time allowed for field testing (15 days) was based on CIFOR's experience from other C&I studies. Members with the same expertise worked together closely for all field activities as a subgroup within each team. The team as a whole worked together as an interdisciplinary group providing different views on C&I issues from the perspective of each discipline.

The knowledge and experience with C&I and familiarity with the field sites varied between teams. However, it is important to note that all teams included at least two members who were familiar with C&I and certification.

Composition and some important cognitive data of the three teams are presented in Table 1. Years of experience relates to practical field as well as academic work experience and reflects the background knowledge of a team member of the study site.

The diversity of experiences and knowledge on C&I of teams will ultimately affect the outcome of C&I testing. It is therefore important for team members to have a common understanding of C&I and the process of evaluation. It took several days to achieve this simply because team members came from totally different backgrounds in terms of education, training, attitude and culture.

2.3 Test Sites

2.3.1 Background

Since its introduction in Indonesia in the mid-1980s *A. mangium* has become one of the three most common tree species for the establishment of plantations. It is

Table 1. Composition of the Indonesian test teams

Team	Expertise	Years of Experience	Knowledge of C&I	Region of Origin/Gender	Site Knowledge
1	Silviculture, <i>forest management</i>	8	None	Malaysia/M	Fair
	Forest planning, <i>forest management</i>	9	None	West Java/M	Fair
	Forest economy, <i>socio-economics</i>	10	Good	West Java/M	Fair
	Forest management, <i>socio-economics</i>	7	Good	East Kalimantan/M	Fair
	Soil, <i>ecology</i>	7	None	Central Java/M	Fair
	Forest protection, <i>ecology</i>	8	None	Central Java/F	Fair
2	Forest pathology, <i>ecology</i>	10	None	Sumba/M	Fair
	Forest protection, <i>ecology</i>	5	None	Central Java/F	Fair
	Socio-economic forestry, <i>socio-economics</i>	12	Fair	West Java/M	Fair
	Forest management, <i>forest management</i>	10	Fair	West Java/M	Good
	Forest ecology/Silviculture, <i>forest management</i>	7	None	Central Java/M	Fair
3	Silviculture, <i>ecology</i>	5	None	East Java/M	Good
	Forest soils, <i>ecology</i>	10	Fair	North Sumatra/M	Fair
	Public policy, <i>socio-economics</i>	9	Good	East Java/M	Good
	Anthropologist, <i>socio-economics</i>	7	Very Good	Central Java/M	Fair
	Forest economics, <i>management</i>	15	Very Good	Central Java/M	Good
	Forest protection, <i>management</i>	15	None	Bali/M	Fair

widely planted on Sumatra and Kalimantan and plantation areas are expanding rapidly. In Sumatra, the target for the establishment of private plantations is 25,000 ha annually, and the actual planting is estimated at about 18,000 ha each year (Awang and Taylor 1993). The same trend in establishment of *A. mangium* plantations is also observed in Kalimantan. PT Arara Abadi and PT Musi Hutan Persada in Sumatra and PT Inhutani II in Kalimantan are three major concession holders establishing *A. mangium* plantations on these islands.

The vast and scattered areas of plantations established in recent years makes the selection of study sites for the testing of C&I critical. Consequently, in order to produce representative and relevant minimum sets of C&I for SFM of plantations, the field testing of C&I was conducted at three sites, located on the two islands. These sites were selected to cover a range of biophysical, organisational, management, social and economic conditions.

2.3.2 Selection and description of sites

The Ministry of Forestry assigned two forestry plantations to be used as field test sites through the letter of Mr. Titus Sarijanto, Director General of Forest Utilization, No. 848/IV-BPH/1997, dated Jakarta, 25 April 1997:

1. PT Arara Abadi in Riau Province; and
2. PT INHUTANI II in South Kalimantan Province.

However, concurrently, PT Musi Hutan Persada (Barito Pacific Group) expressed its willingness to host a C&I research team at its plantation in the Province of South Sumatra. After consultation with the management of the companies, CIFOR decided to conduct the first phase of the plantation C&I tests in Sumatra, at PT Arara Abadi (3-17 November 1997) and PT Musi Hutan Persada (1-15 December 1997). The second phase of the study was conducted at PT INHUTANI II in mid-1998.

Description of site for Team 1: Riau, Sumatra

PT Arara Abadi

Riau Province, Sumatra

The concession area of PT Arara Abadi is located in Riau Province, Sumatra. PT Arara Abadi is a sister

company of the PT Indah Kiat Pulp and Paper Corporation and is committed to providing a long-term sustainable supply of wood fibre as the raw material for the PT Indah Kiat Pulp and Paper mill at Perawang.

PT Arara Abadi manages a total concession area of 299,975 ha including industrial plantations (235,240 ha), areas for conservation of biological diversity (29,405 ha), areas for other uses like infrastructure (35,325 ha) and areas for life-supporting plant species reserved for the local community. The area of *A. mangium* plantations established up to October 1997 was 139,810 ha.

PT Indah Kiat Pulp and Paper Mill is an international joint venture company producing short fibre bleached kraft pulp, fine paper and industrial paper products. The company groups are Perawang Pulp and Paper Mill, Riau, Sumatra; Tangerang Paper Mill, West Java; and Serang Industrial Paper Mill, West Java.

Both PT Arara Abadi and PT Indah Kiat Pulp and Paper are part of Asia Pulp and Paper Company Ltd, a subsidiary of the Sinar Mas group of companies, one of the leading business conglomerates in Indonesia.

Description of site for Team 2: Subanjeriji, South Sumatra

PT Musi Hutan Persada

Subanjeriji, South Sumatra

PT Musi Hutan Persada is a joint-venture corporation of Barito Pacific Group and PT INHUTANI V managing plantation forests. The working area of this concession holder is located in South Sumatra and comprises three major plantation areas at Subanjeriji, Benakat and Martapura. After nine years the company has already successfully established 193,500 ha of industrial plantations, mainly by rehabilitating vast areas of marginal land covered in along-alang grass and other weedy shrubs. The total concession area of Musi Hutan Persada is 296,400 ha. This includes industrial plantations (193,500 ha), forest areas for the conservation of biodiversity (63,046 ha) and areas for multiple use (39,854 ha) such as infrastructure and establishment of multipurpose species other than *A. mangium* for use by the local communities.

Description of site for Team 3: Pulau Laut, South Kalimantan

PT INHUTANI II, Unit Stagen Pulau Laut, South Kalimantan

PT INHUTANI II is a state enterprise established in 1975 to promote forestry development in the Outer Islands. The Company operates a total of 2,178,150 ha of forest concessions located in several provinces of Kalimantan and Sulawesi. The Company also manages saw mills and moulding plants. Its head office is in Jakarta. A branch office managing the operational activities in South Kalimantan is at Stagen, Pulau Laut.

The PT INHUTANI II concession in Pulau Laut covers 110,925 ha. This includes 5,300 ha of protection forest, about 3,000 ha of human settlements and approximately 102,000 ha for timber production. The production forest includes 34,500 ha for the development of industrial plantations mainly at Senakin. The company has already established 22,000 ha of plantations, primarily with *A. mangium*.

2.4 Method Used to Evaluate and Develop Criteria and Indicators

The CIFOR process for development of C&I for sustainable forest management at the forest management unit level presented in detail by Prabhu *et al.* (1999) was used in this study. This process can be broken down into a number of steps:

1. Clarify and review the overall goals of sustainable forest management as well as the objectives of the procedures.
2. Identify candidate sets of C&I prior to actual field testing.
3. Select sites where the testing of the C&I will be carried out.
4. Select a group of experts to carry out the test.
5. Allow the experts to review and comment on candidate C&I.
6. Compile the results of expert comments.
7. Assemble a workshop of experts to discuss and refine the candidate C&I.
8. Field test candidate C&I by experts.
9. Assemble a workshop of experts to finalise C&I.
10. Document test results and the C&I selected.

The evaluation of C&I is based on an iterative filtering and generation method (IFGM) with three stages of evaluation defined as three separate filters. A flow chart depicting this evaluation process is shown in Annex 4. The evolving process of testing a candidate set of C&I permits creative inputs and modifications at each stage of evaluation.

CIFOR Filter No. 1: This pre-fieldwork activity is essentially a desk exercise for the preliminary evaluation of all C&I selected from various sources and is based mainly on professional judgements by the expert team members. This initial selection of candidate C&I by the expert team is focussed on eliminating C&I that are obviously inappropriate for the site. The selection process of a candidate set of C&I based on Form 1 (Annex 1) was conducted at the teams' home bases in the field and took approximately seven days to complete.

CIFOR Filter No. 2: This stage is designed to evaluate in the field candidate C&I, generated from Filter No.1, in order to determine the minimum set of C&I. The Filter No. 2 process consists of two steps, an initial team discussion and field testing. Initial team discussion is aimed at clarifying methodology of the test to all team members. The field exercise is designed to test the viability of the selected C&I. Evaluation of C&I is made by addressing a series of attributes identified on Form 2 (Annex 2).

Testing and developing minimum sets of C&I requires the expert panel members to conduct:

- group discussions with key stakeholders and forest actors;
- individual interviews with key persons (e.g. loggers or farmers);
- field surveys (e.g. logging sites, road conditions, boundaries, regeneration); and
- a review of relevant documented information.

Regular team discussions during the field testing stage are necessary to screen C&I for redundancy, modify existing ones where necessary to make them more relevant, and propose new C&I to fill deficiencies identified during fieldwork. Throughout this iterative process team members apply their expert knowledge to modify and re-evaluate C&I under field conditions.

CIFOR Filter 3: This stage is a post-fieldwork workshop to clearly define a minimum set of C&I

relevant to the FMU. The workshop format provides peer review of the results of the field test. New participants at this workshop are drawn from different institutional and disciplinary backgrounds, but they have expert knowledge and an interest in sustainable forest management. Following this workshop each team prepared a final report with the minimum set of C&I identified for each site and with comments by team members on the IFGM process.

2.5 Analysis Method

Principles and C&I reported by Teams 1, 2 and 3 for the three field sites formed the basis for the present country report. The C&I sets for each site were

compiled and compared systematically based on keywords and comments recorded in the team reports to determine commonality. This provided the framework for the synthesis of a core set of C&I applicable to the sustainable management of plantations at all three sites.

To finalise the country report, a consultation process was conducted involving LEI (Lembaga Ekolabel Indonesia/the Indonesian Ecolabelling Institute) and managers from the companies that participated in the field evaluations of C&I. As part of this consultation process the three field sites were revisited and the proposed core set of C&I was discussed with company staff.

3. Results and Discussion

3.1 Home-based Evaluation of Criteria and Indicators: Form 1 Data

All teams were provided with documents that were used for C&I evaluation including a “tool box”. This “tool box” was subsequently published (CIFOR 1999). The first step of the C&I evaluation was that all teams were required to include as many C&I as possible (a so-called base set) from well-known international sources such as ITTO, CIFOR, LEI, WWF-IUCN and SmartWood. The selected C&I were recorded on Form 1 and team experts were then required to reject any C&I considered to be irrelevant to the conditions prevailing at the sites in question. It should be noted that it took several days for team members to fully understand this process. A number of team members felt that the time allocated for this home-based evaluation was insufficient.

The approach taken to obtain a base set of C&I for this initial evaluation varied between teams. Team 1 started from the original sources of published C&I, while Team 2 made use of the C&I already selected by Team 1. In contrast, Team 3 used the combined sets of C&I from Teams 1 and 2 as the base set for evaluation at site 3.

According to Prabhu *et al.* (1999) the purpose of home-based evaluation is to provide a preliminary evaluation of all C&I based on professional judgement to determine the most appropriate set of C&I for field testing. Following this process the number of C&I proposed for field testing by the teams was reviewed and those retained are summarised by discipline in Table 2.

The mean number of C&I retained for field testing was similar for forest management (58) and socio-economic issues (56) but was much lower for the ecological aspects (29). The teams considered ecological issues to be less complex and easier to evaluate therefore requiring less C&I for the assessment of sustainability.

Table 2. Number of Criteria and Indicators accepted for further evaluation by team members, based on pre-field evaluation

Teams	Management	Ecology	Social	Total
T1	38 (29%)	29 (22%)	65 (49%)	132 (100%)
T2	49 (59%)	15 (18%)	19 (23%)	83 (100%)
T3	87 (41%)	44 (20%)	84 (39%)	215 (100%)
Total	174 (43%)	88 (20%)	168 (37%)	
Average	58	29	56	

T1: Team 1 and so on

3.2 Field Evaluation of Criteria and Indicators: Form 2 Data

3.2.1 Background

Field testing of the candidate sets of C&I was carried out at three plantation sites at Riau, Sumatra and Subanjeriji, South Sumatra, during November and December 1997; and at Pulau Laut, South Kalimantan during July 1998. Over the period of evaluation, all team members spent some time in the forest, interviewed important stakeholders and forest actors and reviewed existing information. All team members were expected to justify their selection of the proposed C&I first within their own subgroup, then to the other experts in the team, and finally to the peer review team. Ample time was required at this phase for every member to be fully confident in their judgements of the ideas and concepts underpinning the C&I proposed. The results for these field tests have been reported independently for the sites at Riau (Purnadjaja *et al.* 1997a), Subanjeriji (Purnadjaja *et al.* 1997b) and Pulau Laut (Purnadjaja *et al.* 1998).

3.2.2 Quantitative analysis of the results from Form 2

All indicators for socio-economic, management and ecology issues submitted by the three teams were examined for commonality. Indicators were classified

into three categories, namely common (selected by all teams), semi-common (selected by two teams) and unique (selected by one team only). Results of this analysis are summarised in Table 3.

Table 3. Level of commonality of C&I proposed by the three Indonesian teams

Parameter	Common (%)	Semi-common (%)	Unique (%)	Total number of indicators based on synthesis set
Social	46	30	24	46
Management	65	31	4	65
Ecology	65	35	0	23

There was relatively good agreement between the teams on C&I selected, as reflected in the high percentage of common indicators related to management (65%), social (46%) and ecological (65%) issues. The level of semi-common indicators was similar for all teams, ranging from 30% to 35% (Table 3). In contrast, a relatively high percentage of social indicators (24%) were unique for each site.

The high degree of commonality in indicators related to forest management is a reflection of the similarity in management systems adopted by the companies developing the *A. mangium* plantation resources in Sumatra and Kalimantan.

Good agreement between ecological indicators was not entirely unexpected as the environmental issues to be addressed were similar at each site.

Commonality for the social indicators was lower and a comparatively high percentage of indicators were unique (24%), reflecting those social and economic issues specific to the local and indigenous communities at each site. It is therefore important to allow sufficient time during field testing to formulate C&I addressing specific socio-economic issues. It is probably also a reflection of the more qualitative nature of information to be captured by social C&I with greater reliance on interviews and discussions with stakeholders. The social issues to be addressed by C&I are often complex, requiring substantial judgement and interpretation by the team (Wollenberg and Colfer 1997; Prabhu *et al.* 1999).

It should be noted that the number of sourced C&I varied between teams as mentioned in section 3.1 dealing with the selection of the base set of C&I for field testing. The base set of C&I used by Team 1 was selected from various published sources. The other teams used the C&I sets selected by the previous team as the base set for field testing. A quantitative overview of the final sets of C&I proposed by each of the three teams is presented in Table 4. A total of 10 principles, 45 criteria and 191 indicators were proposed.

Principles related to socio-economic, forest management and ecological issues were addressed by all teams. One of the teams, however, also addressed issues related to forest policy and institutional arrangements. The other two teams did not include this principle because it was considered to be a national issue not appropriate for evaluation at the FMU level.

Teams 1 and 3 proposed a relatively higher number of C&I as the minimum reliable sets compared with Team 2 (Table 4). The indicators selected by the teams after field testing showed a common trend with the majority of indicators dealing with issues related to forest management (46% to 60%) compared with socio-economics (20% to 24%) and ecology (18% to 30%).

The IFGM process for testing and developing a minimum set of C&I includes the re-evaluation and justification of proposed C&I by the interdisciplinary team. This activity was designed to check and re-check whether or not particular indicators are to be included in the final set. The process also allows for the inclusion of new C&I to address site-specific issues. As a result, the total number of C&I initially selected for testing may either increase or decrease after field evaluation.

Table 4. Number of C&I (Indicators) accepted as final by team members, based on field evaluation (Form 2)

	Team 1	Team 2	Team 3
Sourced ¹	132	83	215
Total C&I (Indicators) ²	83	45	63
Total Management	49 (59%)	27 (60%)	29 (46%)
Total Ecology	15 (18%)	9 (20%)	19 (30%)
Total Social	19 (23%)	9 (20%)	15 (24%)

Notes: ¹ These are C&I (indicators) employed by teams as a base set. Modification was made when necessary.

² These are C&I (indicators) cited partly from the base set plus a few new C&I (indicators) derived from the field exercise.

Changes in the total number of C&I before and after field evaluation are summarised in Table 5. In general the number of C&I decreased after field testing except for forest management where Team 1 added a further 11 indicators during field evaluation.

The results of the IFGM process are three sets of C&I, one for each site (Annex 5). These were the starting points for the next step in the procedure in defining a common or core set of C&I applicable to all three sites.

3.2.3 Content analysis of C&I proposed by teams

One of the major objectives of this project was to identify a minimum set of C&I applicable to all three sites. Accordingly, the three sets of C&I were compared to obtain a core set for the assessment of the sustainability of industrial plantations in Indonesia. This comparison was based on the analysis of commonalities and differences in C&I as described by Prabhu *et al.* (1999).

Comparison of the three sets of C&I for the synthesis of a common core set showed some overlap and redundancy of indicators, mainly those addressing issues related to forest management and ecology.

Examination of the content and intent of C&I, based on keywords and comments by the expert teams, showed the need to clarify some of the differences in terminology used by the teams. For example, the terms local people, local community, indigenous people and forest-dependent people were used somewhat indiscriminately by all teams and need clarification. Local people and local community are defined as those who have been living in the area for some time but are not the original inhabitants of the area. In contrast,

indigenous people are defined as original inhabitants who have been living in the area for a relatively long time and have a unique cultural identity. Forest-dependent people are defined as those dependent on forest resources for their daily life. This may apply to local communities as well as indigenous people.

3.2.3.1 Socio-economic C&I

The C&I on socio-economic issues reported by the three teams were developed and evaluated by team members with a wide range of expertise including anthropology, socio-economics, public policy and forest management. The analysis of C&I reported by the teams as shown in Annex 5 was conducted in an hierarchical manner starting with principles, then criteria and the relevant indicators. This approach also made it easier to identify commonality between indicators addressing similar issues but allocated to different criteria.

Principle

The teams defined the principle dealing with socio-economic issues in different ways:

- Human well-being is enhanced (Team 1).
- Sustainable management of forest plantations positively enhances socio-economic condition of local people (Team 2).
- Socio-economic dynamics of the community is supportive of sustainable forest management (Team 3).

Team 1 adopted a broad definition inclusive of socio-economic as well as cultural aspects. Team 2 placed greater emphasis on the socio-economic status

Table 5. Changes in the total number of C&I at pre-field and post-field evaluations (accepted C&I)

Teams	Management		Ecology		Social	
	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>
1	38	49	29	15	65	19
2	49	27	15	9	19	9
3	87	29	44	19	84	15

and prosperity of local people, including transmigrants as well as indigenous people. In contrast, Team 3 wanted to place emphasis on the dynamics or process of socio-economic development of the local community.

The teams all agreed that sustainable development of plantations must improve the socio-economic condition and well-being of the local community, including transmigrants and indigenous people. This is captured comprehensively by the Principle: ‘Human well-being is enhanced’.

Criteria and Indicators

The criteria proposed for the principle of human well-being by the three teams are presented in Annex 5. The number of criteria defined by the teams varied from 3 to 4 and all teams addressed the following issues:

- security of land tenure and land use (criterion 1);
- participation in forest management (criterion 2);
- sharing of social and economic benefits (criterion 3); and
- industrial relations and responsibilities of stakeholders (criterion 4).

The four criteria and the relevant indicators proposed by the teams are examined in more detail below. The core set of C&I considered to be applicable to socio-economic issues at all sites is presented in Table 6.

Security of land tenure and land use

The teams were in agreement that security of land tenure and rights to use land (Annex 6) is important for the long-term sustainability of a plantation enterprise. This applies to all stakeholders, ranging from security of land tenure for the company to traditional rights of land use for the indigenous people.

The indicators for this criterion proposed by the teams (Annex 6) reflect the relative importance of specific aspects of land tenure between sites. These include the definition of tenures, legal arrangements, recognition of traditional rights, compensation for displacement, conflict resolution, etc. The indicators selected for the core set of C&I are shown in Table 6.

Participation in forest management

Participation of stakeholders in forest management was a common criterion for all teams (Annex 7) although the definitions varied between teams. The criterion ‘Stakeholders participate in forest management’ was considered representative for all sites. This criterion was debated extensively at the workshops as it raises the question of who should participate and at what level of management, e.g. regional government, district foresters (Dinas Kehutanan), local communities and NGOs. The teams agreed that the stakeholders whose livelihoods are directly affected should be invited to participate at the appropriate stage in the process of management, e.g. at the stage of planning, implementation, monitoring or evaluation.

The indicators proposed for this criterion place emphasis on communication and consultation between the major stakeholders, i.e. company management and the local community (Annex 7). Issues addressed specifically are consultation of the local community about the planning and implementation of forest activities; mechanisms for conflict resolution; and the recognition of traditional rights, local knowledge and gender roles. Team 1 also identified the need for forest management to assume a role in community development. The proposed core indicators are defined in Table 6.

Sharing of social and economic benefits

The criterion dealing with the sharing of social and economic benefits was expressed differently by the teams (Annex 8), reflecting the differences in emphasis at each site. Team 1 defined this criterion in more general terms while the other teams were more specific with emphasis on more tangible socio-economic benefits and increased prosperity for the local community. The statement ‘Socio-economic performance of local community is enhanced’ was considered representative for all sites.

The indicators for this criterion varied somewhat between teams reflecting the specific issues identified at each site (Annex 8). Together these indicators focus mainly on the impacts and benefits of plantation development to the local community. Indicators address issues such as opportunities for work and training; incomes and social benefits; public

Table 6. Synthesis of common Criteria and Indicators related to socio-economic issues at FMU level, as proposed by the three teams

Issues P C I			
Human well-being is enhanced	T1	T2	T3
<p><i>Stakeholders' tenure and land use rights are secure</i></p> <p>Conflicts are minimal or settled</p> <p>Tenures are well defined and upheld</p> <p>Long-term tenure or agreement to land is guaranteed and customary rights are respected</p> <p>Opportunities exist for local communities to continue socio-economic activities within the forest concession area</p> <p>Opportunities exist for local communities to get compensating rewards for loss of land and other resources</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>
<p><i>Stakeholders participate in forest management</i></p> <p>Fair and effective mechanisms for conflict resolution exist</p> <p>Local communities understand and are involved in the process of forest management activities</p> <p>Management understands and considers local knowledge in the forest management activities</p> <p>Effective mechanisms exist for two-way communication and consultation</p> <p>Professional staff for community development is available and fully supported by company management</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>
<p><i>Socio-economic performance of local community is enhanced</i></p> <p>People's incomes have increased in real terms since the establishment of forest plantations</p> <p>Local communities have significant opportunities to work and be trained by the company without discrimination</p> <p>Local communities are encouraged to grow timber on their own land to supply raw materials needed for the mill</p> <p>Contribution to the increase in the well-being of local people (forest-dependent people)</p> <p>Contribution to the maintenance of cultural values and diversity, and of indigenous and local knowledge</p> <p>Contribution to the development of public infrastructure and services should meet the local community's needs and aspirations</p> <p>Contribution to the development of alternative economic activities and linkages exist</p> <p>Social benefits are maximised and social disruption is minimised</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>

Table 6. Continued

Issues					
P	C	I			
Human well-being is enhanced			T1	T2	T3
<i>Responsibility of primary stakeholders is well defined</i>			*		
		Agreements exist between local communities and the management regarding rights and responsibilities of both parties	*		
		Effective control mechanisms for executing the agreement exist	*		
		Education and training programme for local communities concerning the adverse effects of plantation activities exist	*		
		Activities within the area conserved for environmental, social and cultural reasons are carefully recorded and monitored	*		
		All applicable laws/regulations covering health and safety are met or exceeded			*
		Wages and other facilities are met or exceed local standards			*
		Career development is clearly planned for all employees without discrimination			*

Note: Indents indicate the hierarchical level, where P=principle, C=criterion, I=indicator, T=team.

infrastructure and services; community forestry for wood production; and the impact on cultural values and lifestyle. A set of common indicators is proposed in Table 6.

Industrial relations

The responsibility of stakeholders for industrial relations between company management, employees and local communities was defined as a separate criterion by Teams 1 and 3 (Annex 9). These teams wanted to put particular emphasis on the need for agreements between management and local community employees on industrial issues such as wages, training, education, health and safety. Team 2 did not address these issues directly but some aspects were covered by indicators under criteria 1 and 2 (Annex 5). It was considered necessary to include this criterion 'Responsibility of primary stakeholders is well defined' in the core set of C&I.

Indicators for this criterion proposed by Teams 1 and 3 are listed in Annex 9. The issues addressed by the indicators include rights and responsibilities of the primary stakeholders; education, training and career development; occupational health and safety;

protection of conservation areas. It should be noted that Team 1 addressed occupational health and safety separately as part of forest management issues (see Annex 18). This is now included as an indicator of the responsibility of the primary stakeholder as a socio-economic rather than forest management issue. Indicators selected for the core set of C&I are shown in Table 6.

3.2.3.2 C&I for forest management

The C&I on forest management issues were developed and evaluated by team members with expertise in forestry, forest silviculture, management and economics. C&I reported for each site by the teams (Annex 5) were analysed in an hierarchical manner starting with principles, then criteria and the relevant indicators. This identified commonality between indicators addressing the same issues but sometimes allocated by teams to different criteria.

Principle

The teams defined the principle related to the management of plantations and other forests within the FMU as follows:

- A management system is in place to ensure sustainability (Team 1).
- Forest management resources support, and activities are conducive to, sustainable yield (Team 2).
- A forest management system is in place to ensure sustainable yield (Team 3).

Team 1 adopted a broader definition of this principle while the other teams placed emphasis on sustainable yield of wood and forest products. All teams agreed that the system of forest management should maintain or improve long-term site productivity. The broader statement ‘A management system is in place to enhance sustainability’ was adopted for the core set of C&I (Table 7).

Criteria and Indicators

Criteria for forest management proposed by the teams for each of the three sites are presented in Annex 5. Teams identified 6 to 8 criteria each and although teams defined these criteria in different ways, the issues addressed were very similar. The emphasis at all sites was on forest management plans and their implementation, resource inventory, research and development, and the availability of funds for the management of plantations and conservation areas. Other issues identified include the implementation and monitoring of silvicultural practices, forest health and protection, and the development of human resources.

The criteria and related indicators were grouped for comparison and analysis of commonality in Annexes 10 to 19. The common criteria and related indicators selected for the core set are shown in Table 7 and address:

- management plans (criterion 1);
- resource management strategy (criterion 2);
- research and development (criterion 3);
- financial support (criterion 4);
- monitoring of activities (criterion 5);
- forest protection (criterion 6); and
- human resources (criterion 7).

The indicators related to the above criteria were often prescriptive in order to address specific aspects of forest management and silvicultural practices. Indicators dealing with similar issues were sometimes

assigned to different criteria or may have been addressed as part of socio-economic issues, e.g. training and development of staff. It is inevitable that there will be some overlap or even duplication of indicators dealing with similar issues but under different site conditions. The comparison of the three site-specific sets of C&I related to forest management enabled the formulation of a core set applicable to all three sites (Table 7).

Management plans

All teams agreed on the need for a well-defined management plan reflecting the objectives of the company responsible for the management of a forest resource and also operating as a business in an international market place. Teams placed emphasis on the different aspects of planning and implementation of forest management reflecting the specific conditions at each site (Annexes 10, 11 and 13).

The indicators for this criterion address the various aspects of forest management plans including site suitability for plantation development, species selection, prescriptions for silvicultural management, market evaluation, yield regulation and financial arrangements. Nine core indicators are proposed to address these various forest planning aspects (Table 7).

It should be noted that the indicator “Use of full baseline data” refers to the availability of biophysical data such as soil, geological maps, flora and fauna surveys, and socio-economic data to support any management activities in the decision making process.

Resource management strategy

A further criterion was proposed specifically addressing a strategy for the development of plantations and retention of conservation forests within the concession area (Annex 12). The indicators selected by Team 1 placed emphasis on the delineation and security of plantation and conservation areas. In contrast, yield regulation and silvicultural practices were selected as important for sites 2 and 3. The core set of indicators proposed is shown in Table 7.

Research and development

The need for research and development in support of silvicultural management and operational activities was recognised by all teams as being important for the long-term sustainability of the plantation resource (Annex 16).

Table 7. Synthesis of common Criteria and Indicators related to management at FMU level, as proposed by the three teams

Issues P C I			
A management system is in place to enhance sustainability	T1	T2	T3
<p><i>A comprehensive management plan is available</i></p> <p>Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting are available</p> <p>Use of full baseline data</p> <p>Implementation of site-species matching</p> <p>Operations and forecasting should refer to management plan</p> <p>Planting programme detailing monthly planting targets, operational schedules, manpower, infrastructure and machinery/equipment requirements is in existence</p> <p>Financial budget cash flow projection is developed in long-term planning document</p> <p>Yield regulations by area and/or volume are set out</p> <p>Management objectives are clearly defined and stated</p> <p>A market assessment is carried out and stated in long-term planning document</p>	* * * * * * * *	* * * * * * *	* * * * * * *
<p><i>Good forest resource management strategy is in place</i></p> <p>External boundary is lawfully and permanently demarcated</p> <p>Clear demarcation of production forest area into smaller management units</p> <p>Forest map produced from interpretation of aerial photographs showing details of planting</p> <p>Growth and yield data from PSPs (permanent sample plots) to monitor growth/yield trends</p>	* * * *	* * * *	* * * *
<p><i>A comprehensive research and development programme is in place</i></p> <p>Research and development programme supporting the operational activities is in existence</p> <p>Research and development programme responding and contributing to new information and technology is practised</p>	* * *	* * *	* * *
<p><i>There is sustained and adequate funding for running the operation</i></p> <p>Liquidity of cash flow to support infrastructure development, acquisition of machinery and equipment and to meet day-to-day running of the operation</p>	* *	* *	* *

Table 7. *Continued*

Issues P C I			
A management system is in place to enhance sustainability	T1	T2	T3
<p><i>Effective monitoring and control system audits conformity with management plan</i></p> <p>Documentation and records of all forest management activities are kept for monitoring purposes</p> <p>Periodical forest inventory system exist</p> <p>Standard of planting and tending</p>	*		*
<p><i>Forest maintenance and protection programmes are implemented</i></p> <p>Operational systems of forest fire prevention and suppression are implemented</p> <p>Well-defined integrated pest and disease management programmes are practised</p> <p>Operational system of forest security is implemented</p>	*	*	*
<p><i>Professional and dedicated human resources are enhanced</i></p> <p>Adequate human resources at all levels of management</p> <p>Human resources development is implemented</p> <p>Clear organisational structure with job description is developed</p> <p>Human resources welfare programme exists</p> <p>Operational guidelines of safety procedures for handling chemicals, vehicles and machinery are available</p>	*	*	*

Note: Indents indicate the hierarchical level, where P=principle, C=criterion, I=indicator, T=team.

Indicators related to this deal with research projects and priorities, funding and staffing of research programmes, as well as the implementation and adoption of new technologies. The proposed core set of indicators for R&D is shown in Table 7.

Funding

The availability of adequate funding to implement the management plan and to undertake the operational activities at the various stages of plantation development was recognised by all teams (Annex 14). Indicators highlight the importance of funding for infrastructure, forestry equipment and day-to-day operations at site 1; adequate cash flow and capital for human resources and R&D at site 2; and sufficient starting capital for the establishment of plantations and re-investment of income from harvested wood at site 3. These have all been captured in one indicator proposed for the core set of C&I in Table 7.

Monitoring of activities

Effective monitoring of management and operational activities to assess compliance with the management plan was considered essential by Teams 1 and 3 (Annex 17). In contrast, monitoring and auditing of activities were not addressed specifically by the C&I proposed by Team 2.

The indicators address the documentation of field operations and activities as well as the recording of resource assessment data based on inventory plots. In addition Team 1 included indicators for accounting records and other aspects of forest management such as fire protection and R&D (Annex 17). Three core indicators are proposed in Table 7 dealing with the documentation of all forest management activities in general and the establishment and tending as well as a forest inventory system for plantations in particular.

Forest protection

Protection of forest from fire, pests and diseases was considered to be part of forest management by Teams 2 and 3 (Annex 15). In contrast, Team 1 viewed these as issues related to forest ecology (Annex 22). The indicators proposed by all teams relate to the prevention and suppression of fire as well as the integrated management and control of pests and diseases (Annex 15). In addition, forest security, i.e. protection of the plantation resource as well as natural forest in conservation areas from illegal logging was identified as an important issue at all sites. The presence and implementation of a forest security system is proposed as a core indicator (Table 7).

Human resources

Effective infrastructure and human resources were addressed by separate criteria proposed by Teams 2 and 3 (Annex 18). In contrast, this issue was dealt with as part of the implementation of the management plan by Team 1 (Annex 13). The indicators covered human resources, staff development and training. In addition, indicators proposed by Team 3 also dealt with wages and facilities as well as occupational health and safety (Annex 18). The core indicators proposed for this criterion are presented in Table 7.

3.2.3.3 C&I for ecology

Industrial plantations of *A. mangium* are managed primarily for wood production but the intensity of management varies considerably between companies responsible for the various concession areas. Long-term sustainability of this plantation resource requires management to take into account not only wood production but also ecological and environmental values (e.g. soil, water, biodiversity) as well as socio-economic issues. It is therefore important to evaluate the impact of plantation development on the structure, function and resilience of the entire ecosystem of the FMU.

Principle

Teams agreed that sustainable management of plantations can only be achieved if the ecological functioning of the FMU is either maintained or improved. There was close agreement between the teams on the definition of the principle related to forest ecology (Annex 5).

Criteria and Indicators

The criteria selected by the teams reflected differences in approach as well as issues of specific importance at

each of the sites. Team 1 defined the criteria in more general terms of maintenance of the function, biodiversity and resilience of the ecosystem. In contrast, Teams 2 and 3 proposed the maintenance of ecosystem function as the first criterion then placed emphasis on potentially adverse environmental impacts of plantation development and the maintenance of land and water resources (Annex 5). It should be noted that the ecological issues are relevant to the entire FMU, comprising plantations as well as conservation areas, for the protection of biodiversity and to meet the needs of local communities.

Comparison of C&I proposed by the teams for the three sites showed that there was close agreement on the major ecological issues relevant to the long-term sustainability of a plantation resource. These were selected as core criteria as shown in Table 8 and address:

- structure and function of the ecosystem (criterion 1);
- soil and water resources (criterion 2); and
- environmental impacts (criterion 3).

Comparison of indicators for each of the criteria showed a high degree of commonality although indicators addressing similar issues were often proposed under different criteria by the teams (Annexes 20, 21 and 22). The key aspects addressed by these indicators are presented below and the core set of C&I for this principle is shown in Table 8.

Structure and function of the ecosystem

The indicators for this criterion addressed:

- Use of chemicals and fertilisers in plantations and the potentially adverse impacts on the environment, e.g. soil, water, flora and fauna, as well as the effects of pollution by these chemicals on the health of local communities.
- Maintenance of protected areas for the conservation of biodiversity, but also including buffer strips along watercourses for the protection of water quality and areas with high soil erosion hazard.
- Protection of endangered flora and fauna as well as remnant vegetation where appropriate. This applies in particular to the initial stage of planning and development of plantations and the requirement to set aside forested and other vegetated tracts of ecological significance within

the concession area. The continued protection of such areas is important for the maintenance of biodiversity within the FMU.

- Change in microclimate and hydrologic function of forested catchments refers to the potential impact of fast-growing plantations on water yield and the downstream use of water by local communities.
- Growth and quality of plantations is included as an indicator of tree health with reference to the impact of pests, diseases and nutrient disorders on the growth and condition of stands. It is a supplementary indicator related to the maintenance and protection of forests as part of the forest management principle (Table 7).

Soil and water resources

The maintenance of physical and chemical properties of the soil is an important aspect related to long-term productive capacity of the site. Soil disturbance at plantation establishment and harvesting can cause compaction and erosion with potential detrimental effects on growth and productivity of subsequent rotations. Likewise, natural soil fertility may not be adequate to support fast-growing plantations and

therefore the use of appropriate fertilisers may be necessary to maintain or improve site productivity.

In addition, the maintenance of water quality is complementary to the indicator for water yield and hydrologic function of forested catchments under the preceding criterion (Table 8). Excessive soil disturbance and erosion as a result of construction of forest roads and site preparation for plantation establishment can be expected to increase turbidity and sediment in water and therefore decrease water quality.

Environmental impacts

The indicators under the previous criteria address various aspects with potentially adverse impacts on the environment. Two teams did propose additional indicators dealing with the prevention of fire and the increased risks associated with the establishment of a plantation monoculture on a large scale. The issue of fire protection is largely covered by a similar indicator under the maintenance and protection of forests as part of the forest management principle (Table 7).

The risks associated with large-scale monocultures are mostly related to greater vulnerability to pests and diseases. While there are good technical reasons for a wood resource based on a single species

Table 8. Synthesis of common Criteria and Indicators related to ecology at FMU level, as proposed by the three teams

Issues			
P C I			
Ecosystem function is maintained or improved	T1	T2	T3
<i>Structure and ecosystem function are maintained</i>	*	*	*
Judicious use of fertiliser, and chemicals for pest, disease and weed management	*	*	*
Protected area and conservation area are maintained	*	*	*
Endangered flora and fauna are protected	*		*
Microclimatic change and hydrologic function are improved	*	*	*
Stand growth quality is satisfactory	*		*
<i>Soil and water resources are maintained or improved</i>	*	*	*
Physical and chemical properties of the soil are maintained	*	*	*
Water quality is maintained	*	*	*
<i>Adverse environmental influence is minimised</i>	*	*	*
Fire prevention is in force	*		*
Genetic diversity of plantation species is maintained	*		*

Note: Indents indicate the hierarchical level, where P=principle, C=criterion, I=indicator, T=team.

in terms of ease of silvicultural management and uniformity of wood products, it is important to have in place an integrated pest and disease management plan (see Table 7) able to deal with incursions.

3.3 Closing Workshop and Consultation Process

It was intended to conduct a final workshop with all major stakeholders as part of this project to discuss the findings of the three teams and propose a core set of C&I applicable to all sites. Unfortunately this workshop did not take place due to illness and passing away of the Country Coordinator. Instead a consultation process was conducted at a later stage involving LEI and the companies that participated with the field testing of C&I. The consultation process included discussions with the stakeholders and visits to the three field sites. Comments on the proposed core set of C&I resulting from this consultation process are recorded below. The core sets of C&I proposed in Tables 6, 7 and 8 were revised and modified following the consultation with major stakeholders. This final core set of Principles and C&I are presented in Table 9.

One of the issues raised during the consultation process related to the C&I for assessing the financial performance of the company managing industrial plantations (Table 7). It was recognised by the teams and stakeholders that indicators related to the financial status of forestry companies often rely on confidential information that is likely to be commercially sensitive. Therefore companies may not want to disclose this information unless confidentiality can be assured.

Companies expressed concern about the maintenance of security and protection of conservation areas and the prevention of illegal logging. This was clearly recognised by the teams as an important threat to the long-term sustainability of these areas within the FMU and therefore indicators addressing this issue were included as part of forest management (Table 7) and ecosystem function (Table 8). It is essential to retain these indicators especially if illegal logging is threatening SFM. The responsibility for maintaining security to prevent illegal logging is an issue that needs to be addressed by institutional and legal arrangements between concession holders and appropriate government authorities at the national level, but also at regional level.

It was acknowledged that a change in microclimate resulting from large-scale plantation establishment is difficult to determine. However, it is considered that impacts on the hydrologic function of

forested catchments and the change in yield and quality of water from these catchments (Table 8) provide a good surrogate measure of a change in microclimate.

It was agreed during the consultation process that maximising social benefits and minimising social disruption (see Table 6) of forest management operations are important aspects of SFM. In fact, all indicators dealing with social criteria implicitly reflect this intent. Therefore, it was felt that there was no need to include these explicitly as a separate indicator in the core set (Table 9).

The issue of customary or traditional rights of local communities (see Table 6) was discussed at length. It was recognised that customary rights are an important aspect of a long-term agreement on land tenure. However such agreements also include many other aspects related to land use and tenure as well. To ensure all these are covered, specific reference to customary rights was omitted from this indicator in the final version of the core set (Table 9). During the drafting of such an agreement between stakeholders, local communities have the opportunity to state the nature of their customary rights and where these apply. Likewise, the companies should indicate the areas they consider to be necessary for their activities. Where there is a conflict of interest, problems need to be identified and resolved to the satisfaction of all stakeholders using appropriate mechanisms. A clear understanding by all parties of the various rights to land within the concession area is essential. This should be reflected in a long-term agreement involving all parties.

In general, the main concern of companies is the economic profitability of their activities within the forest concession areas. Security to harvest the trees according to a harvest management plan is critical. Involvement of neighbouring communities in wood production on an economic basis may sometimes be perceived as a threat by plantation companies because it may encroach on their timber resource. Such a risk can certainly be minimised and mutual understanding and confidence developed with proper accompanying social measures. At the final consultation it was agreed that economic activities of local communities should be encouraged and not limited to subsistence economic activities. This intent is reflected in the core set of indicators proposed in Table 9.

Some participants expressed concern about future introduction of genetically modified organisms (GMO) in plantation forestry and the potential weakening of the genetic base. This concern is partly addressed by the need to keep a high level of genetic diversity within species as a prerequisite for the maintenance of plantation health (Table 9). All stakeholders agreed on this requirement.

Table 9. Core set of Criteria and Indicators for sustainable forest management in plantations, based on final consultation with users

Issues: Socio-economic		
P	C	I
Human well-being is enhanced		
<i>Stakeholders' tenure and land use rights secured</i>		
Conflicts are minimal and settled through appropriate conflict resolution mechanisms		
Long-term tenure or agreement to land use is well defined and upheld		
Opportunities exist for local communities and indigenous communities to continue socio-cultural activities and economic activities within the forest concession area		
Opportunities exist for local communities and indigenous communities to receive compensating rewards for loss of land and other resources		
<i>Stakeholders participate in forest management</i>		
Fair and effective mechanisms for conflict resolution exist		
Local communities understand and are involved in the process of forest management activities		
Management understands and considers local knowledge in forest management activities		
Professional staff for community development is available and fully supported by company management		
<i>Socio-economic performance of local community is enhanced</i>		
People's incomes have increased in real terms since the establishment of forest plantations		
Local communities have significant opportunities to work and be trained by the company without discrimination		
Local communities are encouraged to grow timber on their own land to supply raw materials needed for the mill		
Contribution to the increase in the well-being of local people (forest-dependent people)		
Contribution to the maintenance of cultural values and diversity, and of indigenous and local knowledge		
Contribution to the development of public infrastructure and services should meet the local community's needs and aspirations		
Contribution to the development of alternative economic activities and linkages exist		
<i>Responsibility of primary stakeholders is well defined</i>		
Agreement exists between local communities and management regarding rights and responsibilities of both parties and is implemented through an effective control mechanism for executing the agreement		
Education and training programmes for local communities concerning the adverse and positive effects of plantation activities exist		
Activities within the area protected for environmental, social and cultural reasons are carefully recorded and monitored		
All applicable laws and regulations covering health and safety are met or exceeded		
Wages and other facilities are met or exceed local standards		
Career development is clearly planned and implemented for all employees without discrimination		
Issues: Management/Production		
P	C	I
A management system is in place to enhance sustainability		
<i>A comprehensive management plan is available</i>		
Management objectives are clearly defined and stated		
Operations and forecasting should refer to management plan		
A market assessment is carried out and stated in a long-term planning document		
Financial budget cash flow projection is developed in a long-term planning document		
Use of full base line data		
Planting programme detailing monthly planting targets, operational schedules, manpower, infrastructure and machinery/equipment requirements exists		

Table 9. *Continued*

Issues: Management/Production		
P	C	I
		<p>Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting are available</p> <p>Yield regulations by area and/or volume are set out</p> <p>Implementation of site-species suitability</p>
		<p><i>Good forest resource management strategy is in place</i></p> <p>External boundary is lawfully and permanently demarcated</p> <p>Clear demarcation of production forest area into smaller management units</p> <p>Forest map produced from interpretation of aerial photographs showing details of planting</p> <p>Growth and yield data from PSPs to monitor growth/yield trends</p>
		<p><i>A comprehensive research and development programme is in place</i></p> <p>Research and development programme supporting the operational activities is in existence</p> <p>Research and development programme responding and contributing to new information and technology is practised</p>
		<p><i>There is sustained and adequate funding for running the operation</i></p> <p>Availability of finance to support infrastructure development, acquisition of machinery/equipment and to meet day-to-day running of the operation</p>
		<p><i>Forest maintenance and protection programme are implemented</i></p> <p>Operational system of forest fire prevention and suppression is implemented</p> <p>Well-defined integrated pest and disease management programmes are practised</p> <p>Operational system of forest security is implemented</p>
		<p><i>Effective monitoring and control system audits conformity with management plan</i></p> <p>Documentation and records of all forest management activities are kept for monitoring purposes</p> <p>Periodic forest inventory system exists</p> <p>Standards of planting and tending are defined and implemented</p>
		<p><i>Professional and dedicated human resources are enhanced</i></p> <p>Adequate human resources at all levels of management</p> <p>Human resources development is implemented</p> <p>Clear organisational structure with job descriptions is developed</p> <p>Human resources welfare programme exists</p> <p>Operational guidelines of safety procedures for handling chemicals, vehicles and machinery are available</p>

Table 9. *Continued*

Issues: Ecology		
P	C	I
Ecosystem function is maintained or improved		
<i>Structure and ecosystem function is maintained</i>		
		Judicious use of fertilisers, and chemicals for pest, disease and weed management
		Protected area and conservation area are maintained and managed
		Endangered flora and fauna are protected and managed
		Microclimatic change and hydrology function are improved
		Stand growth quality is satisfactory
<i>Soil and water resources are maintained or improved</i>		
		Physical, biological and chemical properties of the soil are maintained
		Water quality is maintained
<i>Adverse environmental influence is minimised</i>		
		Fire prevention is in force
		Genetic diversity of plantation species is maintained

Note: Indents indicate the hierarchical level, where P=principle, C=criterion, I=indicator.

4. Conclusions

4.1 The Process

The IFGM is an adaptive process that actually allows for some level of modification and creative input by the field test team. The first team selected a base set of C&I from a wide range of sources while subsequent teams made use of this initial work to select a candidate set of C&I for field testing at the second and third test sites. It was generally concluded that more time was needed to carry out home-based analysis for the selection of a candidate set of C&I.

Most of the social experts commented that time allocated for the evaluation of social C&I was very limited. Social issues are usually more complex and it is critical to allow more time for the careful selection and evaluation of C&I that address issues specific to the FMU. It was also considered that more time was needed to conduct interviews and to consult with local communities to fully evaluate the C&I addressing human well-being.

Since the beginning of the project LEI has taken an active part in the various stages of the project. LEI experts made significant contributions to such issues as the use of exotic species and chemicals in plantations, erosion control and the rights of indigenous people. Practical issues related to the evaluation, verification and implementation of some of the indicators proposed were raised frequently during the field testing of C&I. This contributed greatly to the development and modification of indicators, especially those requiring field monitoring.

In addition, LEI suggested that indicator development should differentiate output indicators from process indicators. An output indicator is defined as the actual or desired result of a management process which describes the state or capacity of the ecosystem, the state of a physical component, or the state of the related social system or its components. In contrast, a

process indicator is defined as the management process or a component of the management process, or other human action, describing human activities but not the result of the activity. The proposed core set of C&I comprises a mixture of process- and output-oriented indicators of SFM (Table 9). For example, 'Fair and effective mechanism for conflict resolution exists' is a process indicator, while 'Conflicts are minimal and settled through appropriate conflict resolution mechanisms' is an output indicator (Table 9). Both indicators provide important information for the assessment of SFM. The first one demonstrates that a process is in place that enables disputes between stakeholders to be resolved. The second one evaluates the effectiveness of this process. Non-compliance with this second indicator alerts stakeholders of a conflict situation that is threatening SFM. The reason for conflict could be a flaw in the mechanism at the FMU level or it may be due to a larger issue such as land use allocation at the regional or national level.

It is essential to have both process and output indicators to provide not only an assessment of the mechanisms or management procedures that are in place but also to evaluate the effectiveness of these in delivering results conducive to long-term SFM. Non-compliance with either indicator alerts stakeholders of a potential threat to SFM that needs to be investigated. In the above case the company may in fact have all the correct mechanisms in place to resolve land use disputes with the local community. However, continued conflict may be the result of lack of consultation and lack of recognition of the land rights of local communities by government agencies responsible for the initial allocation of plantation concession areas. Quite clearly, these government agencies are also stakeholders and need to be part of the C&I process. This demonstrates the importance of including C&I on legal and

institutional arrangements at the national and regional levels as these quite clearly have an impact on SFM at the FMU level. The same argument applies to other issues raised at the final consultation of stakeholders, such as the problem of protection of forest resources against illegal logging.

Concern was expressed that consultation and participation in the project was limited mainly to primary stakeholders and did not cover the full range of interests in SFM during both field testing of C&I and the final consultation workshop. The final consultation workshop was important and useful because all main stakeholders who will also be the users of C&I were involved. The process of developing C&I must be transparent and ideally should involve all stakeholders with an interest in SFM. This ensures a diverse input into the selection and testing of C&I reflecting the widest possible range of interests in SFM.

4.2 The Contents of Criteria and Indicators

A comprehensive set of C&I selected from various published sources was evaluated at three forest concession areas. These site-specific C&I formed the basis of the core set proposed for SFM addressing aspects of socio-economics, management and ecology at the FMU level (Table 9).

The focus of the socio-economic issues is on the relationship between primary stakeholders, i.e. the companies managing the forest resource, and the local communities including indigenous people. The C&I address issues such as land tenure and access, employment, health and safety, consultation and participation in management, social and economic benefits, and impacts on community infrastructure and culture. It was noted during field testing of C&I that land tenure and traditional rights to land use were often considered to be the single most critical issues affecting long-term SFM.

The C&I for forest management deal with more specific issues that contribute to the long-term sustainability of forest resources including land capability, management plans, silvicultural management, forest inventory, growth and yield regulation, forest protection, research and development, human resources and financial management.

The ecology C&I mainly deal with the environmental impacts of changes in land use and the effects of intensive management of plantations on the ecosystem. This includes the use of chemicals, health and productivity of plantations, water yield and water quality of forested catchments, soil protection, fire prevention, conservation of natural forest and protection of endangered flora and fauna.

The initial brief for the project was to evaluate C&I at the FMU level and therefore issues related to legal and institutional arrangements at regional and national levels were not included in the process. However, these arrangements can have a significant impact on SFM at the FMU level and therefore cannot be ignored. For example, the initial allocation of land for plantation development without due consideration of the traditional rights of local communities was often stated as the primary source of conflict and land demarcation disputes between stakeholders at the FMU level. Likewise the issue of responsibility for forest protection against illegal logging requires resolution between stakeholders at the regional, if not the national, level.

Compared with the CIFOR generic set of C&I for natural forest, the proposed core set of C&I for industrial plantations has less emphasis on the conservation of biodiversity. While the plantations C&I have a strong focus on forest management and environmental impacts, it is of interest to note that the primary concern of stakeholders for long-term SFM was related to social rather than management or environmental issues.

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Annex 2. Form 2

TESTING CRITERIA AND INDICATORS: CIFOR METHOD
Form 2: Field responses

TEAM NO.

3

Expert's Initial

JB

A=....., B=.....
C=.....

Source

State Source
document

ATO

Identification No.

IN SOURCE

E6

Final Identification No. (AS REPORTED IN FINAL LIST)

E6

CLASS

S/M

Policy=P, Social=S, Production of Goods & Services=M
Ecology=F, Financial & Economic aspects=ERECOMMENDATION
(AFTER FIELD TESTING)

Yes

No

X

Enter the selected criterion or indicator as stated in the source document in this space (use Box O for Final Vers.):

There is a procedure for dialogue and conflict resolution between various stakeholders

A

Justify your selection of this criterion or indicators:

The logging company in the XXX area has an opportunistic attitude vis-a-vis the population. Conflicts are solved in an ad hoc manner, and most often external authorities are called upon to restore order and to 'solve' problems. The actual way of dialogue and conflict resolution causes dissatisfaction among local people.

B

ATTRIBUTES

C

Two entry boxes have been provided for each question in this section. The first box (a) refers to the criterion or indicator as listed in Box A, which is the initial selection. If the initial selection has to be modified, this will be recorded in Box F. This final version must be subjected to a renewed evaluation (f). By comparing evaluation (a) and (f) the reader can assess whether the final version is significantly better than the initial version.

Please use a scale of 1-5 when answering, where 1=no/bad/unimportant and 5=yes/good/important.

	(a)	(f)		(a)	(f)
Provides a summary or integrative measure?	3	3	Easy to detect, record and interpret? Feasible?	5	5
Closely and unambiguously related to the assessment goal ?	5	5	Precisely defined?	5	5
Adequate response range to stresses? (sensitive)	3	3	Will it produce replicable results? (reliable)	5	5
Diagnostically specific?	5	5	How relevant is this criterion or indicator?	4	5
Appealing to users?	5	5	Other:		

Annex 2. Continued

Provide bibliographic references (if any):

D

Give the ref. of C&I in the Base Set (e.g. ATO) that overlaps (come closest) to the criterion or indicator recommended above:

	1-5		1-5		1-5		1-5		1-5
Base Set 1									
Base Set 2									
Base Set 3									

E

Final version of criterion/indicator, state only if different to definition on page 1 (Box A):

There is a procedure for dialogue and conflict resolution between various stakeholders and within stakeholder group (indicators)

F

NOTES : Please record your notes on evaluating the criterion/indicator (Box A) here :

G

30/10 *Village people working in town often enjoy a high status and can play an important role as intermediaries between their fellow in the village, the logger and the state. Villagers prefer to solve conflicts between them at village level, and hesitate to involve the authorities. Village chiefs do not have enough authority to control forest utilisation by fellow villagers and outsiders. The villagers feel powerless regarding the empty promises of the logger.*

02/11 *The villagers try to negotiate with the logging companies on 'empty promises'. They feel on the one hand that the officials do not want to help them because they get advantages from the logger. On the other hand they count on them. Quite an ambiguous attitude!*

Would this C&I need to be evaluated

H

in the field?

in the office?

both?

Please note below what kind of documentation would be required if the C&I were to be used in a proper field assessment of sustainable forest management.

I

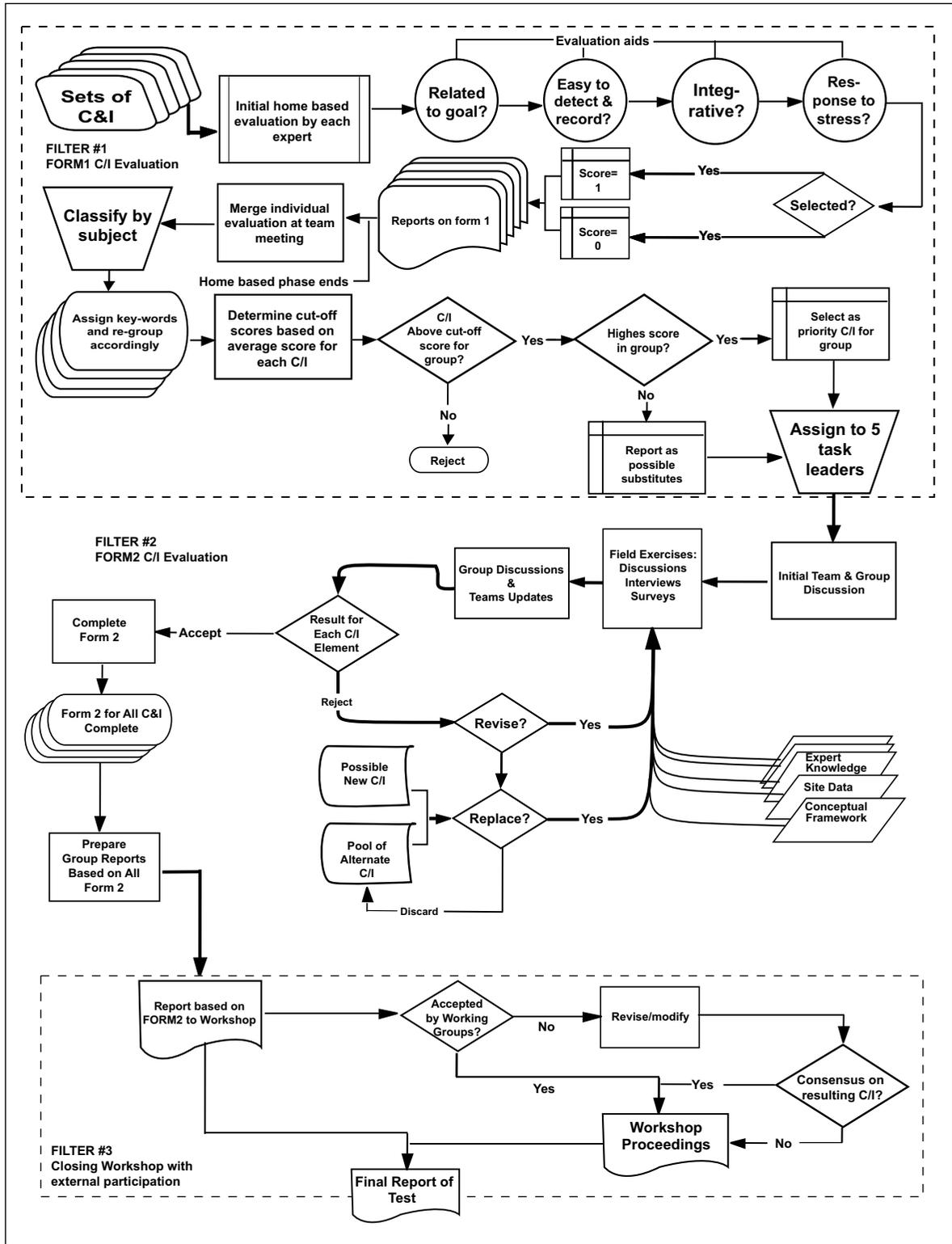
- *Document on socio-political organisation of the ethnic group concerned.*
- *Documentation on the forestry law.*

Annex 3. Continued

AUTHORS' NOTE: The box below was not used by the expert team members

WORKSHOP NOTES (for office use only)					
<p>Did the workshop accept this criterion/indicator unchanged? Why?</p>	<table border="1" style="margin: auto;"> <tr> <td style="width: 25%;">YES</td> <td style="width: 25%;"></td> <td style="width: 25%;">NO</td> <td style="width: 25%;"></td> </tr> </table>	YES		NO	
YES		NO			
<p>Were revisions called for? State revision:</p>	<table border="1" style="margin: auto;"> <tr> <td style="width: 25%;">YES</td> <td style="width: 25%;"></td> <td style="width: 25%;">NO</td> <td style="width: 25%;"></td> </tr> </table>	YES		NO	
YES		NO			
<p>State justification for revision:</p>					
<p>OR was this criterion or indicators rejected as being unsuitable? State reasons:</p>	<table border="1" style="margin: auto;"> <tr> <td style="width: 25%;">YES</td> <td style="width: 25%;"></td> <td style="width: 25%;">NO</td> <td style="width: 25%;"></td> </tr> </table>	YES		NO	
YES		NO			
N					

Annex 4. Iterative Filtering and Generation Method (IFGM) flow chart
(Prabhu *et al.* 1999)



Annex 5. A compilation of all criteria and indicators proposed by the three teams

Socio-economic P, C&I		
P	C	I
Team 1		
<i>Human well-being is enhanced</i>		
Equitable benefit sharing		
		<ul style="list-style-type: none"> Economic alternatives/supplements to local communities are increasing People's incomes have increased in real terms since the establishment of forest plantation Mechanism for fair compensation from losses incurred by local communities existed Local communities have significant opportunities to work for and be trained by the company without discrimination Local communities are encouraged to grow timber on their own land to supply raw materials needed for the mill Public infrastructures for local communities are provided and maintained
Stakeholders' long-term tenure and rights are secured		
		<ul style="list-style-type: none"> Long-term tenure and rights have been legally settled prior to the establishment of forest plantation Traditional land use patterns and practices of local communities are respected and protected
Participatory co-management is in place		
		<ul style="list-style-type: none"> Effective mechanism exist for two-way communication and consultation Local communities understand the company's plan for sustainable plantation management Management understands traditional rights and gender roles Professional staff capable of community development is available and fully supported by the management Fair and effective mechanisms for conflict resolution exist
Responsibility of primary stakeholder is well-defined		
		<ul style="list-style-type: none"> Agreement exists between local communities and the management regarding rights and responsibilities of both parties Effective control mechanisms for executing the agreement exist Education and training programme for local communities concerning the adverse effects of plantation activities exist Activities within the areas conserved for environmental, social and cultural reasons are carefully recorded and monitored Minimum social and environmental disruption to local communities Government standards/regulations regarding wages (UMR) are met
Team 2		
<i>Sustainable management of forest plantation positively enhances socio-economic condition of local people</i>		
Stakeholders' (forest actors') tenure and use rights are secure		
		<ul style="list-style-type: none"> Tenures are well defined and upheld Conflicts are minimal or settled Opportunities exist for local people (forest-dependent people) to get employment, training and compensating rewards from forest company

Annex 5. Continued

P C I
<p>Stakeholders (forest actors) participate in forest management</p> <ul style="list-style-type: none"> Effective “bottom-up” and “top-down” communications between primary and other stakeholders Forest-dependent people and company officials understand each other’s plans and interests Forest-dependent people share in economic benefits of plantation forest utilisation
<p>Socio-economic performance of local people</p> <ul style="list-style-type: none"> Contribution to the increase in the well-being of local people (forest-dependent people) Contributing to the maintenance of cultural values and diversity, and of indigenous and local knowledge Contribution to the provision of facilities for general recreation and tourism
Team 3
<i>Socio-economic dynamics of the community is supportive of sustainable forest management</i>
<p>Stakeholders’ tenure and land use rights secure</p> <ul style="list-style-type: none"> Tenures are well defined and upheld Long-term tenure or agreements to land is guaranteed and customary rights are respected Opportunities exist for the local community to continue socio-economic activities within the forest concession area Opportunities exist for the local community to get compensating rewards for loss of land and other resources Fair and effective mechanisms for conflict resolution exist
<p>Stakeholders participate in forest management</p> <ul style="list-style-type: none"> Effective mechanisms exist for communication and consultation among stakeholders Local communities understand and are involved in the process of forest management activities Management understands and considers local knowledge in forest management activities Local communities are given first preference in forest management activities in terms of management, training and employment
<p>Socio-economic performance of local community is enhanced</p> <ul style="list-style-type: none"> Contribution to the development of public infrastructure and services should meet the local community’s needs and aspirations Contribution to the development of alternative economic activities and linkages exist Social benefits are maximised and social disruption is minimised
<p>Forest management enhances employee relation</p> <ul style="list-style-type: none"> All applicable laws/regulations covering health and safety are met or exceeded Wages and other facilities are met or exceed local standards Career development is clearly planned for all employees without discrimination

Annex 5. Continued

Management P, C&I
P C I
Team 1
<i>A management system is in place to ensure sustainability</i>
<p>Management objectives are well defined Progress of the plantation development programme is in line with achievement of management objectives</p>
<p>A comprehensive management plan is available</p> <ul style="list-style-type: none"> Map of the area showing location, including vegetation and topographic details An assessment of the suitability of the site in terms of its production potential, environmental perspective, social implications and availability of sufficient land has been carried out Choice of species including of native species and allocation of respective planting sites are in accordance with management objectives Planting programme detailing monthly planting targets, operational schedules, manpower, infrastructure and machinery/equipment requirements is in existence Environmental conservation, social and cultural strategies for plantation are specified Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting in relation to species planted are available An indicative research and development plan outlining short-, medium- and long-term research projects to guide, support plantation development and improve quality and yield of plantation wood Financial projections, including planned market projections for the product
<p>Good forest resource management strategy is in place</p> <ul style="list-style-type: none"> External boundary is lawfully and permanently demarcated and well protected against infringement Clear demarcation of production forest area into smaller and more manageable management units using natural features where applicable Security measures to safeguard against theft of forest resource from FMU Forest map produced from interpretation of aerial photographs showing details of planting Plantation register giving details of planting and crop management Updated aerial photographs and/or satellite imagery of all planted areas Net productive area accurately updated every five years Growth and yield data from PSPs to monitor growth/yield trends Mid- and pre-harvest forest inventory data Volume/yield regulation by area, site and species
<p>Sound plantation practices optimising yields on sustainable basis</p> <ul style="list-style-type: none"> Minimum skidding, mechanical land clearing and site preparation damage Road specification and layout matched forest conditions and operational requirement Wood harvesting and transport systems match forest conditions and meet with environmental requirement Seedling production and nursery management system is capable of producing good quality seedlings in sufficient quantities to meet planting requirement Availability of manpower at all levels Sufficient infrastructure, machinery and equipment to meet the operational requirements

Annex 5. Continued

P C I
<p>Integrated pest and disease prevention and control programme to minimise damage to the trees</p> <p>Sound weed-management programme to reduce weed competition promoting early canopy closure</p> <p>A comprehensive fertilisation programme to improve and maintain soil fertility</p> <p>Appropriate pruning, singling and thinning regimes geared towards optimal production of the desired crop</p> <p>Existence of a fire plan detailing fire prevention and control measures</p> <p>Effective administrative and reporting procedures to ensure smooth running of the operation</p> <p>Human resources development and training prescribed to meet the operational, social and environmental needs of the project</p> <p>An effective purchase and supply department</p> <p>Monitoring, control and verification programmes prescribed to monitor progress of planting and quality of all plantings</p>
<p>There is sustained and adequate funding for running the operation</p> <p>Liquidity of cash flow to support infrastructure development, acquisition of machinery and equipment and to meet the day-to-day running of the operation</p>
<p>Appropriate labour, health and safety considerations</p> <p>Employment conditions for local and non-local employees doing the same job</p> <p>Health care, education, housing and sanitation facilities</p> <p>Clear and transparent programme and procedures to look into the welfare and grievances of the personnel</p> <p>Operational guidelines for safety precautions in handling chemicals, vehicles and machinery are available and are being enforced</p>
<p>A comprehensive research and development programme is in place</p> <p>Types and number of research projects and research priorities</p> <p>Number of qualified researchers and areas of discipline</p> <p>Size of funding to ensure continuity of research programme</p> <p>Evidence of fruits from R&D benefiting the plantation programme</p>
<p>Monitoring and assessment of plantation activities to ensure conformity of management plan</p> <p>Actual areas planted and progress of planting</p> <p>Species are planted on correct site/soil types, as planned</p> <p>A full stand of planted trees, with a survival rate of at least 90%</p> <p>Standard for planting and tending</p> <p>Records of management activities such as R&D, fire incidence and complaints from the local community</p> <p>Sound estate auditing and cost accounting procedures</p>

Annex 5. Continued

P C I
Team 2
<i>Forest management resources support and activities are conducive to sustainable yield</i>
<p>Professional and dedicated human resources</p> <ul style="list-style-type: none"> Adequate human resources at all levels of management Systematic and continuous training and career promotion programme and rewards Human resources welfare programme exists Effective and efficient organisational structure
<p>Comprehensive management plan exists and is well defined</p> <ul style="list-style-type: none"> Use of full baseline data Well-programmed and well-implemented monitoring and evaluation An integrated information system used at all levels of management Operations and forecasting should refer to the management plan Appropriate infrastructure to support activities Management activities should be integrated Forest land allocation should be the functional base
<p>Normal forest structure</p> <ul style="list-style-type: none"> Clear and consistent yield regulation Silvicultural practices are well prescribed and appropriate to forest classes Rotation length relatively close to stand age approaching maximum MAI Use of reliable methods for monitoring growing stock and increment
<p>Appropriate technologies are available</p> <ul style="list-style-type: none"> Implementation of species-site matching Development of tree improvement Implementation of proper seedling production procedures Implementation of proper tending operation procedures Efficient and effective felling techniques and transportation
<p>Forest protection programme</p> <ul style="list-style-type: none"> Effective and efficient operational system of forest fire prevention and suppression Well-defined and practice of integrated pest management programmes Effective and efficient operational system of forest security
<p>Adequate funding secure</p> <ul style="list-style-type: none"> Reliable company financial cash flow Guaranteed and adequate investment in capital, human resources and research and development

Annex 5. Continued

P C I
Team 3
<i>A forest management system is in place to ensure sustainable yield</i>
<p>Planning system at both forest and business management levels is in place</p> <p>Planning system comprised of all planning levels, master plan, periodic long-run and short-run planning, both at forest and business levels are in place</p> <p>Management objectives are clearly defined and stated in the long term planning (master plan) document</p> <p>A market assessment is carried out and stated in the long-term planning (master plan) document for proposing selected species</p> <p>Projections (in long-term planning) of planting and harvesting programmes conform, in terms of area and location</p> <p>Planting, forest maintenance and protection, and logging (if any), conducted in respective years are set out in monthly targets; operational schedules, manpower, infrastructure and equipment are in existence</p> <p>Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting are available</p> <p>Yield regulations by area and/or volume are set out</p> <p>Financial budget cash flow projections are developed and recorded in the long-term planning document</p>
<p>Professional and dedicated human resources are enhanced</p> <p>Adequate human resources at all levels of management</p> <p>Clear and effective organisational structure with job descriptions is developed</p> <p>Human resource development is implemented</p> <p>Wages and other facilities are provided</p> <p>Operational guidelines for safety procedures for handling chemicals, vehicles and machinery are available and are being enforced</p>
<p>Implementation of timber plantation (area and species), is consistent with planning programme</p> <p>Proper tending operation procedure is implemented</p>
<p>Implementation of logging (if any) is consistent with the planning programme</p> <p>Harvesting/logging area and location conformed with yield regulations</p> <p>Felling techniques and transportation are implemented efficiently and effectively</p>
<p>Forest maintenance and protection are implemented and consistent with the planning programme</p> <p>Operational system of forest fire prevention and suppression, are implemented effectively and efficiently</p> <p>Well-defined integrated pest and disease management programmes are practised</p> <p>Effective and efficient operational system of forest security is implemented</p>
<p>Research and development (R&D) programme is conducted</p> <p>R&D development programme supporting the operational activities is implemented</p> <p>R&D development programme responding and contributing to new information and technology is practised</p>

Annex 5. Continued

P C I
<p>There is sustained and adequate funding for running the operation</p> <p>During establishment period, an adequate funding source for financing the required forest development programme exists</p> <p>As the post-establishment period initiated annual income from timber harvested is generated and able to finance all forest management activities adequately</p>
<p>An effective monitoring and control system audits management's conformity with planning</p> <p>Periodic forest inventory system exists, Entire (total) timber standing stock volume increases either time during establishment period, and thereafter if either increase or constant</p> <p>Continuous forest inventory (CFI) plots established and measured regularly</p> <p>Documentation and records of all forest management activities are kept in a form that makes it possible for monitoring to occur</p>
Ecology P, C&I
P C I
Team 1
<i>Ecological integrity is maintained</i>
<p>Ecosystem function is maintained</p> <p>Toxic and dangerous chemicals, including banned chemicals, are not in use</p> <p>Use of acceptable chemicals and fertilisers is carefully monitored to avoid or minimise contamination of food chain</p> <p>Ecologically sensitive areas are protected</p> <p>Extent of soil disturbance in terms of exposed, eroded and compacted soils</p> <p>Programme to maintain and enhance chemical and physical properties of the soil is in place</p> <p>Water quality in the catchment area is acceptable</p> <p>Extent of microclimatic change</p>
<p>Biodiversity of ecosystem is maintained</p> <p>Existence of patches and strips of natural forest for conservation</p> <p>The potential danger of monoculture is minimised through mixed cropping</p> <p>Species selected should be readily adaptable to the local edaphic condition</p> <p>Record of protected fauna and flora</p>
<p>Resilience of ecosystem is maintained</p> <p>Fire prevention and control measures are in force</p> <p>Measures to prevent spread of pathogen, pests and weeds exist and are implemented</p> <p>Species that are not known to be susceptible to serious to pests, diseases, weeds and fire are promoted</p> <p>Integrated Pest Management is practised</p>

Annex 5. Continued

P C I
Team 2
<i>Ecosystem is improved and maintained</i>
<p>Ecosystem is functionally improved Existing biodiversity supportive to plantation forest sustainability Improved microclimate and hydrologic functions</p>
<p>Land productivity is secure Balance of biogeochemical cycles Improved soil fertility Improved land capability</p>
<p>Negative environmental impacts are minimised Land degradation is minimal Pollution is minimal Specific ecological function areas are conserved Damaged areas are rehabilitated</p>
Team 3
<i>Ecosystem function is maintained or improved</i>
<p>Structure and ecosystem function are maintained Buffer zones along watercourses are protected Plantation health is maintained Fire break is employed Site-species matching is considered Mixed cropping is preferable to monoculture Tree growth rate is satisfactory Important remnant vegetation is maintained Indigenous species are used for enrichment planting</p>
<p>Soil and water resources are maintained or improved Chemical and physical properties of the soil are conserved Fertilisers and chemical needs are judiciously used Water quality is maintained Soil erosion hazard is controlled Hydrological function is secured Soil and water pollution is controlled</p>
<p>Adverse environmental influence is minimised Eutrophication is minimised Endangered flora and fauna are conserved Air pollution is controlled Waste control management is secured Pests and diseases are controlled</p>

Annex 6. Socio-economic – Criterion 1 and related indicators

Team Test	Criterion 1	Indicators	Keywords
1	<i>Stakeholders' long-term tenure and rights are secured</i>	<ol style="list-style-type: none"> 1. Long-term tenure and rights have been legally settled prior to the establishment of forest plantation 2. Traditional land use patterns and practices of local communities are respected and protected 	<ol style="list-style-type: none"> 1. tenure, rights, legal, settle 2. traditional land use, respected, protected
2	<i>Stakeholders' (forest actors') tenure and use rights are secured</i>	<ol style="list-style-type: none"> 1. Tenures are well defined and upheld 2. Conflicts are minimal or settled 3. Opportunities exist for local people (forest-dependent people) to get employment, training and compensating rewards from forest company 	<ol style="list-style-type: none"> 1. tenure, well-defined, upheld 2. conflicts, minimal, settled 3. opportunity
3	<i>Stakeholders' tenure and land use rights secured</i>	<ol style="list-style-type: none"> 1. Tenures are well defined and upheld 2. Long-term tenure or agreement to land is guaranteed and customary rights are respected 3. Opportunities exist for local community to continue socio-economic activities within the forest concession area 4. Opportunities exist for local community to get compensating rewards for loss of land and other resources 	<ol style="list-style-type: none"> 1. tenure, well-defined, upheld 2. long-term tenure, respected 3. opportunity, activity 4. opportunity, compensation

Annex 7. Socio-economic – Criterion 2 and related indicators

Team Test	Criterion 2	Indicators	Keywords
1	<i>Participatory co-management is in place</i>	<ol style="list-style-type: none"> 1. Effective mechanisms exist for two-way communication and consultation 2. Local communities understand the company's plan for sustainable plantation management 3. Management understands traditional rights and gender roles 4. Professional staff capable of community development is available and fully supported by the management 	<ol style="list-style-type: none"> 1. mechanism 2. community, understand, plan 3. management, understand, rights 4. capable, community development
2	<i>Stakeholders (forest actors) participate in forest management</i>	<ol style="list-style-type: none"> 1. Effective "bottom-up" and "top-down" communication between primary and other stakeholders 2. Forest-dependent people and company officials understand each other's plan and interests 3. Forest-dependent people share in economic benefits of plantation forest utilisation 4. Fair and effective mechanisms for conflict resolution exist 	<ol style="list-style-type: none"> 1. effective, communication 2. understand, each other's plans 3. economic benefits 4. effective mechanism, conflict resolution
3	<i>Stakeholders participate in forest management</i>	<ol style="list-style-type: none"> 1. Effective mechanisms exist for communication and consultation among stakeholders 2. Local communities understand and are involved in forest management activities 3. Management understands and considers local knowledge in forest management activities 4. Local communities are given first preference in forest management activities in terms of management, training and employment 	<ol style="list-style-type: none"> 1. Effective mechanism, communication, consultation 2. Local community, understand, involve 3. Local knowledge 4. Local community, first preference

Annex 8. Socio-economic – Criterion 3 and related indicators

Team Test	Criterion 3	Indicators	Keywords
1	<i>Equitable benefit sharing</i>	<ol style="list-style-type: none"> 1. Economic alternatives/ supplements to local communities are increasing 2. People's incomes have increased in real terms since the establishment of forest plantation 3. Mechanisms for fair compensation from losses incurred by local communities exist 4. Local communities have significant opportunities to work in and be trained by the company without discrimination 5. Local communities are encouraged to grow timber on their own land to supply raw materials needed for the mill 6. Public infrastructures for local communities are provided and maintained 	<ol style="list-style-type: none"> 1. economic alternative, increase 2. income, increase 3. mechanism, compensation 4. opportunity, training 5. grow, timber 6. public infrastructure
2	<i>Socio-economic performance for local people</i>	<ol style="list-style-type: none"> 1. Contribution to the increase in the well-being of local people (forest-dependent people) 2. Contribution to the maintenance of cultural values and diversity, and of indigenous and local knowledge 3. Contribution to the provision of facilities for general recreation and tourism 	<ol style="list-style-type: none"> 1. well-being, increase 2. maintenance, cultural values, indigenous knowledge, local knowledge 3. facilities, recreation
3	<i>Socio-economic performance of local community is enhanced</i>	<ol style="list-style-type: none"> 1. Contribution to the development of public infrastructure and services should meet the local community's needs and aspirations 2. Contribution to the development of alternative economic activities and linkages exist 3. Social benefits are maximised and social disruption is minimised 	<ol style="list-style-type: none"> 1. public infrastructure, community's needs, aspirations 2. alternative economic, linkages 3. social benefits, maximise, social disruption, minimise

Annex 9. Socio-economic – Criterion 4 and related indicators

Team Test	Criterion 4	Indicators	Keywords
1	<i>Responsibility of primary stakeholders is well defined</i>	<ol style="list-style-type: none"> 1. Agreement exists between local communities and the management regarding rights and responsibilities of both parties 2. Effective control mechanisms for executing the agreement exist 3. Education and training programmes for local communities concerning the adverse effects of plantation activities exist 4. Activities within the area conserved for environmental, social and cultural reasons are carefully recorded and monitored 5. Minimum social and environmental disruption to local communities 6. Government standards/ regulations regarding wages (UMR) are met 	<ol style="list-style-type: none"> 1. agreement, both parties 2. mechanism, agreement execution 3. adverse effect 4. conserved areas, environmental, social, cultural reasons, recorded, monitored 5. social, environment, disruption, minimum 6. UMR
2	-	-	-
3	<i>Forest management enhances employee relations</i>	<ol style="list-style-type: none"> 1. All applicable laws/regulations covering health and safety are met or exceeded 2. Wages and other facilities are met or exceed local standards 3. Career development is clearly planned for all employees without discrimination 	<ol style="list-style-type: none"> 1. laws, regulation, health, safety 2. wage, local standards 3. career development

Annex 10. Management – Criterion 1 and related indicators

Team Test	Criterion 1	Indicators	Keywords
1	<i>Management objectives are well defined</i>	1. Progress of the plantation development programme is in line with achievement of management objectives	1. management objectives
2	-	-	-
3	-	-	-

Annex 11. Management – Criterion 2 and related indicators

Team Test	Criterion 2	Indicators	Keywords
1	<i>Comprehensive management plan is available</i>	<ol style="list-style-type: none"> 1. Maps of the area showing location of plantation, including vegetation and topographic details 2. Assessment of suitability of site in terms of its production potential, environmental perspective, social implications and availability of sufficient land has been carried out 3. Choices of species include native species and allocation of respective planting sites are in accordance with management objectives 4. Planting programme detailing monthly planting targets, operational schedules, manpower, infrastructure and machinery/equipment requirements is in existence 5. Environmental conservation, social and cultural strategies for the plantation are specified 6. Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting in relation to species planted are available 7. Indicative research and development plan outlining short-, medium- and long-term research projects to guide, support plantation development and improve quality and yield of plantation wood 8. Financial projections including planned market projections for the produce 	<ol style="list-style-type: none"> 1. vegetation and topo maps 2. site assessment 3. species choice 4. planting programme 5. conservation, social and cultural strategies 6. silvicultural prescriptions 7. research and development 8. financial projections
2	<i>Comprehensive management plan exists and is well defined</i>	<ol style="list-style-type: none"> 1. Use of full baseline data 2. Well-programmed and implemented monitoring and evaluation 3. An integrated information system used at all levels of management plan 4. Operations and forecasting should refer to the management plan 5. Appropriate infrastructure to support activities 6. Management activities should be integrated 7. Forest land allocation should be the functional base 	<ol style="list-style-type: none"> 1. full baseline data 2. monitoring, evaluation 3. information system, management plan 4. management plan 5. infrastructure 6. management activities 7. land allocation
3	<i>Planning system at both forest and business management levels is in place</i>	<ol style="list-style-type: none"> 1. Planning system comprised of all planning levels, master plan, periodic long-run and short-run planning, both at forest and business levels is in place 2. Management objectives are clearly defined and stated in the long-term planning (master plan) document 	<ol style="list-style-type: none"> 1. planning 2. management objectives

Annex 11. Continued

Team Test	Criterion 2	Indicators	Keywords
		<ol style="list-style-type: none"> 3. A market assessment is carried out and stated in the long-term planning (master plan) document in coming up with selected species 4. Projections (in the long-term planning) of planting and harvesting programmes, in terms of area and location, conform 5. Planting, forest maintenance and protection, and logging (if any), conducted in respective years are set out in monthly targets; operational schedules, manpower, infrastructure and equipment are in existence 6. Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting are available 7. Yield regulations by area and/or volume are set out 8. Financial budget cash flow projections are developed and recorded in the long-term planning document 	<ol style="list-style-type: none"> 3. market assessment 4. planting and harvesting programme 5. forest maintenance, protection 6. silvicultural prescriptions 7. yield regulation 8. budget cash flow

Annex 12. Management – Criterion 3 and related indicators

Team Test	Criterion 3	Indicators	Keywords
1	Good forest resource management strategy is in place.	<ol style="list-style-type: none"> 1. External boundary is lawfully and permanently demarcated and well protected against infringement 2. Clear demarcation of production forest area into smaller and more manageable management units using natural features where applicable 3. Security measures to safeguard theft of forest resource from FMU 4. Forest map produced from interpretation of aerial photographs showing details of planting 5. Plantation register giving details of planting and crop management 6. Updated aerial photographs and/or satellite imagery of all planted areas 7. Net productive area accurately updated every five years 8. Growth and yield data from PSPs to monitor growth/yield trends 9. Mid- and pre-harvest forest inventory data 10. Volume/yield regulation by area, site and species 	<ol style="list-style-type: none"> 1. clear external boundary 2. clear demarcation 3. security measures 4. forest map 5. plantation register and management 6. aerial photographs, satellite imagery 7. net productive areas 8. growth and yield 9. forest inventory 10. volume/yield regulation
2	Normal forest structure	<ol style="list-style-type: none"> 1. Clear and consistent yield regulation 2. Silvicultural practices are well prescribed and appropriate to forest classes 3. Rotation length relatively close to stand age approaching maximum MAI 4. Use of reliable methods for monitoring growing stock and increment 	<ol style="list-style-type: none"> 1. yield regulation 2. silvicultural practice 3. rotation length 4. monitoring growing stock
3	Forest maintenance and protection are implemented and consistent with the planning programme	<ol style="list-style-type: none"> 1. Operational systems of forest fire prevention and suppression are implemented effectively and efficiently 2. Well-defined integrated pest and disease management programmes are practised 3. Effective and efficient operational system of forest security is implemented 	<ol style="list-style-type: none"> 1. forest fire prevention 2. pest and disease management 3. forest security

Annex 13. Management – Criterion 4 and related indicators

Team Test	Criterion 4	Indicators	Keywords
1	<i>Sound plantation practices optimising yields on sustainable basis</i>	<ol style="list-style-type: none"> 1. Minimum skidding, mechanical land clearing and site preparation damage. 2. Road specification and layout match forest conditions and operational requirements 3. Wood harvesting and transport systems match forest conditions and meet with environmental requirements 4. Seedling production and nursery management system is capable of producing good quality seedlings in sufficient quantities to meet planting requirements 5. Availability of manpower at all levels 6. Sufficient infrastructure, machinery and equipment to meet the operational requirements 7. Integrated pest and disease prevention and control programme to minimise damage to the trees 8. Sound weed management programme to reduce weed competition promoting early canopy closure 9. A comprehensive fertilisation programme to improve and maintain soil fertility 10. Appropriate pruning, singling and thinning regimes geared towards optimal production of the desired crop 11. Existence of a fire plan detailing fire prevention and control measures 12. Effective administrative and reporting procedures to ensure smooth running of the operation 13. Human resources development and training prescribed to meet the operational, social and environmental needs of the project 14. An effective purchase and supply department 15. Monitoring, control and verification programmes prescribed to monitor progress of planting and quality of all plantings 	<ol style="list-style-type: none"> 1. minimum skidding road 2. road specification 3. harvesting and transport system 4. nursery management system 5. manpower 6. infrastructure, machinery and equipment 7. pest and disease management 8. weed management 9. fertilisation programme 10. thinning system 11. fire prevention 12. administrative and reporting procedure 13. human resources development 14. purchase and supply department 15. planting management
2	<i>Appropriate technologies are available</i>	<ol style="list-style-type: none"> 1. Implementation of species-site matching 2. Development of tree improvement 3. Implementation of proper seedling production procedures 4. Implementation of proper tending operation procedures 5. Efficient and effective felling techniques and transportation 	<ol style="list-style-type: none"> 1. species-site matching 2. tree improvement 3. seedling production procedures 4. tending procedures 5. felling and transport

Annex 13. Continued

Team Test	Criterion 4	Indicators	Keywords
3	<i>Implementation of timber planting (area and species) is consistent with planning programme</i>	<ol style="list-style-type: none"> 1. Planting area and location conform with long-term planning 2. Species planted are in market demand 3. Proper seedling production procedure is applied 4. Proper tending operation procedure is implemented 	<ol style="list-style-type: none"> 1. planting management 2. market demand 3. seedling production procedures 4. tending procedures

Annex 14. Management – Criterion 5 and related indicators

Team Test	Criterion 5	Indicators	Keywords
1	<i>There is sustained and adequate funding for running the operation</i>	1. Liquidity of cash flow to support infrastructure development, acquisition of machinery and equipment and to meet the day-to-day running of the operation	1. cash flow for infrastructure, machinery and equipment
2	<i>Adequate funding secure</i>	1. Reliable company financial cash flow 2. Guaranteed and adequate investment in capital, human resources and research and development	1. financial cash flow 2. investment in capital, human resources and research development
3	<i>There is sustained and adequate funding for running the operation</i>	1. During establishment period, an adequate funding source for financing the required forest development programme exists 2. In the post-establishment period annual income from timber harvesting is generated and able to finance all forest management activities adequately	1. funding for forest development 2. financing forest management activities

Annex 15. Management – Criterion 6 and related indicators

Team Test	Criterion 6	Indicators	Keywords
1	<i>Appropriate labour, health and safety considerations</i>	<ol style="list-style-type: none"> 1. Employment conditions for local and non-local employees doing the same job 2. Health care, education, housing and sanitation facilities 3. Clear and transparent programme and procedures to look into the welfare and grievances of the personnel 4. Operational guidelines for safety precautions in handling chemicals, vehicles and machinery are available and are being enforced 	<ol style="list-style-type: none"> 1. employment for local and non-local employees 2. facilities 3. welfare programme 4. safety guidelines
2	<i>Forest protection programme</i>	<ol style="list-style-type: none"> 1. Effective and efficient operational system of forest fire prevention and suppression 2. Well-defined and practise of integrated pest management programmes 3. Effective and efficient operational system of forest security 	<ol style="list-style-type: none"> 1. forest fire control system 2. pest management 3. forest security system
3	-	-	-

Annex 16. Management – Criterion 7 and related indicators

Team Test	Criterion 7	Indicators	Keywords
1	<i>A comprehensive research and development programme is in place</i>	<ol style="list-style-type: none"> 1. Types and number of research projects and research priorities 2. Number of qualified researchers and areas of discipline 3. Size of funding to ensure continuity of research programme 4. Evidence of fruits from R&D benefiting the plantation programme 	<ol style="list-style-type: none"> 1. research priorities 2. researcher and discipline 3. funding ensuring research 4. fruitful research
2	<i>Research and development programme</i>	<ol style="list-style-type: none"> 1. Research and development programme supporting the operational activities 2. Research and development respond and contribute to new information and technology 	<ol style="list-style-type: none"> 1. research and development programme 2. research and development programme
3	<i>Research and development programmes are conducted</i>	<ol style="list-style-type: none"> 1. R & D development programmes supporting the operational activities are implemented 2. R & D development programmes responding and contributing to new information and technology are practised 	<ol style="list-style-type: none"> 1. research and development programme 2. research and development programme

Annex 17. Management – Criterion 8 and related indicators

Team Test	Criterion 8	Indicators	Keywords
1	<i>Monitoring and assessment of plantation activities to ensure conformity with management plan</i>	<ol style="list-style-type: none"> 1. Actual areas planted and progress of planting 2. Species are planted on correct site/soil types, as planned 3. A full stand of planted trees, with a survival rate of at least 90% 4. Standard of planting and tending 5. Records of management activities such as R&D, fire incidence and complaints from the local community 6. Sound estate auditing and cost accounting procedures 	<ol style="list-style-type: none"> 1. progress of planting 2. site-species matching 3. full stand with planted trees 4. planting and tending 5. management records 6. estate auditing and accounting procedures
2	-	-	-
3	<i>An effective monitoring and control system audits management's conformity with planning</i>	<ol style="list-style-type: none"> 1. Periodic forest inventory systems exist, entire (total) timber standing stock volume increases during establishment period, and thereafter either increases or is constant 2. Continuous forest inventory (CFI) plots established and measured regularly 3. Documentation and records of all forest management activities are kept in a form that makes it possible for monitoring to occur 	<ol style="list-style-type: none"> 1. forest inventory system 2. forest inventory system 3. records of forest management activities

Annex 18. Management – Criterion 9 and related indicators

Team Test	Criterion 9	Indicators	Keywords
1	-	-	-
2	<i>Professional and dedicated human resources</i>	<ol style="list-style-type: none"> 1. Adequate human resources at all levels of management 2. Systematic and continuous training and career promotion programme and rewards 3. Human resources welfare programme exists 4. Effective and efficient organisational structure 	<ol style="list-style-type: none"> 1. human resources 2. training and career promotion 3. human resources, welfare 4. organisational structure
3	<i>Professional and dedicated human resources are enhanced</i>	<ol style="list-style-type: none"> 1. Adequate human resources at all levels of management 2. Clear and effective organisational structure with job descriptions is developed 3. Human resource development is implemented 4. Wages and other facilities are provided 5. Operational guidelines for safety procedures for handling chemicals, vehicles and machinery are available and are being enforced 	<ol style="list-style-type: none"> 1. human resources 2. organisational structure 3. human resource development 4. wages and facilities 5. safety guidelines procedure

Annex 19. Management – Criterion 10 and related indicators

Team Test	Criterion 10	Indicators	Keywords
1	-	-	-
2	-	-	-
3	<i>Implementation of logging (if any) is consistent with the planning programme</i>	<ol style="list-style-type: none"> 1. Harvesting/logging area and location conform with yield regulations 2. Felling techniques and transportation are implemented efficiently and effectively 	<ol style="list-style-type: none"> 1. logging area, yield regulation 2. felling and transportation

Annex 20. Ecology – Criterion 1 and related indicators

Team Test	Criterion 1	Indicators	Keywords
1	<i>Ecosystem function is maintained</i>	<ol style="list-style-type: none"> 1. Toxic and dangerous chemicals, including banned chemicals, are not in use 2. Use of acceptable chemicals and fertilisers is carefully monitored to avoid or minimise contamination of food chain 3. Ecologically sensitive areas are protected 4. Extent of soil disturbance in terms of exposed, eroded and compacted soils 5. Programme to maintain and enhance chemical and physical properties of the soil is in place 6. Water quality in the catchment area is acceptable 7. Extent of microclimatic change 	<ol style="list-style-type: none"> 1. dangerous chemicals 2. food chain 3. sensitive areas 4. soil disturbances 5. maintaining chemical and physical properties of the soil 6. water quality 7. microclimatic change
2	<i>Ecosystem is functionally improved</i>	<ol style="list-style-type: none"> 1. Existing biodiversity supportive to plantation forest sustainability 2. Improved microclimate and hydrologic functions 	<ol style="list-style-type: none"> 1. biodiversity 2. microclimate, hydrology
3	<i>Structure and ecosystem function is maintained</i>	<ol style="list-style-type: none"> 1. Buffer zones along watercourses are protected 2. Plantation health is maintained 3. Fire break is employed 4. Site-species matching is considered 5. Mixed cropping is preferable to monoculture 6. Tree growth rate is satisfactory 7. Important remnant vegetation is maintained 8. Indigenous species are used for enrichment planting 	<ol style="list-style-type: none"> 1. buffer zones 2. plantation health 3. fire break 4. site species matching 5. mix cropping 6. tree growth 7. remnant vegetation 8. indigenous species

Annex 21. Ecology – Criterion 2 and related indicators

Team Test	Criterion 2	Indicators	Keywords
1	<i>Biodiversity of ecosystem is maintained</i>	<ol style="list-style-type: none"> 1. Existence of patches of strips and patches of conservation forest 2. The potential danger of monoculture is minimised through mixed cropping 3. Species selected should be readily adaptable to the local edaphic condition 4. Record of protected fauna and flora 	<ol style="list-style-type: none"> 1. conservation area 2. monoculture, mixed cropping 3. species adaptable 4. protected flora and fauna
2	<i>Negative environmental impacts are minimised</i>	<ol style="list-style-type: none"> 1. Land degradation is minimal 2. Pollution is minimal 3. Specific ecological function areas are conserved 4. Damaged areas are rehabilitated 	<ol style="list-style-type: none"> 1. land degradation 2. pollution 3. ecological function 4. damaged areas
3	<i>Adverse environmental influence is minimised</i>	<ol style="list-style-type: none"> 1. Eutrophication is minimised 2. Endangered flora and fauna are conserved 3. Air pollution is controlled 4. Waste control management is secure 5. Pest and diseases are controlled 	<ol style="list-style-type: none"> 1. eutrophication 2. endangered flora and fauna 3. air pollution 4. waste control 5. pest and disease control

Annex 22. Ecology – Criterion 3 and related indicators

Team Test	Criterion 3	Indicators	Keywords
1	<i>Resilience of ecosystem is maintained</i>	<ol style="list-style-type: none"> 1. Fire prevention and control measures are in force 2. Measures to prevent spread of pathogens, pests and weeds exist and are implemented 3. Species that are not known to be susceptible to serious pests, diseases, weeds and fire are promoted 4. Integrated Pest Management is practised 	<ol style="list-style-type: none"> 1. fire prevention 2. pest, disease and weed management 3. selected species 4. integrated pest management
2	<i>Land productivity is secure</i>	<ol style="list-style-type: none"> 1. Balance of biogeochemical cycles 2. Improved soil fertility 3. Improved land capability 	<ol style="list-style-type: none"> 1. biogeochemical cycles 2. soil fertility 3. land capability
3	<i>Soil and water resources are maintained or improved</i>	<ol style="list-style-type: none"> 1. Chemical and physical properties of the soil are conserved 2. Fertilisers and chemical needs are judiciously judged 3. Water quality is maintained 4. Soil erosion hazard is controlled 5. Hydrologic function is secure 6. Soil and water pollution is controlled 	<ol style="list-style-type: none"> 1. soil chemical and physical properties 2. judicious use of chemical 3. water quality 4. soil erosion 5. hydrologic function 6. soil and water pollution

Annex 23. List of participants for final consultation round with companies

No.	Name	Position	Company
1	Harie Trianto	Field Unit Manager	INHUTANI II, Pulau Laut
2	Winarto	Sub-Field Unit Manager	HTI Senakin, INHUTANI II, Pulau Laut
3	Sumarmo Pd	Sub-Field Unit Manager	Sub Unit Pulau Laut
4	Usmandoyo	Section Coordinator (Kasi) for Forest Management	INHUTANI II, Pulau Laut
5	Syafuddin Sultan	Kasi Production	INHUTANI II, Pulau Laut
6	Rosiono Widodo	Coordinator Sub-Section (Kaur) Administration and Production	INHUTANI II, Pulau Laut
7	Bambang W	Kaur Observation and Development	INHUTANI II, Pulau Laut
8	Beni Supeno	Kaur Forest Management and Rehabilitation	INHUTANI II, Pulau Laut
9	Parjono	Kaur HTI	INHUTANI II, Pulau Laut
10	Sudirman	Kaur community development (PMDH/PUKK)	INHUTANI II, Pulau Laut
11	Wu Wen Tsan	Forest Development	PT Arara Abadi, Pekanbaru, Riau
12	Agus Awali	Forest Development	PT Arara Abadi, Pekanbaru, Riau
13	Zulhadi	Forest Information and Certification, Forest Development	PT Arara Abadi, Pekanbaru, Riau
14	Bambang Dwi Laksono	Forest Information and Certification, Forest Development	PT Arara Abadi, Pekanbaru, Riau
15	Anthony Rizal	Research and Development	PT Arara Abadi, Pekanbaru, Riau
16	M. Syarif Hidayat	Forest Information and Certification, Forest Development	PT Arara Abadi, Pekanbaru, Riau
17	Amirudin	CIF	PT Arara Abadi, Pekanbaru, Riau
18	Gunadi W	PPS	PT Arara Abadi, Pekanbaru, Riau
19	Herdhy KS	FSA	PT Arara Abadi, Pekanbaru, Riau
20	Hardjono Arisman	Director, Plant and Research	PT Musi Hutan Persada, Subanjeriji
21	Eko Bhakti Hardiyanto	R&D Advisor	PT Musi Hutan Persada, Subanjeriji
22	F. Syarkawi	R&D Socio-economic scientist	PT Musi Hutan Persada, Subanjeriji
23	Rachmat Wahyono	Growth and Yield Section Coordinator	PT Musi Hutan Persada, Subanjeriji
24	Susatyo Hutomo	Socio-economic scientist	PT Musi Hutan Persada, Subanjeriji
25	Bambang Hendro	R&D Advisor	PT Musi Hutan Persada, Subanjeriji
26	Sabar Siregar	R&D	PT Musi Hutan Persada, Subanjeriji
27	Aris Riyantoko	Planting Section	PT Musi Hutan Persada, Subanjeriji
28	Bastian Gumay	Planting Division	PT Musi Hutan Persada, Subanjeriji
29	Benni Rosa	HTI Unit III	PT Musi Hutan Persada, Subanjeriji
30	Saifuddin Anshori	R&D	PT Musi Hutan Persada, Subanjeriji
31	Edi Purwanto	R&D	PT Musi Hutan Persada, Subanjeriji
32	Christianus	SA	PT Musi Hutan Persada, Subanjeriji
33	Harnios Arief	Forest management specialist	LEI/CIFOR
34	Semiarto Aji Purwanto	Social scientist	LEI/CIFOR
35	Chairil Anwar Siregar	Ecologist	FRD, Ministry of Forestry/CIFOR
36	Dwi Rahmad Muhtaman	Social scientist	LATIN/CIFOR

Annex 24. Itinerary of final consultation process with companies

Date	Activities	Remarks
6 Nov. 1999	10.15-18.30 Bogor-Jakarta	INHUTANI
	07.10-09.25 To Banjarmasin, South Kalimantan	
	10.15-18.30 To Inhutani II, Pulau Laut	Spend the night in Stagen
7 Nov.	09.00-10.00 Meeting with Unit Manager	Discussing the plan for presentation
	10.00-13.00 Presentation preparation and team discussion	
8 Nov.	09.00-16.30 Presentation	
9 Nov.	10.00-18.00 To Banjarmasin	Spend the night in Banjarmasin
10 Nov.	10.15-12.30 To Jakarta and continue to Bogor	
14 Nov.	04.00 Bogor - Jakarta	
	07.15-09.25 To Pekanbaru, Riau	Stay in Pekanbaru
15 Nov.	08.00-09.30 To PT Arara Abadi office, Sembawang	
	10.00-16.30 Presentation	
	17.00-18.30 To Pekanbaru	
16 Nov.	08.45-13.00 To Palembang and directly went to Musi Hutan Persada, Palembang office	Stay in Palembang
17 Nov.	05.30-09.30 To the MHP plantation site	
	10.00-11.00 Meeting with field staff to discuss the plan	
	12.00-15.30 Field visit around plantation	
	16.00-19.30 To Palembang	Stay in Palembang
18 Nov.	05.00-09.00 To MHP site for presentation	
	09.15-15.30 Presentation	
	16.00-19.30 To Palembang	
19 Nov.	08.55-10.00 To Jakarta and continue to Bogor	
20 Nov.	Report writing	Bogor
24 Nov	Debriefing with Christian Cossalter	CIFOR Office
25-26 Nov.	Report writing	
30 Nov.	Final Meeting with Christian Cossalter	CIFOR Office

3. Results and Discussion

3.1 Home-based Evaluation of Criteria and Indicators: Form 1 Data

All teams were provided with documents that were used for C&I evaluation including a “tool box”. This “tool box” was subsequently published (CIFOR 1999). The first step of the C&I evaluation was that all teams were required to include as many C&I as possible (a so-called base set) from well-known international sources such as ITTO, CIFOR, LEI, WWF-IUCN and SmartWood. The selected C&I were recorded on Form 1 and team experts were then required to reject any C&I considered to be irrelevant to the conditions prevailing at the sites in question. It should be noted that it took several days for team members to fully understand this process. A number of team members felt that the time allocated for this home-based evaluation was insufficient.

The approach taken to obtain a base set of C&I for this initial evaluation varied between teams. Team 1 started from the original sources of published C&I, while Team 2 made use of the C&I already selected by Team 1. In contrast, Team 3 used the combined sets of C&I from Teams 1 and 2 as the base set for evaluation at site 3.

According to Prabhu *et al.* (1999) the purpose of home-based evaluation is to provide a preliminary evaluation of all C&I based on professional judgement to determine the most appropriate set of C&I for field testing. Following this process the number of C&I proposed for field testing by the teams was reviewed and those retained are summarised by discipline in Table 2.

The mean number of C&I retained for field testing was similar for forest management (58) and socio-economic issues (56) but was much lower for the ecological aspects (29). The teams considered ecological issues to be less complex and easier to evaluate therefore requiring less C&I for the assessment of sustainability.

Table 2. Number of Criteria and Indicators accepted for further evaluation by team members, based on pre-field evaluation

Teams	Management	Ecology	Social	Total
T1	38 (29%)	29 (22%)	65 (49%)	132 (100%)
T2	49 (59%)	15 (18%)	19 (23%)	83 (100%)
T3	87 (41%)	44 (20%)	84 (39%)	215 (100%)
Total	174 (43%)	88 (20%)	168 (37%)	
Average	58	29	56	

T1: Team 1 and so on

3.2 Field Evaluation of Criteria and Indicators: Form 2 Data

3.2.1 Background

Field testing of the candidate sets of C&I was carried out at three plantation sites at Riau, Sumatra and Subanjeriji, South Sumatra, during November and December 1997; and at Pulau Laut, South Kalimantan during July 1998. Over the period of evaluation, all team members spent some time in the forest, interviewed important stakeholders and forest actors and reviewed existing information. All team members were expected to justify their selection of the proposed C&I first within their own subgroup, then to the other experts in the team, and finally to the peer review team. Ample time was required at this phase for every member to be fully confident in their judgements of the ideas and concepts underpinning the C&I proposed. The results for these field tests have been reported independently for the sites at Riau (Purnadjaja *et al.* 1997a), Subanjeriji (Purnadjaja *et al.* 1997b) and Pulau Laut (Purnadjaja *et al.* 1998).

3.2.2 Quantitative analysis of the results from Form 2

All indicators for socio-economic, management and ecology issues submitted by the three teams were examined for commonality. Indicators were classified

into three categories, namely common (selected by all teams), semi-common (selected by two teams) and unique (selected by one team only). Results of this analysis are summarised in Table 3.

Table 3. Level of commonality of C&I proposed by the three Indonesian teams

Parameter	Common (%)	Semi-common (%)	Unique (%)	Total number of indicators based on synthesis set
Social	46	30	24	46
Management	65	31	4	65
Ecology	65	35	0	23

There was relatively good agreement between the teams on C&I selected, as reflected in the high percentage of common indicators related to management (65%), social (46%) and ecological (65%) issues. The level of semi-common indicators was similar for all teams, ranging from 30% to 35% (Table 3). In contrast, a relatively high percentage of social indicators (24%) were unique for each site.

The high degree of commonality in indicators related to forest management is a reflection of the similarity in management systems adopted by the companies developing the *A. mangium* plantation resources in Sumatra and Kalimantan.

Good agreement between ecological indicators was not entirely unexpected as the environmental issues to be addressed were similar at each site.

Commonality for the social indicators was lower and a comparatively high percentage of indicators were unique (24%), reflecting those social and economic issues specific to the local and indigenous communities at each site. It is therefore important to allow sufficient time during field testing to formulate C&I addressing specific socio-economic issues. It is probably also a reflection of the more qualitative nature of information to be captured by social C&I with greater reliance on interviews and discussions with stakeholders. The social issues to be addressed by C&I are often complex, requiring substantial judgement and interpretation by the team (Wollenberg and Colfer 1997; Prabhu *et al.* 1999).

It should be noted that the number of sourced C&I varied between teams as mentioned in section 3.1 dealing with the selection of the base set of C&I for field testing. The base set of C&I used by Team 1 was selected from various published sources. The other teams used the C&I sets selected by the previous team as the base set for field testing. A quantitative overview of the final sets of C&I proposed by each of the three teams is presented in Table 4. A total of 10 principles, 45 criteria and 191 indicators were proposed.

Principles related to socio-economic, forest management and ecological issues were addressed by all teams. One of the teams, however, also addressed issues related to forest policy and institutional arrangements. The other two teams did not include this principle because it was considered to be a national issue not appropriate for evaluation at the FMU level.

Teams 1 and 3 proposed a relatively higher number of C&I as the minimum reliable sets compared with Team 2 (Table 4). The indicators selected by the teams after field testing showed a common trend with the majority of indicators dealing with issues related to forest management (46% to 60%) compared with socio-economics (20% to 24%) and ecology (18% to 30%).

The IFGM process for testing and developing a minimum set of C&I includes the re-evaluation and justification of proposed C&I by the interdisciplinary team. This activity was designed to check and re-check whether or not particular indicators are to be included in the final set. The process also allows for the inclusion of new C&I to address site-specific issues. As a result, the total number of C&I initially selected for testing may either increase or decrease after field evaluation.

Table 4. Number of C&I (Indicators) accepted as final by team members, based on field evaluation (Form 2)

	Team 1	Team 2	Team 3
Sourced ¹	132	83	215
Total C&I (Indicators) ²	83	45	63
Total Management	49 (59%)	27 (60%)	29 (46%)
Total Ecology	15 (18%)	9 (20%)	19 (30%)
Total Social	19 (23%)	9 (20%)	15 (24%)

Notes: ¹ These are C&I (indicators) employed by teams as a base set. Modification was made when necessary.

² These are C&I (indicators) cited partly from the base set plus a few new C&I (indicators) derived from the field exercise.

Changes in the total number of C&I before and after field evaluation are summarised in Table 5. In general the number of C&I decreased after field testing except for forest management where Team 1 added a further 11 indicators during field evaluation.

The results of the IFGM process are three sets of C&I, one for each site (Annex 5). These were the starting points for the next step in the procedure in defining a common or core set of C&I applicable to all three sites.

3.2.3 Content analysis of C&I proposed by teams

One of the major objectives of this project was to identify a minimum set of C&I applicable to all three sites. Accordingly, the three sets of C&I were compared to obtain a core set for the assessment of the sustainability of industrial plantations in Indonesia. This comparison was based on the analysis of commonalities and differences in C&I as described by Prabhu *et al.* (1999).

Comparison of the three sets of C&I for the synthesis of a common core set showed some overlap and redundancy of indicators, mainly those addressing issues related to forest management and ecology.

Examination of the content and intent of C&I, based on keywords and comments by the expert teams, showed the need to clarify some of the differences in terminology used by the teams. For example, the terms local people, local community, indigenous people and forest-dependent people were used somewhat indiscriminately by all teams and need clarification. Local people and local community are defined as those who have been living in the area for some time but are not the original inhabitants of the area. In contrast,

indigenous people are defined as original inhabitants who have been living in the area for a relatively long time and have a unique cultural identity. Forest-dependent people are defined as those dependent on forest resources for their daily life. This may apply to local communities as well as indigenous people.

3.2.3.1 Socio-economic C&I

The C&I on socio-economic issues reported by the three teams were developed and evaluated by team members with a wide range of expertise including anthropology, socio-economics, public policy and forest management. The analysis of C&I reported by the teams as shown in Annex 5 was conducted in an hierarchical manner starting with principles, then criteria and the relevant indicators. This approach also made it easier to identify commonality between indicators addressing similar issues but allocated to different criteria.

Principle

The teams defined the principle dealing with socio-economic issues in different ways:

- Human well-being is enhanced (Team 1).
- Sustainable management of forest plantations positively enhances socio-economic condition of local people (Team 2).
- Socio-economic dynamics of the community is supportive of sustainable forest management (Team 3).

Team 1 adopted a broad definition inclusive of socio-economic as well as cultural aspects. Team 2 placed greater emphasis on the socio-economic status

Table 5. Changes in the total number of C&I at pre-field and post-field evaluations (accepted C&I)

Teams	Management		Ecology		Social	
	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>	<i>Pre</i>	<i>Post</i>
1	38	49	29	15	65	19
2	49	27	15	9	19	9
3	87	29	44	19	84	15

and prosperity of local people, including transmigrants as well as indigenous people. In contrast, Team 3 wanted to place emphasis on the dynamics or process of socio-economic development of the local community.

The teams all agreed that sustainable development of plantations must improve the socio-economic condition and well-being of the local community, including transmigrants and indigenous people. This is captured comprehensively by the Principle: ‘Human well-being is enhanced’.

Criteria and Indicators

The criteria proposed for the principle of human well-being by the three teams are presented in Annex 5. The number of criteria defined by the teams varied from 3 to 4 and all teams addressed the following issues:

- security of land tenure and land use (criterion 1);
- participation in forest management (criterion 2);
- sharing of social and economic benefits (criterion 3); and
- industrial relations and responsibilities of stakeholders (criterion 4).

The four criteria and the relevant indicators proposed by the teams are examined in more detail below. The core set of C&I considered to be applicable to socio-economic issues at all sites is presented in Table 6.

Security of land tenure and land use

The teams were in agreement that security of land tenure and rights to use land (Annex 6) is important for the long-term sustainability of a plantation enterprise. This applies to all stakeholders, ranging from security of land tenure for the company to traditional rights of land use for the indigenous people.

The indicators for this criterion proposed by the teams (Annex 6) reflect the relative importance of specific aspects of land tenure between sites. These include the definition of tenures, legal arrangements, recognition of traditional rights, compensation for displacement, conflict resolution, etc. The indicators selected for the core set of C&I are shown in Table 6.

Participation in forest management

Participation of stakeholders in forest management was a common criterion for all teams (Annex 7) although the definitions varied between teams. The criterion ‘Stakeholders participate in forest management’ was considered representative for all sites. This criterion was debated extensively at the workshops as it raises the question of who should participate and at what level of management, e.g. regional government, district foresters (Dinas Kehutanan), local communities and NGOs. The teams agreed that the stakeholders whose livelihoods are directly affected should be invited to participate at the appropriate stage in the process of management, e.g. at the stage of planning, implementation, monitoring or evaluation.

The indicators proposed for this criterion place emphasis on communication and consultation between the major stakeholders, i.e. company management and the local community (Annex 7). Issues addressed specifically are consultation of the local community about the planning and implementation of forest activities; mechanisms for conflict resolution; and the recognition of traditional rights, local knowledge and gender roles. Team 1 also identified the need for forest management to assume a role in community development. The proposed core indicators are defined in Table 6.

Sharing of social and economic benefits

The criterion dealing with the sharing of social and economic benefits was expressed differently by the teams (Annex 8), reflecting the differences in emphasis at each site. Team 1 defined this criterion in more general terms while the other teams were more specific with emphasis on more tangible socio-economic benefits and increased prosperity for the local community. The statement ‘Socio-economic performance of local community is enhanced’ was considered representative for all sites.

The indicators for this criterion varied somewhat between teams reflecting the specific issues identified at each site (Annex 8). Together these indicators focus mainly on the impacts and benefits of plantation development to the local community. Indicators address issues such as opportunities for work and training; incomes and social benefits; public

Table 6. Synthesis of common Criteria and Indicators related to socio-economic issues at FMU level, as proposed by the three teams

Issues P C I			
Human well-being is enhanced	T1	T2	T3
<p><i>Stakeholders' tenure and land use rights are secure</i></p> <p>Conflicts are minimal or settled</p> <p>Tenures are well defined and upheld</p> <p>Long-term tenure or agreement to land is guaranteed and customary rights are respected</p> <p>Opportunities exist for local communities to continue socio-economic activities within the forest concession area</p> <p>Opportunities exist for local communities to get compensating rewards for loss of land and other resources</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>
<p><i>Stakeholders participate in forest management</i></p> <p>Fair and effective mechanisms for conflict resolution exist</p> <p>Local communities understand and are involved in the process of forest management activities</p> <p>Management understands and considers local knowledge in the forest management activities</p> <p>Effective mechanisms exist for two-way communication and consultation</p> <p>Professional staff for community development is available and fully supported by company management</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>
<p><i>Socio-economic performance of local community is enhanced</i></p> <p>People's incomes have increased in real terms since the establishment of forest plantations</p> <p>Local communities have significant opportunities to work and be trained by the company without discrimination</p> <p>Local communities are encouraged to grow timber on their own land to supply raw materials needed for the mill</p> <p>Contribution to the increase in the well-being of local people (forest-dependent people)</p> <p>Contribution to the maintenance of cultural values and diversity, and of indigenous and local knowledge</p> <p>Contribution to the development of public infrastructure and services should meet the local community's needs and aspirations</p> <p>Contribution to the development of alternative economic activities and linkages exist</p> <p>Social benefits are maximised and social disruption is minimised</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>

Table 6. Continued

Issues					
P	C	I			
Human well-being is enhanced			T1	T2	T3
<i>Responsibility of primary stakeholders is well defined</i>			*		
Agreements exist between local communities and the management regarding rights and responsibilities of both parties			*		
Effective control mechanisms for executing the agreement exist			*		
Education and training programme for local communities concerning the adverse effects of plantation activities exist			*		
Activities within the area conserved for environmental, social and cultural reasons are carefully recorded and monitored			*		
All applicable laws/regulations covering health and safety are met or exceeded					*
Wages and other facilities are met or exceed local standards					*
Career development is clearly planned for all employees without discrimination					*

Note: Indents indicate the hierarchical level, where P=principle, C=criterion, I=indicator, T=team.

infrastructure and services; community forestry for wood production; and the impact on cultural values and lifestyle. A set of common indicators is proposed in Table 6.

Industrial relations

The responsibility of stakeholders for industrial relations between company management, employees and local communities was defined as a separate criterion by Teams 1 and 3 (Annex 9). These teams wanted to put particular emphasis on the need for agreements between management and local community employees on industrial issues such as wages, training, education, health and safety. Team 2 did not address these issues directly but some aspects were covered by indicators under criteria 1 and 2 (Annex 5). It was considered necessary to include this criterion 'Responsibility of primary stakeholders is well defined' in the core set of C&I.

Indicators for this criterion proposed by Teams 1 and 3 are listed in Annex 9. The issues addressed by the indicators include rights and responsibilities of the primary stakeholders; education, training and career development; occupational health and safety;

protection of conservation areas. It should be noted that Team 1 addressed occupational health and safety separately as part of forest management issues (see Annex 18). This is now included as an indicator of the responsibility of the primary stakeholder as a socio-economic rather than forest management issue. Indicators selected for the core set of C&I are shown in Table 6.

3.2.3.2 C&I for forest management

The C&I on forest management issues were developed and evaluated by team members with expertise in forestry, forest silviculture, management and economics. C&I reported for each site by the teams (Annex 5) were analysed in an hierarchical manner starting with principles, then criteria and the relevant indicators. This identified commonality between indicators addressing the same issues but sometimes allocated by teams to different criteria.

Principle

The teams defined the principle related to the management of plantations and other forests within the FMU as follows:

- A management system is in place to ensure sustainability (Team 1).
- Forest management resources support, and activities are conducive to, sustainable yield (Team 2).
- A forest management system is in place to ensure sustainable yield (Team 3).

Team 1 adopted a broader definition of this principle while the other teams placed emphasis on sustainable yield of wood and forest products. All teams agreed that the system of forest management should maintain or improve long-term site productivity. The broader statement ‘A management system is in place to enhance sustainability’ was adopted for the core set of C&I (Table 7).

Criteria and Indicators

Criteria for forest management proposed by the teams for each of the three sites are presented in Annex 5. Teams identified 6 to 8 criteria each and although teams defined these criteria in different ways, the issues addressed were very similar. The emphasis at all sites was on forest management plans and their implementation, resource inventory, research and development, and the availability of funds for the management of plantations and conservation areas. Other issues identified include the implementation and monitoring of silvicultural practices, forest health and protection, and the development of human resources.

The criteria and related indicators were grouped for comparison and analysis of commonality in Annexes 10 to 19. The common criteria and related indicators selected for the core set are shown in Table 7 and address:

- management plans (criterion 1);
- resource management strategy (criterion 2);
- research and development (criterion 3);
- financial support (criterion 4);
- monitoring of activities (criterion 5);
- forest protection (criterion 6); and
- human resources (criterion 7).

The indicators related to the above criteria were often prescriptive in order to address specific aspects of forest management and silvicultural practices. Indicators dealing with similar issues were sometimes

assigned to different criteria or may have been addressed as part of socio-economic issues, e.g. training and development of staff. It is inevitable that there will be some overlap or even duplication of indicators dealing with similar issues but under different site conditions. The comparison of the three site-specific sets of C&I related to forest management enabled the formulation of a core set applicable to all three sites (Table 7).

Management plans

All teams agreed on the need for a well-defined management plan reflecting the objectives of the company responsible for the management of a forest resource and also operating as a business in an international market place. Teams placed emphasis on the different aspects of planning and implementation of forest management reflecting the specific conditions at each site (Annexes 10, 11 and 13).

The indicators for this criterion address the various aspects of forest management plans including site suitability for plantation development, species selection, prescriptions for silvicultural management, market evaluation, yield regulation and financial arrangements. Nine core indicators are proposed to address these various forest planning aspects (Table 7).

It should be noted that the indicator “Use of full baseline data” refers to the availability of biophysical data such as soil, geological maps, flora and fauna surveys, and socio-economic data to support any management activities in the decision making process.

Resource management strategy

A further criterion was proposed specifically addressing a strategy for the development of plantations and retention of conservation forests within the concession area (Annex 12). The indicators selected by Team 1 placed emphasis on the delineation and security of plantation and conservation areas. In contrast, yield regulation and silvicultural practices were selected as important for sites 2 and 3. The core set of indicators proposed is shown in Table 7.

Research and development

The need for research and development in support of silvicultural management and operational activities was recognised by all teams as being important for the long-term sustainability of the plantation resource (Annex 16).

Table 7. Synthesis of common Criteria and Indicators related to management at FMU level, as proposed by the three teams

Issues P C I			
A management system is in place to enhance sustainability	T1	T2	T3
<p><i>A comprehensive management plan is available</i></p> <p>Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting are available</p> <p>Use of full baseline data</p> <p>Implementation of site-species matching</p> <p>Operations and forecasting should refer to management plan</p> <p>Planting programme detailing monthly planting targets, operational schedules, manpower, infrastructure and machinery/equipment requirements is in existence</p> <p>Financial budget cash flow projection is developed in long-term planning document</p> <p>Yield regulations by area and/or volume are set out</p> <p>Management objectives are clearly defined and stated</p> <p>A market assessment is carried out and stated in long-term planning document</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>
<p><i>Good forest resource management strategy is in place</i></p> <p>External boundary is lawfully and permanently demarcated</p> <p>Clear demarcation of production forest area into smaller management units</p> <p>Forest map produced from interpretation of aerial photographs showing details of planting</p> <p>Growth and yield data from PSPs (permanent sample plots) to monitor growth/yield trends</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p>
<p><i>A comprehensive research and development programme is in place</i></p> <p>Research and development programme supporting the operational activities is in existence</p> <p>Research and development programme responding and contributing to new information and technology is practised</p>	<p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p>
<p><i>There is sustained and adequate funding for running the operation</i></p> <p>Liquidity of cash flow to support infrastructure development, acquisition of machinery and equipment and to meet day-to-day running of the operation</p>	<p>*</p> <p>*</p>	<p>*</p> <p>*</p>	<p>*</p> <p>*</p>

Table 7. *Continued*

Issues P C I			
A management system is in place to enhance sustainability	T1	T2	T3
<p><i>Effective monitoring and control system audits conformity with management plan</i></p> <p>Documentation and records of all forest management activities are kept for monitoring purposes</p> <p>Periodical forest inventory system exist</p> <p>Standard of planting and tending</p>	*		*
<p><i>Forest maintenance and protection programmes are implemented</i></p> <p>Operational systems of forest fire prevention and suppression are implemented</p> <p>Well-defined integrated pest and disease management programmes are practised</p> <p>Operational system of forest security is implemented</p>	*	*	*
<p><i>Professional and dedicated human resources are enhanced</i></p> <p>Adequate human resources at all levels of management</p> <p>Human resources development is implemented</p> <p>Clear organisational structure with job description is developed</p> <p>Human resources welfare programme exists</p> <p>Operational guidelines of safety procedures for handling chemicals, vehicles and machinery are available</p>	*	*	*

Note: Indents indicate the hierarchical level, where P=principle, C=criterion, I=indicator, T=team.

Indicators related to this deal with research projects and priorities, funding and staffing of research programmes, as well as the implementation and adoption of new technologies. The proposed core set of indicators for R&D is shown in Table 7.

Funding

The availability of adequate funding to implement the management plan and to undertake the operational activities at the various stages of plantation development was recognised by all teams (Annex 14). Indicators highlight the importance of funding for infrastructure, forestry equipment and day-to-day operations at site 1; adequate cash flow and capital for human resources and R&D at site 2; and sufficient starting capital for the establishment of plantations and re-investment of income from harvested wood at site 3. These have all been captured in one indicator proposed for the core set of C&I in Table 7.

Monitoring of activities

Effective monitoring of management and operational activities to assess compliance with the management plan was considered essential by Teams 1 and 3 (Annex 17). In contrast, monitoring and auditing of activities were not addressed specifically by the C&I proposed by Team 2.

The indicators address the documentation of field operations and activities as well as the recording of resource assessment data based on inventory plots. In addition Team 1 included indicators for accounting records and other aspects of forest management such as fire protection and R&D (Annex 17). Three core indicators are proposed in Table 7 dealing with the documentation of all forest management activities in general and the establishment and tending as well as a forest inventory system for plantations in particular.

Forest protection

Protection of forest from fire, pests and diseases was considered to be part of forest management by Teams 2 and 3 (Annex 15). In contrast, Team 1 viewed these as issues related to forest ecology (Annex 22). The indicators proposed by all teams relate to the prevention and suppression of fire as well as the integrated management and control of pests and diseases (Annex 15). In addition, forest security, i.e. protection of the plantation resource as well as natural forest in conservation areas from illegal logging was identified as an important issue at all sites. The presence and implementation of a forest security system is proposed as a core indicator (Table 7).

Human resources

Effective infrastructure and human resources were addressed by separate criteria proposed by Teams 2 and 3 (Annex 18). In contrast, this issue was dealt with as part of the implementation of the management plan by Team 1 (Annex 13). The indicators covered human resources, staff development and training. In addition, indicators proposed by Team 3 also dealt with wages and facilities as well as occupational health and safety (Annex 18). The core indicators proposed for this criterion are presented in Table 7.

3.2.3.3 C&I for ecology

Industrial plantations of *A. mangium* are managed primarily for wood production but the intensity of management varies considerably between companies responsible for the various concession areas. Long-term sustainability of this plantation resource requires management to take into account not only wood production but also ecological and environmental values (e.g. soil, water, biodiversity) as well as socio-economic issues. It is therefore important to evaluate the impact of plantation development on the structure, function and resilience of the entire ecosystem of the FMU.

Principle

Teams agreed that sustainable management of plantations can only be achieved if the ecological functioning of the FMU is either maintained or improved. There was close agreement between the teams on the definition of the principle related to forest ecology (Annex 5).

Criteria and Indicators

The criteria selected by the teams reflected differences in approach as well as issues of specific importance at

each of the sites. Team 1 defined the criteria in more general terms of maintenance of the function, biodiversity and resilience of the ecosystem. In contrast, Teams 2 and 3 proposed the maintenance of ecosystem function as the first criterion then placed emphasis on potentially adverse environmental impacts of plantation development and the maintenance of land and water resources (Annex 5). It should be noted that the ecological issues are relevant to the entire FMU, comprising plantations as well as conservation areas, for the protection of biodiversity and to meet the needs of local communities.

Comparison of C&I proposed by the teams for the three sites showed that there was close agreement on the major ecological issues relevant to the long-term sustainability of a plantation resource. These were selected as core criteria as shown in Table 8 and address:

- structure and function of the ecosystem (criterion 1);
- soil and water resources (criterion 2); and
- environmental impacts (criterion 3).

Comparison of indicators for each of the criteria showed a high degree of commonality although indicators addressing similar issues were often proposed under different criteria by the teams (Annexes 20, 21 and 22). The key aspects addressed by these indicators are presented below and the core set of C&I for this principle is shown in Table 8.

Structure and function of the ecosystem

The indicators for this criterion addressed:

- Use of chemicals and fertilisers in plantations and the potentially adverse impacts on the environment, e.g. soil, water, flora and fauna, as well as the effects of pollution by these chemicals on the health of local communities.
- Maintenance of protected areas for the conservation of biodiversity, but also including buffer strips along watercourses for the protection of water quality and areas with high soil erosion hazard.
- Protection of endangered flora and fauna as well as remnant vegetation where appropriate. This applies in particular to the initial stage of planning and development of plantations and the requirement to set aside forested and other vegetated tracts of ecological significance within

the concession area. The continued protection of such areas is important for the maintenance of biodiversity within the FMU.

- Change in microclimate and hydrologic function of forested catchments refers to the potential impact of fast-growing plantations on water yield and the downstream use of water by local communities.
- Growth and quality of plantations is included as an indicator of tree health with reference to the impact of pests, diseases and nutrient disorders on the growth and condition of stands. It is a supplementary indicator related to the maintenance and protection of forests as part of the forest management principle (Table 7).

Soil and water resources

The maintenance of physical and chemical properties of the soil is an important aspect related to long-term productive capacity of the site. Soil disturbance at plantation establishment and harvesting can cause compaction and erosion with potential detrimental effects on growth and productivity of subsequent rotations. Likewise, natural soil fertility may not be adequate to support fast-growing plantations and

therefore the use of appropriate fertilisers may be necessary to maintain or improve site productivity.

In addition, the maintenance of water quality is complementary to the indicator for water yield and hydrologic function of forested catchments under the preceding criterion (Table 8). Excessive soil disturbance and erosion as a result of construction of forest roads and site preparation for plantation establishment can be expected to increase turbidity and sediment in water and therefore decrease water quality.

Environmental impacts

The indicators under the previous criteria address various aspects with potentially adverse impacts on the environment. Two teams did propose additional indicators dealing with the prevention of fire and the increased risks associated with the establishment of a plantation monoculture on a large scale. The issue of fire protection is largely covered by a similar indicator under the maintenance and protection of forests as part of the forest management principle (Table 7).

The risks associated with large-scale monocultures are mostly related to greater vulnerability to pests and diseases. While there are good technical reasons for a wood resource based on a single species

Table 8. Synthesis of common Criteria and Indicators related to ecology at FMU level, as proposed by the three teams

Issues P C I			
Ecosystem function is maintained or improved	T1	T2	T3
<i>Structure and ecosystem function are maintained</i>	*	*	*
Judicious use of fertiliser, and chemicals for pest, disease and weed management	*	*	*
Protected area and conservation area are maintained	*	*	*
Endangered flora and fauna are protected	*		*
Microclimatic change and hydrologic function are improved	*	*	*
Stand growth quality is satisfactory	*		*
<i>Soil and water resources are maintained or improved</i>	*	*	*
Physical and chemical properties of the soil are maintained	*	*	*
Water quality is maintained	*	*	*
<i>Adverse environmental influence is minimised</i>	*	*	*
Fire prevention is in force	*		*
Genetic diversity of plantation species is maintained	*		*

Note: Indents indicate the hierarchical level, where P=principle, C=criterion, I=indicator, T=team.

in terms of ease of silvicultural management and uniformity of wood products, it is important to have in place an integrated pest and disease management plan (see Table 7) able to deal with incursions.

3.3 Closing Workshop and Consultation Process

It was intended to conduct a final workshop with all major stakeholders as part of this project to discuss the findings of the three teams and propose a core set of C&I applicable to all sites. Unfortunately this workshop did not take place due to illness and passing away of the Country Coordinator. Instead a consultation process was conducted at a later stage involving LEI and the companies that participated with the field testing of C&I. The consultation process included discussions with the stakeholders and visits to the three field sites. Comments on the proposed core set of C&I resulting from this consultation process are recorded below. The core sets of C&I proposed in Tables 6, 7 and 8 were revised and modified following the consultation with major stakeholders. This final core set of Principles and C&I are presented in Table 9.

One of the issues raised during the consultation process related to the C&I for assessing the financial performance of the company managing industrial plantations (Table 7). It was recognised by the teams and stakeholders that indicators related to the financial status of forestry companies often rely on confidential information that is likely to be commercially sensitive. Therefore companies may not want to disclose this information unless confidentiality can be assured.

Companies expressed concern about the maintenance of security and protection of conservation areas and the prevention of illegal logging. This was clearly recognised by the teams as an important threat to the long-term sustainability of these areas within the FMU and therefore indicators addressing this issue were included as part of forest management (Table 7) and ecosystem function (Table 8). It is essential to retain these indicators especially if illegal logging is threatening SFM. The responsibility for maintaining security to prevent illegal logging is an issue that needs to be addressed by institutional and legal arrangements between concession holders and appropriate government authorities at the national level, but also at regional level.

It was acknowledged that a change in microclimate resulting from large-scale plantation establishment is difficult to determine. However, it is considered that impacts on the hydrologic function of

forested catchments and the change in yield and quality of water from these catchments (Table 8) provide a good surrogate measure of a change in microclimate.

It was agreed during the consultation process that maximising social benefits and minimising social disruption (see Table 6) of forest management operations are important aspects of SFM. In fact, all indicators dealing with social criteria implicitly reflect this intent. Therefore, it was felt that there was no need to include these explicitly as a separate indicator in the core set (Table 9).

The issue of customary or traditional rights of local communities (see Table 6) was discussed at length. It was recognised that customary rights are an important aspect of a long-term agreement on land tenure. However such agreements also include many other aspects related to land use and tenure as well. To ensure all these are covered, specific reference to customary rights was omitted from this indicator in the final version of the core set (Table 9). During the drafting of such an agreement between stakeholders, local communities have the opportunity to state the nature of their customary rights and where these apply. Likewise, the companies should indicate the areas they consider to be necessary for their activities. Where there is a conflict of interest, problems need to be identified and resolved to the satisfaction of all stakeholders using appropriate mechanisms. A clear understanding by all parties of the various rights to land within the concession area is essential. This should be reflected in a long-term agreement involving all parties.

In general, the main concern of companies is the economic profitability of their activities within the forest concession areas. Security to harvest the trees according to a harvest management plan is critical. Involvement of neighbouring communities in wood production on an economic basis may sometimes be perceived as a threat by plantation companies because it may encroach on their timber resource. Such a risk can certainly be minimised and mutual understanding and confidence developed with proper accompanying social measures. At the final consultation it was agreed that economic activities of local communities should be encouraged and not limited to subsistence economic activities. This intent is reflected in the core set of indicators proposed in Table 9.

Some participants expressed concern about future introduction of genetically modified organisms (GMO) in plantation forestry and the potential weakening of the genetic base. This concern is partly addressed by the need to keep a high level of genetic diversity within species as a prerequisite for the maintenance of plantation health (Table 9). All stakeholders agreed on this requirement.

Table 9. Core set of Criteria and Indicators for sustainable forest management in plantations, based on final consultation with users

Issues: Socio-economic		
P	C	I
Human well-being is enhanced		
<i>Stakeholders' tenure and land use rights secured</i>		
Conflicts are minimal and settled through appropriate conflict resolution mechanisms		
Long-term tenure or agreement to land use is well defined and upheld		
Opportunities exist for local communities and indigenous communities to continue socio-cultural activities and economic activities within the forest concession area		
Opportunities exist for local communities and indigenous communities to receive compensating rewards for loss of land and other resources		
<i>Stakeholders participate in forest management</i>		
Fair and effective mechanisms for conflict resolution exist		
Local communities understand and are involved in the process of forest management activities		
Management understands and considers local knowledge in forest management activities		
Professional staff for community development is available and fully supported by company management		
<i>Socio-economic performance of local community is enhanced</i>		
People's incomes have increased in real terms since the establishment of forest plantations		
Local communities have significant opportunities to work and be trained by the company without discrimination		
Local communities are encouraged to grow timber on their own land to supply raw materials needed for the mill		
Contribution to the increase in the well-being of local people (forest-dependent people)		
Contribution to the maintenance of cultural values and diversity, and of indigenous and local knowledge		
Contribution to the development of public infrastructure and services should meet the local community's needs and aspirations		
Contribution to the development of alternative economic activities and linkages exist		
<i>Responsibility of primary stakeholders is well defined</i>		
Agreement exists between local communities and management regarding rights and responsibilities of both parties and is implemented through an effective control mechanism for executing the agreement		
Education and training programmes for local communities concerning the adverse and positive effects of plantation activities exist		
Activities within the area protected for environmental, social and cultural reasons are carefully recorded and monitored		
All applicable laws and regulations covering health and safety are met or exceeded		
Wages and other facilities are met or exceed local standards		
Career development is clearly planned and implemented for all employees without discrimination		
Issues: Management/Production		
P	C	I
A management system is in place to enhance sustainability		
<i>A comprehensive management plan is available</i>		
Management objectives are clearly defined and stated		
Operations and forecasting should refer to management plan		
A market assessment is carried out and stated in a long-term planning document		
Financial budget cash flow projection is developed in a long-term planning document		
Use of full base line data		
Planting programme detailing monthly planting targets, operational schedules, manpower, infrastructure and machinery/equipment requirements exists		

Table 9. Continued

Issues: Management/Production		
P	C	I
		<p>Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting are available</p> <p>Yield regulations by area and/or volume are set out</p> <p>Implementation of site-species suitability</p>
		<p><i>Good forest resource management strategy is in place</i></p> <p>External boundary is lawfully and permanently demarcated</p> <p>Clear demarcation of production forest area into smaller management units</p> <p>Forest map produced from interpretation of aerial photographs showing details of planting</p> <p>Growth and yield data from PSPs to monitor growth/yield trends</p>
		<p><i>A comprehensive research and development programme is in place</i></p> <p>Research and development programme supporting the operational activities is in existence</p> <p>Research and development programme responding and contributing to new information and technology is practised</p>
		<p><i>There is sustained and adequate funding for running the operation</i></p> <p>Availability of finance to support infrastructure development, acquisition of machinery/equipment and to meet day-to-day running of the operation</p>
		<p><i>Forest maintenance and protection programme are implemented</i></p> <p>Operational system of forest fire prevention and suppression is implemented</p> <p>Well-defined integrated pest and disease management programmes are practised</p> <p>Operational system of forest security is implemented</p>
		<p><i>Effective monitoring and control system audits conformity with management plan</i></p> <p>Documentation and records of all forest management activities are kept for monitoring purposes</p> <p>Periodic forest inventory system exists</p> <p>Standards of planting and tending are defined and implemented</p>
		<p><i>Professional and dedicated human resources are enhanced</i></p> <p>Adequate human resources at all levels of management</p> <p>Human resources development is implemented</p> <p>Clear organisational structure with job descriptions is developed</p> <p>Human resources welfare programme exists</p> <p>Operational guidelines of safety procedures for handling chemicals, vehicles and machinery are available</p>

Table 9. *Continued*

Issues: Ecology		
P	C	I
Ecosystem function is maintained or improved		
<i>Structure and ecosystem function is maintained</i>		
		Judicious use of fertilisers, and chemicals for pest, disease and weed management
		Protected area and conservation area are maintained and managed
		Endangered flora and fauna are protected and managed
		Microclimatic change and hydrology function are improved
		Stand growth quality is satisfactory
<i>Soil and water resources are maintained or improved</i>		
		Physical, biological and chemical properties of the soil are maintained
		Water quality is maintained
<i>Adverse environmental influence is minimised</i>		
		Fire prevention is in force
		Genetic diversity of plantation species is maintained

Note: Indents indicate the hierarchical level, where P=principle, C=criterion, I=indicator.

4. Conclusions

4.1 The Process

The IFGM is an adaptive process that actually allows for some level of modification and creative input by the field test team. The first team selected a base set of C&I from a wide range of sources while subsequent teams made use of this initial work to select a candidate set of C&I for field testing at the second and third test sites. It was generally concluded that more time was needed to carry out home-based analysis for the selection of a candidate set of C&I.

Most of the social experts commented that time allocated for the evaluation of social C&I was very limited. Social issues are usually more complex and it is critical to allow more time for the careful selection and evaluation of C&I that address issues specific to the FMU. It was also considered that more time was needed to conduct interviews and to consult with local communities to fully evaluate the C&I addressing human well-being.

Since the beginning of the project LEI has taken an active part in the various stages of the project. LEI experts made significant contributions to such issues as the use of exotic species and chemicals in plantations, erosion control and the rights of indigenous people. Practical issues related to the evaluation, verification and implementation of some of the indicators proposed were raised frequently during the field testing of C&I. This contributed greatly to the development and modification of indicators, especially those requiring field monitoring.

In addition, LEI suggested that indicator development should differentiate output indicators from process indicators. An output indicator is defined as the actual or desired result of a management process which describes the state or capacity of the ecosystem, the state of a physical component, or the state of the related social system or its components. In contrast, a

process indicator is defined as the management process or a component of the management process, or other human action, describing human activities but not the result of the activity. The proposed core set of C&I comprises a mixture of process- and output-oriented indicators of SFM (Table 9). For example, 'Fair and effective mechanism for conflict resolution exists' is a process indicator, while 'Conflicts are minimal and settled through appropriate conflict resolution mechanisms' is an output indicator (Table 9). Both indicators provide important information for the assessment of SFM. The first one demonstrates that a process is in place that enables disputes between stakeholders to be resolved. The second one evaluates the effectiveness of this process. Non-compliance with this second indicator alerts stakeholders of a conflict situation that is threatening SFM. The reason for conflict could be a flaw in the mechanism at the FMU level or it may be due to a larger issue such as land use allocation at the regional or national level.

It is essential to have both process and output indicators to provide not only an assessment of the mechanisms or management procedures that are in place but also to evaluate the effectiveness of these in delivering results conducive to long-term SFM. Non-compliance with either indicator alerts stakeholders of a potential threat to SFM that needs to be investigated. In the above case the company may in fact have all the correct mechanisms in place to resolve land use disputes with the local community. However, continued conflict may be the result of lack of consultation and lack of recognition of the land rights of local communities by government agencies responsible for the initial allocation of plantation concession areas. Quite clearly, these government agencies are also stakeholders and need to be part of the C&I process. This demonstrates the importance of including C&I on legal and

institutional arrangements at the national and regional levels as these quite clearly have an impact on SFM at the FMU level. The same argument applies to other issues raised at the final consultation of stakeholders, such as the problem of protection of forest resources against illegal logging.

Concern was expressed that consultation and participation in the project was limited mainly to primary stakeholders and did not cover the full range of interests in SFM during both field testing of C&I and the final consultation workshop. The final consultation workshop was important and useful because all main stakeholders who will also be the users of C&I were involved. The process of developing C&I must be transparent and ideally should involve all stakeholders with an interest in SFM. This ensures a diverse input into the selection and testing of C&I reflecting the widest possible range of interests in SFM.

4.2 The Contents of Criteria and Indicators

A comprehensive set of C&I selected from various published sources was evaluated at three forest concession areas. These site-specific C&I formed the basis of the core set proposed for SFM addressing aspects of socio-economics, management and ecology at the FMU level (Table 9).

The focus of the socio-economic issues is on the relationship between primary stakeholders, i.e. the companies managing the forest resource, and the local communities including indigenous people. The C&I address issues such as land tenure and access, employment, health and safety, consultation and participation in management, social and economic benefits, and impacts on community infrastructure and culture. It was noted during field testing of C&I that land tenure and traditional rights to land use were often considered to be the single most critical issues affecting long-term SFM.

The C&I for forest management deal with more specific issues that contribute to the long-term sustainability of forest resources including land capability, management plans, silvicultural management, forest inventory, growth and yield regulation, forest protection, research and development, human resources and financial management.

The ecology C&I mainly deal with the environmental impacts of changes in land use and the effects of intensive management of plantations on the ecosystem. This includes the use of chemicals, health and productivity of plantations, water yield and water quality of forested catchments, soil protection, fire prevention, conservation of natural forest and protection of endangered flora and fauna.

The initial brief for the project was to evaluate C&I at the FMU level and therefore issues related to legal and institutional arrangements at regional and national levels were not included in the process. However, these arrangements can have a significant impact on SFM at the FMU level and therefore cannot be ignored. For example, the initial allocation of land for plantation development without due consideration of the traditional rights of local communities was often stated as the primary source of conflict and land demarcation disputes between stakeholders at the FMU level. Likewise the issue of responsibility for forest protection against illegal logging requires resolution between stakeholders at the regional, if not the national, level.

Compared with the CIFOR generic set of C&I for natural forest, the proposed core set of C&I for industrial plantations has less emphasis on the conservation of biodiversity. While the plantations C&I have a strong focus on forest management and environmental impacts, it is of interest to note that the primary concern of stakeholders for long-term SFM was related to social rather than management or environmental issues.

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Annex 2. Form 2

TESTING CRITERIA AND INDICATORS: CIFOR METHOD
Form 2: Field responses

TEAM NO.

3

Expert's Initial

JB

A=....., B=.....
C=.....

Source

State Source
document

ATO

Identification No.

IN SOURCE

E6

Final Identification No. (AS REPORTED IN FINAL LIST)

E6

CLASS

S/M

Policy=P, Social=S, Production of Goods & Services=M
Ecology=F, Financial & Economic aspects=ERECOMMENDATION
(AFTER FIELD TESTING)

Yes

No

X

Enter the selected criterion or indicator as stated in the source document in this space (use Box O for Final Vers.):

There is a procedure for dialogue and conflict resolution between various stakeholders

A

Justify your selection of this criterion or indicators:

The logging company in the XXX area has an opportunistic attitude vis-a-vis the population. Conflicts are solved in an ad hoc manner, and most often external authorities are called upon to restore order and to 'solve' problems. The actual way of dialogue and conflict resolution causes dissatisfaction among local people.

B

ATTRIBUTES

C

Two entry boxes have been provided for each question in this section. The first box (a) refers to the criterion or indicator as listed in Box A, which is the initial selection. If the initial selection has to be modified, this will be recorded in Box F. This final version must be subjected to a renewed evaluation (f). By comparing evaluation (a) and (f) the reader can assess whether the final version is significantly better than the initial version.

Please use a scale of 1-5 when answering, where 1=no/bad/unimportant and 5=yes/good/important.

	(a)	(f)		(a)	(f)
Provides a summary or integrative measure?	3	3	Easy to detect, record and interpret? Feasible?	5	5
Closely and unambiguously related to the assessment goal ?	5	5	Precisely defined?	5	5
Adequate response range to stresses? (sensitive)	3	3	Will it produce replicable results? (reliable)	5	5
Diagnostically specific?	5	5	How relevant is this criterion or indicator?	4	5
Appealing to users?	5	5	Other:		

Annex 2. Continued

Provide bibliographic references (if any):

D

Give the ref. of C&I in the Base Set (e.g. ATO) that overlaps (come closest) to the criterion or indicator recommended above:

	1-5		1-5		1-5		1-5		1-5
Base Set 1									
Base Set 2									
Base Set 3									

E

Final version of criterion/indicator, state only if different to definition on page 1 (Box A):

There is a procedure for dialogue and conflict resolution between various stakeholders and within stakeholder group (indicators)

F

NOTES : Please record your notes on evaluating the criterion/indicator (Box A) here :

G

30/10 *Village people working in town often enjoy a high status and can play an important role as intermediaries between their fellow in the village, the logger and the state. Villagers prefer to solve conflicts between them at village level, and hesitate to involve the authorities. Village chiefs do not have enough authority to control forest utilisation by fellow villagers and outsiders. The villagers feel powerless regarding the empty promises of the logger.*

02/11 *The villagers try to negotiate with the logging companies on 'empty promises'. They feel on the one hand that the officials do not want to help them because they get advantages from the logger. On the other hand they count on them. Quite an ambiguous attitude!*

Would this C&I need to be evaluated

H

in the field?

in the office?

both?

Please note below what kind of documentation would be required if the C&I were to be used in a proper field assessment of sustainable forest management.

I

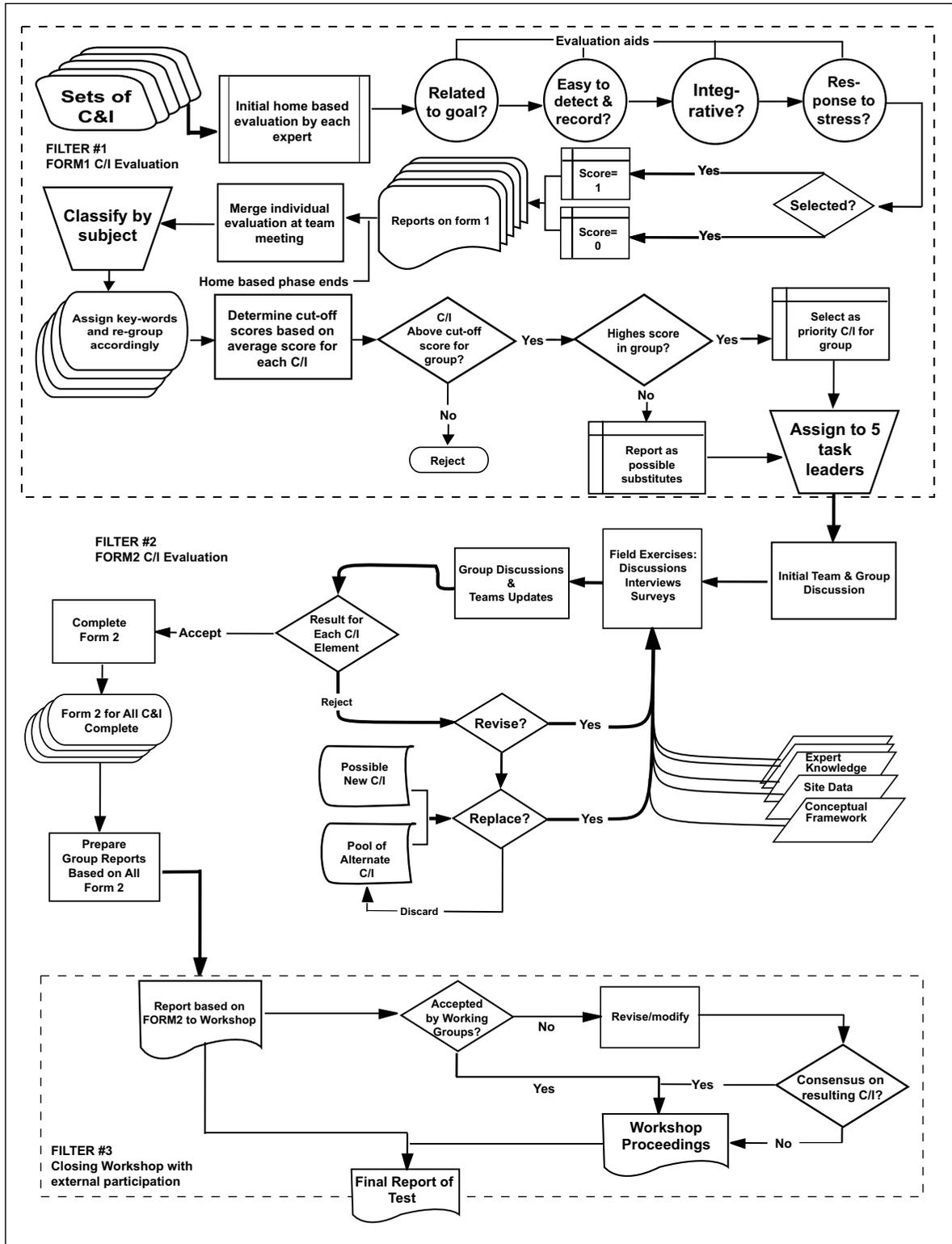
- *Document on socio-political organisation of the ethnic group concerned.*
- *Documentation on the forestry law.*

Annex 3. Continued

AUTHORS' NOTE: The box below was not used by the expert team members

WORKSHOP NOTES (for office use only)					
Did the workshop accept this criterion/indicator unchanged? Why?	<table border="1" style="display: inline-table;"> <tr> <td style="width: 25%;">YES</td> <td style="width: 25%;"></td> <td style="width: 25%;">NO</td> <td style="width: 25%;"></td> </tr> </table>	YES		NO	
YES		NO			
Were revisions called for? State revision:	<table border="1" style="display: inline-table;"> <tr> <td style="width: 25%;">YES</td> <td style="width: 25%;"></td> <td style="width: 25%;">NO</td> <td style="width: 25%;"></td> </tr> </table>	YES		NO	
YES		NO			
State justification for revision:					
OR was this criterion or indicators rejected as being unsuitable? State reasons:					
	<table border="1" style="display: inline-table;"> <tr> <td style="width: 25%;">YES</td> <td style="width: 25%;"></td> <td style="width: 25%;">NO</td> <td style="width: 25%;"></td> </tr> </table>	YES		NO	
YES		NO			
N					

Annex 4. Iterative Filtering and Generation Method (IFGM) flow chart
(Prabhu *et al.* 1999)



Annex 5. A compilation of all criteria and indicators proposed by the three teams

Socio-economic P, C&I		
P	C	I
Team 1		
<i>Human well-being is enhanced</i>		
Equitable benefit sharing		
		<ul style="list-style-type: none"> Economic alternatives/supplements to local communities are increasing People's incomes have increased in real terms since the establishment of forest plantation Mechanism for fair compensation from losses incurred by local communities existed Local communities have significant opportunities to work for and be trained by the company without discrimination Local communities are encouraged to grow timber on their own land to supply raw materials needed for the mill Public infrastructures for local communities are provided and maintained
Stakeholders' long-term tenure and rights are secured		
		<ul style="list-style-type: none"> Long-term tenure and rights have been legally settled prior to the establishment of forest plantation Traditional land use patterns and practices of local communities are respected and protected
Participatory co-management is in place		
		<ul style="list-style-type: none"> Effective mechanism exist for two-way communication and consultation Local communities understand the company's plan for sustainable plantation management Management understands traditional rights and gender roles Professional staff capable of community development is available and fully supported by the management Fair and effective mechanisms for conflict resolution exist
Responsibility of primary stakeholder is well-defined		
		<ul style="list-style-type: none"> Agreement exists between local communities and the management regarding rights and responsibilities of both parties Effective control mechanisms for executing the agreement exist Education and training programme for local communities concerning the adverse effects of plantation activities exist Activities within the areas conserved for environmental, social and cultural reasons are carefully recorded and monitored Minimum social and environmental disruption to local communities Government standards/regulations regarding wages (UMR) are met
Team 2		
<i>Sustainable management of forest plantation positively enhances socio-economic condition of local people</i>		
Stakeholders' (forest actors') tenure and use rights are secure		
		<ul style="list-style-type: none"> Tenures are well defined and upheld Conflicts are minimal or settled Opportunities exist for local people (forest-dependent people) to get employment, training and compensating rewards from forest company

Annex 5. Continued

P C I
<p>Stakeholders (forest actors) participate in forest management</p> <ul style="list-style-type: none"> Effective “bottom-up” and “top-down” communications between primary and other stakeholders Forest-dependent people and company officials understand each other’s plans and interests Forest-dependent people share in economic benefits of plantation forest utilisation
<p>Socio-economic performance of local people</p> <ul style="list-style-type: none"> Contribution to the increase in the well-being of local people (forest-dependent people) Contributing to the maintenance of cultural values and diversity, and of indigenous and local knowledge Contribution to the provision of facilities for general recreation and tourism
Team 3
<i>Socio-economic dynamics of the community is supportive of sustainable forest management</i>
<p>Stakeholders’ tenure and land use rights secure</p> <ul style="list-style-type: none"> Tenures are well defined and upheld Long-term tenure or agreements to land is guaranteed and customary rights are respected Opportunities exist for the local community to continue socio-economic activities within the forest concession area Opportunities exist for the local community to get compensating rewards for loss of land and other resources Fair and effective mechanisms for conflict resolution exist
<p>Stakeholders participate in forest management</p> <ul style="list-style-type: none"> Effective mechanisms exist for communication and consultation among stakeholders Local communities understand and are involved in the process of forest management activities Management understands and considers local knowledge in forest management activities Local communities are given first preference in forest management activities in terms of management, training and employment
<p>Socio-economic performance of local community is enhanced</p> <ul style="list-style-type: none"> Contribution to the development of public infrastructure and services should meet the local community’s needs and aspirations Contribution to the development of alternative economic activities and linkages exist Social benefits are maximised and social disruption is minimised
<p>Forest management enhances employee relation</p> <ul style="list-style-type: none"> All applicable laws/regulations covering health and safety are met or exceeded Wages and other facilities are met or exceed local standards Career development is clearly planned for all employees without discrimination

Annex 5. Continued

Management P, C&I
P C I
Team 1
<i>A management system is in place to ensure sustainability</i>
<p>Management objectives are well defined Progress of the plantation development programme is in line with achievement of management objectives</p>
<p>A comprehensive management plan is available</p> <ul style="list-style-type: none"> Map of the area showing location, including vegetation and topographic details An assessment of the suitability of the site in terms of its production potential, environmental perspective, social implications and availability of sufficient land has been carried out Choice of species including of native species and allocation of respective planting sites are in accordance with management objectives Planting programme detailing monthly planting targets, operational schedules, manpower, infrastructure and machinery/equipment requirements is in existence Environmental conservation, social and cultural strategies for plantation are specified Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting in relation to species planted are available An indicative research and development plan outlining short-, medium- and long-term research projects to guide, support plantation development and improve quality and yield of plantation wood Financial projections, including planned market projections for the product
<p>Good forest resource management strategy is in place</p> <ul style="list-style-type: none"> External boundary is lawfully and permanently demarcated and well protected against infringement Clear demarcation of production forest area into smaller and more manageable management units using natural features where applicable Security measures to safeguard against theft of forest resource from FMU Forest map produced from interpretation of aerial photographs showing details of planting Plantation register giving details of planting and crop management Updated aerial photographs and/or satellite imagery of all planted areas Net productive area accurately updated every five years Growth and yield data from PSPs to monitor growth/yield trends Mid- and pre-harvest forest inventory data Volume/yield regulation by area, site and species
<p>Sound plantation practices optimising yields on sustainable basis</p> <ul style="list-style-type: none"> Minimum skidding, mechanical land clearing and site preparation damage Road specification and layout matched forest conditions and operational requirement Wood harvesting and transport systems match forest conditions and meet with environmental requirement Seedling production and nursery management system is capable of producing good quality seedlings in sufficient quantities to meet planting requirement Availability of manpower at all levels Sufficient infrastructure, machinery and equipment to meet the operational requirements

Annex 5. Continued

P C I
<p>Integrated pest and disease prevention and control programme to minimise damage to the trees</p> <p>Sound weed-management programme to reduce weed competition promoting early canopy closure</p> <p>A comprehensive fertilisation programme to improve and maintain soil fertility</p> <p>Appropriate pruning, singling and thinning regimes geared towards optimal production of the desired crop</p> <p>Existence of a fire plan detailing fire prevention and control measures</p> <p>Effective administrative and reporting procedures to ensure smooth running of the operation</p> <p>Human resources development and training prescribed to meet the operational, social and environmental needs of the project</p> <p>An effective purchase and supply department</p> <p>Monitoring, control and verification programmes prescribed to monitor progress of planting and quality of all plantings</p>
<p>There is sustained and adequate funding for running the operation</p> <p>Liquidity of cash flow to support infrastructure development, acquisition of machinery and equipment and to meet the day-to-day running of the operation</p>
<p>Appropriate labour, health and safety considerations</p> <p>Employment conditions for local and non-local employees doing the same job</p> <p>Health care, education, housing and sanitation facilities</p> <p>Clear and transparent programme and procedures to look into the welfare and grievances of the personnel</p> <p>Operational guidelines for safety precautions in handling chemicals, vehicles and machinery are available and are being enforced</p>
<p>A comprehensive research and development programme is in place</p> <p>Types and number of research projects and research priorities</p> <p>Number of qualified researchers and areas of discipline</p> <p>Size of funding to ensure continuity of research programme</p> <p>Evidence of fruits from R&D benefiting the plantation programme</p>
<p>Monitoring and assessment of plantation activities to ensure conformity of management plan</p> <p>Actual areas planted and progress of planting</p> <p>Species are planted on correct site/soil types, as planned</p> <p>A full stand of planted trees, with a survival rate of at least 90%</p> <p>Standard for planting and tending</p> <p>Records of management activities such as R&D, fire incidence and complaints from the local community</p> <p>Sound estate auditing and cost accounting procedures</p>

Annex 5. Continued

P C I
Team 2
<i>Forest management resources support and activities are conducive to sustainable yield</i>
<p>Professional and dedicated human resources</p> <ul style="list-style-type: none"> Adequate human resources at all levels of management Systematic and continuous training and career promotion programme and rewards Human resources welfare programme exists Effective and efficient organisational structure
<p>Comprehensive management plan exists and is well defined</p> <ul style="list-style-type: none"> Use of full baseline data Well-programmed and well-implemented monitoring and evaluation An integrated information system used at all levels of management Operations and forecasting should refer to the management plan Appropriate infrastructure to support activities Management activities should be integrated Forest land allocation should be the functional base
<p>Normal forest structure</p> <ul style="list-style-type: none"> Clear and consistent yield regulation Silvicultural practices are well prescribed and appropriate to forest classes Rotation length relatively close to stand age approaching maximum MAI Use of reliable methods for monitoring growing stock and increment
<p>Appropriate technologies are available</p> <ul style="list-style-type: none"> Implementation of species-site matching Development of tree improvement Implementation of proper seedling production procedures Implementation of proper tending operation procedures Efficient and effective felling techniques and transportation
<p>Forest protection programme</p> <ul style="list-style-type: none"> Effective and efficient operational system of forest fire prevention and suppression Well-defined and practice of integrated pest management programmes Effective and efficient operational system of forest security
<p>Adequate funding secure</p> <ul style="list-style-type: none"> Reliable company financial cash flow Guaranteed and adequate investment in capital, human resources and research and development

Annex 5. Continued

P C I
Team 3
<i>A forest management system is in place to ensure sustainable yield</i>
<p>Planning system at both forest and business management levels is in place</p> <p>Planning system comprised of all planning levels, master plan, periodic long-run and short-run planning, both at forest and business levels are in place</p> <p>Management objectives are clearly defined and stated in the long term planning (master plan) document</p> <p>A market assessment is carried out and stated in the long-term planning (master plan) document for proposing selected species</p> <p>Projections (in long-term planning) of planting and harvesting programmes conform, in terms of area and location</p> <p>Planting, forest maintenance and protection, and logging (if any), conducted in respective years are set out in monthly targets; operational schedules, manpower, infrastructure and equipment are in existence</p> <p>Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting are available</p> <p>Yield regulations by area and/or volume are set out</p> <p>Financial budget cash flow projections are developed and recorded in the long-term planning document</p>
<p>Professional and dedicated human resources are enhanced</p> <p>Adequate human resources at all levels of management</p> <p>Clear and effective organisational structure with job descriptions is developed</p> <p>Human resource development is implemented</p> <p>Wages and other facilities are provided</p> <p>Operational guidelines for safety procedures for handling chemicals, vehicles and machinery are available and are being enforced</p>
<p>Implementation of timber plantation (area and species), is consistent with planning programme</p> <p>Proper tending operation procedure is implemented</p>
<p>Implementation of logging (if any) is consistent with the planning programme</p> <p>Harvesting/logging area and location conformed with yield regulations</p> <p>Felling techniques and transportation are implemented efficiently and effectively</p>
<p>Forest maintenance and protection are implemented and consistent with the planning programme</p> <p>Operational system of forest fire prevention and suppression, are implemented effectively and efficiently</p> <p>Well-defined integrated pest and disease management programmes are practised</p> <p>Effective and efficient operational system of forest security is implemented</p>
<p>Research and development (R&D) programme is conducted</p> <p>R&D development programme supporting the operational activities is implemented</p> <p>R&D development programme responding and contributing to new information and technology is practised</p>

Annex 5. Continued

P C I
<p>There is sustained and adequate funding for running the operation</p> <p>During establishment period, an adequate funding source for financing the required forest development programme exists</p> <p>As the post-establishment period initiated annual income from timber harvested is generated and able to finance all forest management activities adequately</p>
<p>An effective monitoring and control system audits management's conformity with planning</p> <p>Periodic forest inventory system exists, Entire (total) timber standing stock volume increases either time during establishment period, and thereafter if either increase or constant</p> <p>Continuous forest inventory (CFI) plots established and measured regularly</p> <p>Documentation and records of all forest management activities are kept in a form that makes it possible for monitoring to occur</p>
Ecology P, C&I
P C I
Team 1
<i>Ecological integrity is maintained</i>
<p>Ecosystem function is maintained</p> <p>Toxic and dangerous chemicals, including banned chemicals, are not in use</p> <p>Use of acceptable chemicals and fertilisers is carefully monitored to avoid or minimise contamination of food chain</p> <p>Ecologically sensitive areas are protected</p> <p>Extent of soil disturbance in terms of exposed, eroded and compacted soils</p> <p>Programme to maintain and enhance chemical and physical properties of the soil is in place</p> <p>Water quality in the catchment area is acceptable</p> <p>Extent of microclimatic change</p>
<p>Biodiversity of ecosystem is maintained</p> <p>Existence of patches and strips of natural forest for conservation</p> <p>The potential danger of monoculture is minimised through mixed cropping</p> <p>Species selected should be readily adaptable to the local edaphic condition</p> <p>Record of protected fauna and flora</p>
<p>Resilience of ecosystem is maintained</p> <p>Fire prevention and control measures are in force</p> <p>Measures to prevent spread of pathogen, pests and weeds exist and are implemented</p> <p>Species that are not known to be susceptible to serious to pests, diseases, weeds and fire are promoted</p> <p>Integrated Pest Management is practised</p>

Annex 5. Continued

P C I
Team 2
<i>Ecosystem is improved and maintained</i>
<p>Ecosystem is functionally improved Existing biodiversity supportive to plantation forest sustainability Improved microclimate and hydrologic functions</p>
<p>Land productivity is secure Balance of biogeochemical cycles Improved soil fertility Improved land capability</p>
<p>Negative environmental impacts are minimised Land degradation is minimal Pollution is minimal Specific ecological function areas are conserved Damaged areas are rehabilitated</p>
Team 3
<i>Ecosystem function is maintained or improved</i>
<p>Structure and ecosystem function are maintained Buffer zones along watercourses are protected Plantation health is maintained Fire break is employed Site-species matching is considered Mixed cropping is preferable to monoculture Tree growth rate is satisfactory Important remnant vegetation is maintained Indigenous species are used for enrichment planting</p>
<p>Soil and water resources are maintained or improved Chemical and physical properties of the soil are conserved Fertilisers and chemical needs are judiciously used Water quality is maintained Soil erosion hazard is controlled Hydrological function is secured Soil and water pollution is controlled</p>
<p>Adverse environmental influence is minimised Eutrophication is minimised Endangered flora and fauna are conserved Air pollution is controlled Waste control management is secured Pests and diseases are controlled</p>

Annex 6. Socio-economic – Criterion 1 and related indicators

Team Test	Criterion 1	Indicators	Keywords
1	<i>Stakeholders' long-term tenure and rights are secured</i>	<ol style="list-style-type: none"> 1. Long-term tenure and rights have been legally settled prior to the establishment of forest plantation 2. Traditional land use patterns and practices of local communities are respected and protected 	<ol style="list-style-type: none"> 1. tenure, rights, legal, settle 2. traditional land use, respected, protected
2	<i>Stakeholders' (forest actors') tenure and use rights are secured</i>	<ol style="list-style-type: none"> 1. Tenures are well defined and upheld 2. Conflicts are minimal or settled 3. Opportunities exist for local people (forest-dependent people) to get employment, training and compensating rewards from forest company 	<ol style="list-style-type: none"> 1. tenure, well-defined, upheld 2. conflicts, minimal, settled 3. opportunity
3	<i>Stakeholders' tenure and land use rights secured</i>	<ol style="list-style-type: none"> 1. Tenures are well defined and upheld 2. Long-term tenure or agreement to land is guaranteed and customary rights are respected 3. Opportunities exist for local community to continue socio-economic activities within the forest concession area 4. Opportunities exist for local community to get compensating rewards for loss of land and other resources 	<ol style="list-style-type: none"> 1. tenure, well-defined, upheld 2. long-term tenure, respected 3. opportunity, activity 4. opportunity, compensation

Annex 7. Socio-economic – Criterion 2 and related indicators

Team Test	Criterion 2	Indicators	Keywords
1	<i>Participatory co-management is in place</i>	<ol style="list-style-type: none"> 1. Effective mechanisms exist for two-way communication and consultation 2. Local communities understand the company's plan for sustainable plantation management 3. Management understands traditional rights and gender roles 4. Professional staff capable of community development is available and fully supported by the management 	<ol style="list-style-type: none"> 1. mechanism 2. community, understand, plan 3. management, understand, rights 4. capable, community development
2	<i>Stakeholders (forest actors) participate in forest management</i>	<ol style="list-style-type: none"> 1. Effective "bottom-up" and "top-down" communication between primary and other stakeholders 2. Forest-dependent people and company officials understand each other's plan and interests 3. Forest-dependent people share in economic benefits of plantation forest utilisation 4. Fair and effective mechanisms for conflict resolution exist 	<ol style="list-style-type: none"> 1. effective, communication 2. understand, each other's plans 3. economic benefits 4. effective mechanism, conflict resolution
3	<i>Stakeholders participate in forest management</i>	<ol style="list-style-type: none"> 1. Effective mechanisms exist for communication and consultation among stakeholders 2. Local communities understand and are involved in forest management activities 3. Management understands and considers local knowledge in forest management activities 4. Local communities are given first preference in forest management activities in terms of management, training and employment 	<ol style="list-style-type: none"> 1. Effective mechanism, communication, consultation 2. Local community, understand, involve 3. Local knowledge 4. Local community, first preference

Annex 8. Socio-economic – Criterion 3 and related indicators

Team Test	Criterion 3	Indicators	Keywords
1	<i>Equitable benefit sharing</i>	<ol style="list-style-type: none"> 1. Economic alternatives/ supplements to local communities are increasing 2. People's incomes have increased in real terms since the establishment of forest plantation 3. Mechanisms for fair compensation from losses incurred by local communities exist 4. Local communities have significant opportunities to work in and be trained by the company without discrimination 5. Local communities are encouraged to grow timber on their own land to supply raw materials needed for the mill 6. Public infrastructures for local communities are provided and maintained 	<ol style="list-style-type: none"> 1. economic alternative, increase 2. income, increase 3. mechanism, compensation 4. opportunity, training 5. grow, timber 6. public infrastructure
2	<i>Socio-economic performance for local people</i>	<ol style="list-style-type: none"> 1. Contribution to the increase in the well-being of local people (forest-dependent people) 2. Contribution to the maintenance of cultural values and diversity, and of indigenous and local knowledge 3. Contribution to the provision of facilities for general recreation and tourism 	<ol style="list-style-type: none"> 1. well-being, increase 2. maintenance, cultural values, indigenous knowledge, local knowledge 3. facilities, recreation
3	<i>Socio-economic performance of local community is enhanced</i>	<ol style="list-style-type: none"> 1. Contribution to the development of public infrastructure and services should meet the local community's needs and aspirations 2. Contribution to the development of alternative economic activities and linkages exist 3. Social benefits are maximised and social disruption is minimised 	<ol style="list-style-type: none"> 1. public infrastructure, community's needs, aspirations 2. alternative economic, linkages 3. social benefits, maximise, social disruption, minimise

Annex 9. Socio-economic – Criterion 4 and related indicators

Team Test	Criterion 4	Indicators	Keywords
1	<i>Responsibility of primary stakeholders is well defined</i>	<ol style="list-style-type: none"> 1. Agreement exists between local communities and the management regarding rights and responsibilities of both parties 2. Effective control mechanisms for executing the agreement exist 3. Education and training programmes for local communities concerning the adverse effects of plantation activities exist 4. Activities within the area conserved for environmental, social and cultural reasons are carefully recorded and monitored 5. Minimum social and environmental disruption to local communities 6. Government standards/ regulations regarding wages (UMR) are met 	<ol style="list-style-type: none"> 1. agreement, both parties 2. mechanism, agreement execution 3. adverse effect 4. conserved areas, environmental, social, cultural reasons, recorded, monitored 5. social, environment, disruption, minimum 6. UMR
2	-	-	-
3	<i>Forest management enhances employee relations</i>	<ol style="list-style-type: none"> 1. All applicable laws/regulations covering health and safety are met or exceeded 2. Wages and other facilities are met or exceed local standards 3. Career development is clearly planned for all employees without discrimination 	<ol style="list-style-type: none"> 1. laws, regulation, health, safety 2. wage, local standards 3. career development

Annex 10. Management – Criterion 1 and related indicators

Team Test	Criterion 1	Indicators	Keywords
1	<i>Management objectives are well defined</i>	1. Progress of the plantation development programme is in line with achievement of management objectives	1. management objectives
2	-	-	-
3	-	-	-

Annex 11. Management – Criterion 2 and related indicators

Team Test	Criterion 2	Indicators	Keywords
1	<i>Comprehensive management plan is available</i>	<ol style="list-style-type: none"> 1. Maps of the area showing location of plantation, including vegetation and topographic details 2. Assessment of suitability of site in terms of its production potential, environmental perspective, social implications and availability of sufficient land has been carried out 3. Choices of species include native species and allocation of respective planting sites are in accordance with management objectives 4. Planting programme detailing monthly planting targets, operational schedules, manpower, infrastructure and machinery/equipment requirements is in existence 5. Environmental conservation, social and cultural strategies for the plantation are specified 6. Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting in relation to species planted are available 7. Indicative research and development plan outlining short-, medium- and long-term research projects to guide, support plantation development and improve quality and yield of plantation wood 8. Financial projections including planned market projections for the produce 	<ol style="list-style-type: none"> 1. vegetation and topo maps 2. site assessment 3. species choice 4. planting programme 5. conservation, social and cultural strategies 6. silvicultural prescriptions 7. research and development 8. financial projections
2	<i>Comprehensive management plan exists and is well defined</i>	<ol style="list-style-type: none"> 1. Use of full baseline data 2. Well-programmed and implemented monitoring and evaluation 3. An integrated information system used at all levels of management plan 4. Operations and forecasting should refer to the management plan 5. Appropriate infrastructure to support activities 6. Management activities should be integrated 7. Forest land allocation should be the functional base 	<ol style="list-style-type: none"> 1. full baseline data 2. monitoring, evaluation 3. information system, management plan 4. management plan 5. infrastructure 6. management activities 7. land allocation
3	<i>Planning system at both forest and business management levels is in place</i>	<ol style="list-style-type: none"> 1. Planning system comprised of all planning levels, master plan, periodic long-run and short-run planning, both at forest and business levels is in place 2. Management objectives are clearly defined and stated in the long-term planning (master plan) document 	<ol style="list-style-type: none"> 1. planning 2. management objectives

Annex 11. Continued

Team Test	Criterion 2	Indicators	Keywords
		<ol style="list-style-type: none"> 3. A market assessment is carried out and stated in the long-term planning (master plan) document in coming up with selected species 4. Projections (in the long-term planning) of planting and harvesting programmes, in terms of area and location, conform 5. Planting, forest maintenance and protection, and logging (if any), conducted in respective years are set out in monthly targets; operational schedules, manpower, infrastructure and equipment are in existence 6. Sound silvicultural prescriptions and operational details for planting, maintenance and harvesting are available 7. Yield regulations by area and/or volume are set out 8. Financial budget cash flow projections are developed and recorded in the long-term planning document 	<ol style="list-style-type: none"> 3. market assessment 4. planting and harvesting programme 5. forest maintenance, protection 6. silvicultural prescriptions 7. yield regulation 8. budget cash flow

Annex 12. Management – Criterion 3 and related indicators

Team Test	Criterion 3	Indicators	Keywords
1	Good forest resource management strategy is in place.	<ol style="list-style-type: none"> 1. External boundary is lawfully and permanently demarcated and well protected against infringement 2. Clear demarcation of production forest area into smaller and more manageable management units using natural features where applicable 3. Security measures to safeguard theft of forest resource from FMU 4. Forest map produced from interpretation of aerial photographs showing details of planting 5. Plantation register giving details of planting and crop management 6. Updated aerial photographs and/or satellite imagery of all planted areas 7. Net productive area accurately updated every five years 8. Growth and yield data from PSPs to monitor growth/yield trends 9. Mid- and pre-harvest forest inventory data 10. Volume/yield regulation by area, site and species 	<ol style="list-style-type: none"> 1. clear external boundary 2. clear demarcation 3. security measures 4. forest map 5. plantation register and management 6. aerial photographs, satellite imagery 7. net productive areas 8. growth and yield 9. forest inventory 10. volume/yield regulation
2	Normal forest structure	<ol style="list-style-type: none"> 1. Clear and consistent yield regulation 2. Silvicultural practices are well prescribed and appropriate to forest classes 3. Rotation length relatively close to stand age approaching maximum MAI 4. Use of reliable methods for monitoring growing stock and increment 	<ol style="list-style-type: none"> 1. yield regulation 2. silvicultural practice 3. rotation length 4. monitoring growing stock
3	Forest maintenance and protection are implemented and consistent with the planning programme	<ol style="list-style-type: none"> 1. Operational systems of forest fire prevention and suppression are implemented effectively and efficiently 2. Well-defined integrated pest and disease management programmes are practised 3. Effective and efficient operational system of forest security is implemented 	<ol style="list-style-type: none"> 1. forest fire prevention 2. pest and disease management 3. forest security

Annex 13. Management – Criterion 4 and related indicators

Team Test	Criterion 4	Indicators	Keywords
1	<i>Sound plantation practices optimising yields on sustainable basis</i>	<ol style="list-style-type: none"> 1. Minimum skidding, mechanical land clearing and site preparation damage. 2. Road specification and layout match forest conditions and operational requirements 3. Wood harvesting and transport systems match forest conditions and meet with environmental requirements 4. Seedling production and nursery management system is capable of producing good quality seedlings in sufficient quantities to meet planting requirements 5. Availability of manpower at all levels 6. Sufficient infrastructure, machinery and equipment to meet the operational requirements 7. Integrated pest and disease prevention and control programme to minimise damage to the trees 8. Sound weed management programme to reduce weed competition promoting early canopy closure 9. A comprehensive fertilisation programme to improve and maintain soil fertility 10. Appropriate pruning, singling and thinning regimes geared towards optimal production of the desired crop 11. Existence of a fire plan detailing fire prevention and control measures 12. Effective administrative and reporting procedures to ensure smooth running of the operation 13. Human resources development and training prescribed to meet the operational, social and environmental needs of the project 14. An effective purchase and supply department 15. Monitoring, control and verification programmes prescribed to monitor progress of planting and quality of all plantings 	<ol style="list-style-type: none"> 1. minimum skidding road 2. road specification 3. harvesting and transport system 4. nursery management system 5. manpower 6. infrastructure, machinery and equipment 7. pest and disease management 8. weed management 9. fertilisation programme 10. thinning system 11. fire prevention 12. administrative and reporting procedure 13. human resources development 14. purchase and supply department 15. planting management
2	<i>Appropriate technologies are available</i>	<ol style="list-style-type: none"> 1. Implementation of species-site matching 2. Development of tree improvement 3. Implementation of proper seedling production procedures 4. Implementation of proper tending operation procedures 5. Efficient and effective felling techniques and transportation 	<ol style="list-style-type: none"> 1. species-site matching 2. tree improvement 3. seedling production procedures 4. tending procedures 5. felling and transport

Annex 13. Continued

Team Test	Criterion 4	Indicators	Keywords
3	<i>Implementation of timber planting (area and species) is consistent with planning programme</i>	<ol style="list-style-type: none"> 1. Planting area and location conform with long-term planning 2. Species planted are in market demand 3. Proper seedling production procedure is applied 4. Proper tending operation procedure is implemented 	<ol style="list-style-type: none"> 1. planting management 2. market demand 3. seedling production procedures 4. tending procedures

Annex 14. Management – Criterion 5 and related indicators

Team Test	Criterion 5	Indicators	Keywords
1	<i>There is sustained and adequate funding for running the operation</i>	1. Liquidity of cash flow to support infrastructure development, acquisition of machinery and equipment and to meet the day-to-day running of the operation	1. cash flow for infrastructure, machinery and equipment
2	<i>Adequate funding secure</i>	1. Reliable company financial cash flow 2. Guaranteed and adequate investment in capital, human resources and research and development	1. financial cash flow 2. investment in capital, human resources and research development
3	<i>There is sustained and adequate funding for running the operation</i>	1. During establishment period, an adequate funding source for financing the required forest development programme exists 2. In the post-establishment period annual income from timber harvesting is generated and able to finance all forest management activities adequately	1. funding for forest development 2. financing forest management activities

Annex 15. Management – Criterion 6 and related indicators

Team Test	Criterion 6	Indicators	Keywords
1	<i>Appropriate labour, health and safety considerations</i>	<ol style="list-style-type: none"> 1. Employment conditions for local and non-local employees doing the same job 2. Health care, education, housing and sanitation facilities 3. Clear and transparent programme and procedures to look into the welfare and grievances of the personnel 4. Operational guidelines for safety precautions in handling chemicals, vehicles and machinery are available and are being enforced 	<ol style="list-style-type: none"> 1. employment for local and non-local employees 2. facilities 3. welfare programme 4. safety guidelines
2	<i>Forest protection programme</i>	<ol style="list-style-type: none"> 1. Effective and efficient operational system of forest fire prevention and suppression 2. Well-defined and practise of integrated pest management programmes 3. Effective and efficient operational system of forest security 	<ol style="list-style-type: none"> 1. forest fire control system 2. pest management 3. forest security system
3	-	-	-

Annex 16. Management – Criterion 7 and related indicators

Team Test	Criterion 7	Indicators	Keywords
1	<i>A comprehensive research and development programme is in place</i>	<ol style="list-style-type: none"> 1. Types and number of research projects and research priorities 2. Number of qualified researchers and areas of discipline 3. Size of funding to ensure continuity of research programme 4. Evidence of fruits from R&D benefiting the plantation programme 	<ol style="list-style-type: none"> 1. research priorities 2. researcher and discipline 3. funding ensuring research 4. fruitful research
2	<i>Research and development programme</i>	<ol style="list-style-type: none"> 1. Research and development programme supporting the operational activities 2. Research and development respond and contribute to new information and technology 	<ol style="list-style-type: none"> 1. research and development programme 2. research and development programme
3	<i>Research and development programmes are conducted</i>	<ol style="list-style-type: none"> 1. R & D development programmes supporting the operational activities are implemented 2. R & D development programmes responding and contributing to new information and technology are practised 	<ol style="list-style-type: none"> 1. research and development programme 2. research and development programme

Annex 17. Management – Criterion 8 and related indicators

Team Test	Criterion 8	Indicators	Keywords
1	<i>Monitoring and assessment of plantation activities to ensure conformity with management plan</i>	<ol style="list-style-type: none"> 1. Actual areas planted and progress of planting 2. Species are planted on correct site/soil types, as planned 3. A full stand of planted trees, with a survival rate of at least 90% 4. Standard of planting and tending 5. Records of management activities such as R&D, fire incidence and complaints from the local community 6. Sound estate auditing and cost accounting procedures 	<ol style="list-style-type: none"> 1. progress of planting 2. site-species matching 3. full stand with planted trees 4. planting and tending 5. management records 6. estate auditing and accounting procedures
2	-	-	-
3	<i>An effective monitoring and control system audits management's conformity with planning</i>	<ol style="list-style-type: none"> 1. Periodic forest inventory systems exist, entire (total) timber standing stock volume increases during establishment period, and thereafter either increases or is constant 2. Continuous forest inventory (CFI) plots established and measured regularly 3. Documentation and records of all forest management activities are kept in a form that makes it possible for monitoring to occur 	<ol style="list-style-type: none"> 1. forest inventory system 2. forest inventory system 3. records of forest management activities

Annex 18. Management – Criterion 9 and related indicators

Team Test	Criterion 9	Indicators	Keywords
1	-	-	-
2	<i>Professional and dedicated human resources</i>	<ol style="list-style-type: none"> 1. Adequate human resources at all levels of management 2. Systematic and continuous training and career promotion programme and rewards 3. Human resources welfare programme exists 4. Effective and efficient organisational structure 	<ol style="list-style-type: none"> 1. human resources 2. training and career promotion 3. human resources, welfare 4. organisational structure
3	<i>Professional and dedicated human resources are enhanced</i>	<ol style="list-style-type: none"> 1. Adequate human resources at all levels of management 2. Clear and effective organisational structure with job descriptions is developed 3. Human resource development is implemented 4. Wages and other facilities are provided 5. Operational guidelines for safety procedures for handling chemicals, vehicles and machinery are available and are being enforced 	<ol style="list-style-type: none"> 1. human resources 2. organisational structure 3. human resource development 4. wages and facilities 5. safety guidelines procedure

Annex 19. Management – Criterion 10 and related indicators

Team Test	Criterion 10	Indicators	Keywords
1	-	-	-
2	-	-	-
3	<i>Implementation of logging (if any) is consistent with the planning programme</i>	<ol style="list-style-type: none"> 1. Harvesting/logging area and location conform with yield regulations 2. Felling techniques and transportation are implemented efficiently and effectively 	<ol style="list-style-type: none"> 1. logging area, yield regulation 2. felling and transportation

Annex 20. Ecology – Criterion 1 and related indicators

Team Test	Criterion 1	Indicators	Keywords
1	<i>Ecosystem function is maintained</i>	<ol style="list-style-type: none"> 1. Toxic and dangerous chemicals, including banned chemicals, are not in use 2. Use of acceptable chemicals and fertilisers is carefully monitored to avoid or minimise contamination of food chain 3. Ecologically sensitive areas are protected 4. Extent of soil disturbance in terms of exposed, eroded and compacted soils 5. Programme to maintain and enhance chemical and physical properties of the soil is in place 6. Water quality in the catchment area is acceptable 7. Extent of microclimatic change 	<ol style="list-style-type: none"> 1. dangerous chemicals 2. food chain 3. sensitive areas 4. soil disturbances 5. maintaining chemical and physical properties of the soil 6. water quality 7. microclimatic change
2	<i>Ecosystem is functionally improved</i>	<ol style="list-style-type: none"> 1. Existing biodiversity supportive to plantation forest sustainability 2. Improved microclimate and hydrologic functions 	<ol style="list-style-type: none"> 1. biodiversity 2. microclimate, hydrology
3	<i>Structure and ecosystem function is maintained</i>	<ol style="list-style-type: none"> 1. Buffer zones along watercourses are protected 2. Plantation health is maintained 3. Fire break is employed 4. Site-species matching is considered 5. Mixed cropping is preferable to monoculture 6. Tree growth rate is satisfactory 7. Important remnant vegetation is maintained 8. Indigenous species are used for enrichment planting 	<ol style="list-style-type: none"> 1. buffer zones 2. plantation health 3. fire break 4. site species matching 5. mix cropping 6. tree growth 7. remnant vegetation 8. indigenous species

Annex 21. Ecology – Criterion 2 and related indicators

Team Test	Criterion 2	Indicators	Keywords
1	<i>Biodiversity of ecosystem is maintained</i>	<ol style="list-style-type: none"> 1. Existence of patches of strips and patches of conservation forest 2. The potential danger of monoculture is minimised through mixed cropping 3. Species selected should be readily adaptable to the local edaphic condition 4. Record of protected fauna and flora 	<ol style="list-style-type: none"> 1. conservation area 2. monoculture, mixed cropping 3. species adaptable 4. protected flora and fauna
2	<i>Negative environmental impacts are minimised</i>	<ol style="list-style-type: none"> 1. Land degradation is minimal 2. Pollution is minimal 3. Specific ecological function areas are conserved 4. Damaged areas are rehabilitated 	<ol style="list-style-type: none"> 1. land degradation 2. pollution 3. ecological function 4. damaged areas
3	<i>Adverse environmental influence is minimised</i>	<ol style="list-style-type: none"> 1. Eutrophication is minimised 2. Endangered flora and fauna are conserved 3. Air pollution is controlled 4. Waste control management is secure 5. Pest and diseases are controlled 	<ol style="list-style-type: none"> 1. eutrophication 2. endangered flora and fauna 3. air pollution 4. waste control 5. pest and disease control

Annex 22. Ecology – Criterion 3 and related indicators

Team Test	Criterion 3	Indicators	Keywords
1	<i>Resilience of ecosystem is maintained</i>	<ol style="list-style-type: none"> 1. Fire prevention and control measures are in force 2. Measures to prevent spread of pathogens, pests and weeds exist and are implemented 3. Species that are not known to be susceptible to serious pests, diseases, weeds and fire are promoted 4. Integrated Pest Management is practised 	<ol style="list-style-type: none"> 1. fire prevention 2. pest, disease and weed management 3. selected species 4. integrated pest management
2	<i>Land productivity is secure</i>	<ol style="list-style-type: none"> 1. Balance of biogeochemical cycles 2. Improved soil fertility 3. Improved land capability 	<ol style="list-style-type: none"> 1. biogeochemical cycles 2. soil fertility 3. land capability
3	<i>Soil and water resources are maintained or improved</i>	<ol style="list-style-type: none"> 1. Chemical and physical properties of the soil are conserved 2. Fertilisers and chemical needs are judiciously judged 3. Water quality is maintained 4. Soil erosion hazard is controlled 5. Hydrologic function is secure 6. Soil and water pollution is controlled 	<ol style="list-style-type: none"> 1. soil chemical and physical properties 2. judicious use of chemical 3. water quality 4. soil erosion 5. hydrologic function 6. soil and water pollution

Annex 23. List of participants for final consultation round with companies

No.	Name	Position	Company
1	Harie Trianto	Field Unit Manager	INHUTANI II, Pulau Laut
2	Winarto	Sub-Field Unit Manager	HTI Senakin, INHUTANI II, Pulau Laut
3	Sumarmo Pd	Sub-Field Unit Manager	Sub Unit Pulau Laut
4	Usmandoyo	Section Coordinator (Kasi) for Forest Management	INHUTANI II, Pulau Laut
5	Syafruddin Sultan	Kasi Production	INHUTANI II, Pulau Laut
6	Rosiono Widodo	Coordinator Sub-Section (Kaur) Administration and Production	INHUTANI II, Pulau Laut
7	Bambang W	Kaur Observation and Development	INHUTANI II, Pulau Laut
8	Beni Supeno	Kaur Forest Management and Rehabilitation	INHUTANI II, Pulau Laut
9	Parjono	Kaur HTI	INHUTANI II, Pulau Laut
10	Sudirman	Kaur community development (PMDH/PUKK)	INHUTANI II, Pulau Laut
11	Wu Wen Tsan	Forest Development	PT Arara Abadi, Pekanbaru, Riau
12	Agus Awali	Forest Development	PT Arara Abadi, Pekanbaru, Riau
13	Zulhadi	Forest Information and Certification, Forest Development	PT Arara Abadi, Pekanbaru, Riau
14	Bambang Dwi Laksono	Forest Information and Certification, Forest Development	PT Arara Abadi, Pekanbaru, Riau
15	Anthony Rizal	Research and Development	PT Arara Abadi, Pekanbaru, Riau
16	M. Syarif Hidayat	Forest Information and Certification, Forest Development	PT Arara Abadi, Pekanbaru, Riau
17	Amirudin	CIF	PT Arara Abadi, Pekanbaru, Riau
18	Gunadi W	PPS	PT Arara Abadi, Pekanbaru, Riau
19	Herdhy KS	FSA	PT Arara Abadi, Pekanbaru, Riau
20	Hardjono Arisman	Director, Plant and Research	PT Musi Hutan Persada, Subanjeriji
21	Eko Bhakti Hardiyanto	R&D Advisor	PT Musi Hutan Persada, Subanjeriji
22	F. Syarkawi	R&D Socio-economic scientist	PT Musi Hutan Persada, Subanjeriji
23	Rachmat Wahyono	Growth and Yield Section Coordinator	PT Musi Hutan Persada, Subanjeriji
24	Susatyo Hutomo	Socio-economic scientist	PT Musi Hutan Persada, Subanjeriji
25	Bambang Hendro	R&D Advisor	PT Musi Hutan Persada, Subanjeriji
26	Sabar Siregar	R&D	PT Musi Hutan Persada, Subanjeriji
27	Aris Riyantoko	Planting Section	PT Musi Hutan Persada, Subanjeriji
28	Bastian Gumay	Planting Division	PT Musi Hutan Persada, Subanjeriji
29	Benni Rosa	HTI Unit III	PT Musi Hutan Persada, Subanjeriji
30	Saifuddin Anshori	R&D	PT Musi Hutan Persada, Subanjeriji
31	Edi Purwanto	R&D	PT Musi Hutan Persada, Subanjeriji
32	Christianus	SA	PT Musi Hutan Persada, Subanjeriji
33	Harnios Arief	Forest management specialist	LEI/CIFOR
34	Semiarto Aji Purwanto	Social scientist	LEI/CIFOR
35	Chairil Anwar Siregar	Ecologist	FRD, Ministry of Forestry/CIFOR
36	Dwi Rahmad Muhtaman	Social scientist	LATIN/CIFOR

Annex 24. Itinerary of final consultation process with companies

Date	Activities	Remarks
6 Nov. 1999	10.15-18.30 Bogor-Jakarta	INHUTANI
	07.10-09.25 To Banjarmasin, South Kalimantan	
	10.15-18.30 To Inhutani II, Pulau Laut	Spend the night in Stagen
7 Nov.	09.00-10.00 Meeting with Unit Manager	Discussing the plan for presentation
	10.00-13.00 Presentation preparation and team discussion	
8 Nov.	09.00-16.30 Presentation	
9 Nov.	10.00-18.00 To Banjarmasin	Spend the night in Banjarmasin
10 Nov.	10.15-12.30 To Jakarta and continue to Bogor	
14 Nov.	04.00 Bogor - Jakarta	
	07.15-09.25 To Pekanbaru, Riau	Stay in Pekanbaru
15 Nov.	08.00-09.30 To PT Arara Abadi office, Sembawang	
	10.00-16.30 Presentation	
	17.00-18.30 To Pekanbaru	
16 Nov.	08.45-13.00 To Palembang and directly went to Musi Hutan Persada, Palembang office	Stay in Palembang
17 Nov.	05.30-09.30 To the MHP plantation site	
	10.00-11.00 Meeting with field staff to discuss the plan	
	12.00-15.30 Field visit around plantation	
	16.00-19.30 To Palembang	Stay in Palembang
18 Nov.	05.00-09.00 To MHP site for presentation	
	09.15-15.30 Presentation	
	16.00-19.30 To Palembang	
19 Nov.	08.55-10.00 To Jakarta and continue to Bogor	
20 Nov.	Report writing	Bogor
24 Nov	Debriefing with Christian Cossalter	CIFOR Office
25-26 Nov.	Report writing	
30 Nov.	Final Meeting with Christian Cossalter	CIFOR Office