

13. CRITERIA AND INDICATORS FOR ASSESSING SUSTAINABILITY OF SMALLHOLDER TREE PLANTATIONS IN SELECTED REGIONS IN THE PHILIPPINES

Priscila C. Dolom, Teodoro R. Villanueva and Ma. Magdalena B. Villanueva

A study was conducted in three regions in the Philippines to identify a set of criteria and indicators for assessing sustainability of smallholder tree plantations. The research method involved a combination of key informant interviews, focus group discussions and consultations as well as an examination of existing records, documents and forest regulatory policies at both national and local levels. Six criteria and 41 indicators were selected for assessing sustainability of smallholder tree plantations. The 41 indicators are distributed among the six criteria identified as follows: Criterion 1 – Enabling conditions for sustainable forest management (SFM) with 10 indicators; Criterion 2 – Forest Resource Security with 8 indicators; Criterion 3 – Forest Ecosystem Health and Condition with 2 indicators; Criterion 4 – Flow of Forest Products Produce with 9 indicators; Criterion 5 – Soil and water conservation with 2 indicators; and Criterion 6 – Economic, Social and Cultural aspects with 10 indicators. These criteria and indicators for smallholder tree plantations are designed to provide a comprehensive framework which will guide smallholder tree farmers and the Philippine government towards sustainable forest management.

INTRODUCTION

Over the last 60 years, Philippine forests have declined continuously in physical, economic and environmental terms. Most of the country's once rich forests which used to generate substantial revenue to the government have now disappeared. Forest destruction rose to alarming levels while forest recovery through natural and artificial means could never cope with the rate of forest destruction. The high incidence of poverty in the Philippine uplands continues to exacerbate environmental degradation problems. Furthermore, the institutions mandated to implement policies to address all these problems have not been equipped to fully address the situation.

The Department of Environment and Natural Resources (DENR 1997) as the primary government executive agency responsible for the management of the country's forest resources has undertaken several initiatives through the Forest Management Bureau (FMB 2003) to hasten reforestation and rehabilitation of grasslands and brushlands within public forestlands. The Philippine Government has adopted several programs and entered into various management agreements to speed up reforestation of both public and private land. A range of incentives has been implemented to encourage forest managers to rehabilitate forest resources, increase wood supply and address the needs of upland people. Unfortunately, up to now no adequate Criteria and Indicators (C&I) to determine if the plantations established on both public and private land are being managed sustainably, have been developed.

While the DENR through the FMB with funding support from the International Tropical Timber Organization (ITTO 1992), has developed a set of C&I at national and forest management unit levels, plantations developed by private individuals are not covered. The DENR C&I were developed in 2003 and are applicable to forest management units with bigger areas and also to natural forests. The developed C&I were tested and applied at the national and bigger forest management units.

This study generally aims to identify a set of criteria and indicators of sustainability for smallholder tree plantations which is acceptable to, and measurable by tree planters and forest managers. Specifically, the research aim has been to: (a) identify from existing literature indicators of sustainability of smallholder tree plantations and validate their acceptability and applicability to tree planters/forest managers; (b) develop participatory methodologies of measuring the selected indicators; and (c) recommend measures to adopt the developed C&I as a tool for assessing the sustainability of smallholder tree plantations.

This study was undertaken in selected smallholder tree plantations in the Philippines namely Regions 2 (Northern Luzon), 10 (Northern Mindanao) and 13 (Caraga). These regions were selected because they have numerous existing smallholder tree farms both on private land (alienable and

disposable land) and on public land (forestlands). The study was conducted from February 2005 to July 2006.

The paper is presented in four parts. A brief introduction is provided followed by a discussion of research methods. The next part consists of results and discussions of the applicable criteria and indicators for assessing sustainability of smallholder tree plantations. Issues and recommendations were then identified based on the results of the study and a concluding remark is finally set out at the end of the paper.

RESEARCH METHOD

Purposive sampling was used to select research sites and respondents because of the need to include specific characteristics, such as type of forestland management agreement, species planted and area of tree farms. Regions 2, 10 and 13 were chosen as the study sites because these regions have been found to have the highest number of smallholder tree plantations and have been identified as the timber corridors of the country. Based on the listing of tree planters, these regions have a large number of tree farmers, both on private and public land to serve as respondents for the study. Respondents were selected purposively to ensure that each type of forestland management agreement was represented. A semi-structured questionnaire was developed, in which most of the questions were open-ended so as to elicit more information about their experiences in tree plantation establishment and management.

A series of focus group discussions were conducted with the tree planters in the Caraga region. The first focus group discussion was conducted to inform them about the importance of C&I for assessing sustainability of tree plantations, forest certification and the DENR programs toward SFM. In the second focus group discussion a presentation was made of previous C&I developed in both the national and international arenas as well as the draft C&I for assessing the sustainability of smallholder tree plantations. During the meeting the ITTO C&I and the Philippine C&I were accepted by the participants to be used as the main reference in developing the C&I for smallholder tree plantations. The last focus group discussion was conducted to present the final list of the developed C&I by tree planters after testing in the field had been undertaken with the stakeholders.

The developed C&I for assessing the sustainability of smallholder tree plantations were pre-tested in the various types of tree plantations with the tree planters to determine their applicability and measurability. The testing was done by conducting an interview with the stakeholders, an examination of their records and also ocular observation. Based on the result of the testing, the final list of C&I for assessing smallholder tree plantations was developed and accepted by the stakeholders.

RESULTS AND DISCUSSIONS

Selected C&I of Sustainability for Tree Plantations

The C&I developed for assessing the sustainability of smallholder tree plantations has six (6) criteria and 41 indicators. The six criteria include the following:

1. Enabling Conditions for SFM
2. Forest Resource Security
3. Forest/Plantations Ecosystem Health and Condition
4. Flow of Forest Products Produce
5. Soil and water Conservation
6. Economic, Social and Cultural Aspects

Criterion 1 covers the general institutional requirements for SFM. Ten indicators have been identified under this criterion, and are mainly descriptive in nature (Table 1). These can be measured by examining the records of forest management obtained from interviews with the tree planters.

Table 1. List of indicators for criterion 1 on enabling conditions for sustainable forest management

INDICATORS
<i>1.1 Existence of a framework of forest policies to govern</i>
1.1.a The production, conservation and protection of tree plantations within production forests and A & D lands
1.1.b The participation of local government units, local communities and other stakeholders
1.2 Amount of investment and reinvestment in tree plantation development and management, administration, research, and human resource development from private, domestic and foreign sources
1.3 Existence of economic and other incentives to encourage sustainable tree plantation management
1.4 Existence of institutions to support sustainable tree plantation management
1.5 Presence of professional and technical assistance in the area to perform and support management, implementation, research and extension
1.6 Mechanism for active public participation in forest management, such as planning, data collection, decision-making, implementation, monitoring and assessment, benefit sharing and conflict management
1.7 Adequacy and frequency of information and efforts to increase public awareness and ensure proper/common understanding of forest policies, legislation and sustainable forest management practices
1.8 Number and efficiency of networking, linking and collaboration mechanisms to further ensure sustainable forest management
1.9 Existence and application of appropriate technology to practice sustainable forest management and the efficient processing and utilization of forest produce
1.10 Capacity and mechanisms for (a) planning sustainable forest management and for (b) periodical monitoring, evaluation and (c) feed-back on progress

Criterion 2 which deals with forest resource security, and relates to the extent to which the established tree plantations have a secure and stable forest state to meet the production, protection and other social, cultural, economic and environmental needs of the present and future generations. Eight indicators are included in this criterion (Table 2). These indicators can be verified from progress reports, through field observations and interviews with the stakeholder.

Table 2. List of indicators for criterion 2 on forest resource security

INDICATORS
2.1 Extent (area) and percentage of total land area under:
2.1.a plantation forest
2.1.b natural forest, and
2.1.c other land uses
2.2 Length and percentage of external boundaries of the tree plantations demarcated (or) and clearly defined or marked on the ground (including other land-use boundaries)
2.3 Area of the tree plantation converted to non-forest uses
2.4 Existence of procedures to control encroachment, fire, unregulated grazing, illegal exploitation of forests, and pest and diseases.
2.5 Observance of procedures covering the proper use of chemicals in tree plantations

INDICATORS

- 2.6 Observance of procedures to identify and demarcate sensitive areas for protection of soil and water
 - 2.7 Observance of proper road or trail lay-out, including drainage requirements and/or conservation of the buffer strips along streams and rivers
 - 2.8 Conducting of harvesting procedures:
 - 2.8.a to protect the soil from erosion during harvesting operations, and
 - 2.8.b to protect nearby existing residual stands, new plantings and other flora and fauna
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Criterion 3 relates to the Forest and Plantations Health and Conditions. This criterion deals with the conditions of the area as affected by a variety of human actions and natural causes. The information in this criterion is difficult to measure and verify, so the stakeholders were able to identify only two indicators that are applicable and measurable at their levels (Table 3).

Table 3. List of indicators for criterion 3 on forest ecosystem health and condition

INDICATORS

- 3.1 Within the tree plantation, the extent and nature of:
 - 3.1.a encroachment
 - 3.1.b agriculture
 - 3.1.c roads
 - 3.1.d mining
 - 3.1.e dams and other engineering structures
 - 3.1.f unmanaged fire
 - 3.1.g shifting cultivation
 - 3.1.h grazing
 - 3.1.i timber poaching and gathering of forest resources
 - 3.1.j construction of communication and power facilities, and
 - 3.1.k other forms of damages
 - 3.2 Extent and nature of plantation damage, caused by:
 - 3.2.a wildfire
 - 3.2.b drought
 - 3.2.c storm-related damages
 - 3.2.d pest and diseases, and
 - 3.2.e others (specify)
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Criterion 4 deals with the flow of forest wood and non-wood products. Such production can only be sustained in the long-term if it is economically and financially viable, environmentally sound and socially acceptable. Nine indicators were designed to provide information on resource assessment, planning procedures, management guidelines and monitoring and evaluation related to the flow of forest produce (Table 4). These are all measured through examination of existing reports and documents prepared by the tree planters.

Table 4. List of indicators for criterion 4 on flow of forest products produce

INDICATORS
4.1 Inventory and survey procedures used to define:
4.1.a the quantity and quality of the main forest products, and
4.1.b resource rights and ownership
4.2 Estimate of level of sustainable harvest for each main wood and non-wood forest product by source
4.3 Volume and age of trees harvested
4.4 Existence of an area development plan
4.5 Existence and long-term projections, strategies and plans for production
4.6 Observance of guidelines for each of the main wood and non-wood forest products to be harvested, to cover:
4.6.a the assessment of residuals, and
4.6.b measures for enrichment planting
4.7 Observance of procedures to monitor and review guidelines
4.8 Availability and implementation of guidelines for harvesting to minimize environmental impacts
4.9 Percentage of area harvested for which:
4.9.a post-harvest surveys have been conducted to assess the effectiveness of enrichment planting

Criterion 5 covers conservation of soil and water within the tree plantations and nearby areas. Two indicators have been selected in this criterion because the indicators identified in literature are difficult to measure, expensive to obtain, require an expert's opinion and are not available at smallholder tree plantation level (Table 5).

Table 5. List of indicators for criterion 5 on soil and water conservation

INDICATORS
5.1 Extent and percentage of tree plantation area managed simultaneously for the protection of soil and water
5.2 Extent and percentage of tree plantation to be harvested for which rivers have been demarcated or clearly defined and protected before harvesting

Criterion 6 concerns the economic, social and cultural aspects of tree plantations. A well-managed tree plantation is a self-renewing resource and produces a host of benefits ranging from high quality timber to satisfying the basic needs of people living in and around the forest. It also contributes to the well-being and enhances the quality of life of the communities in providing opportunities for livelihood and industries. Hence, if sustainably managed, the forest has the potential to make an important contribution to the overall sustainable development of the country. A total of ten indicators were identified grouped into socio-economic aspects, cultural aspects and community participation (Table 6).

Table 6. List of indicators for criterion 6 on economic, social and cultural aspects

INDICATORS
<i>6.1 Quantity and value of wood and non-wood products traded in:</i>
6.1 a the domestic market and
6.1 b the international market
6.2 Ratio of domestic production of forest products to the processing capacity of forest-based industries in the region
6.3 Existence and implementation of mechanisms for the effective distribution of incentives and the fair and equitable sharing of costs and benefits
6.4 Existence and implementation of procedures to ensure the health and safety of forest workers
<i>6.5 Employment generated:</i>
6.5.a number employed
6.5.b average wage rate
6.6 Peace and order problems
<i>6.7 Number and extent of tree plantation area available primarily for:</i>
6.7.a research and development
6.7.b education
6.7.c direct use and benefit of local communities, and
6.7.d recreation
Community Participation:
6.8 Extent to which tenure and user of the tree plantation area are recognized by the tree farmer
6.9 Extent to which the tree farmer considers and recognizes legal or customary rights with respect to indigenous people and local communities, forest dwellers and other forest-dependent communities
6.10 Extent of participation by indigenous people and local communities, forest dwellers and other tree plantation-dependent communities in plantation activities towards sustainability

Result of the Assessment of the Identified C&I

The field testing of the draft C&I for assessing the sustainability of smallholder tree plantations among stakeholders indicated that most of the criteria and indicators identified are applicable and measurable at the tree planters' level. However, there are indicators which are not applicable, while others are difficult to measure because the verifying evidence is not available at the tree planters' level. In this case, those indicators were not considered and included in the final list of C&I for assessing the sustainability of smallholder tree plantations. Further explanation of each of the criteria follows.

Criterion 1. Enabling conditions for sustainable forest management

Criterion 1 provides the legal and institutional framework which is necessary to make SFM possible. The parameters for the 10 indicators under this criterion are all available and can be collected from the stakeholders.

Indicator 1.1 relates to the existence of a framework for forest policies governing the production, conservation and protection of tree plantations within production forests and A & D lands as well as the participation of local government units, local communities and other stakeholders. It appears that at the national and regional levels there are adequate policies that provide the framework for sustainable tree plantation management. These policies establish the

national objectives of forest production, conservation and protection, as well as the framework for participation of local communities and other stakeholders.

Indicator 1.2 – concerning the amount of investments and reinvestment in tree plantation development and management, administration, research and human resource development – is difficult to estimate particularly in terms of ascertaining the exact amount of reinvestment. For instance, forest charges and other environmental fees collected go to the National Treasury but out of this amount the value that is being reinvested in forest management can no longer be ascertained. However, details of the amount of investment from private and foreign sources can be collected although existing records are difficult to access because of business confidentiality. Some forest managers seem hesitant to provide the true information on the amount of their investments. On the part of tree planters, the financial records are not organized enough to reliably ascertain their investments in forest management and development.

Economic instruments and incentives exist to encourage sustainable tree plantation management (Indicator 1.3). These instruments include forest charges and fees, while incentives include non-payment of forest charges for planted trees, harvesting and processing rights, and access to financial, material inputs and technical assistance. The question, however, is whether these economic instruments are actually encouraging the sustainability of smallholder tree plantations. Under indicator 1.4 various institutions have been identified which support sustainable tree plantation management at both the national and local levels. Data on the presence and frequency of professional and technical assistance provided in the area was likewise easily collected, including the types of training and experiences of the technical and professional personnel (Indicator 1.5).

All forest managers have indicated that they have mechanisms for active public participation in tree plantation management (Indicator 1.6). The most common mechanism is through consultation meetings and dialogue with local communities, barangay officials and other stakeholders. These community meetings and dialogue exchanges were identified as the most common methods of providing information to increase public awareness about forest policies, legislation and sustainable forest management practices (Indicator 1.7). The other common strategies are through distribution of pamphlets and posters.

Plantation owners likewise indicated that they have established networks and linkages with government agencies and other institutions (Indicator 1.8). They feel this is important to ensure the smooth flow of business transactions and because some agencies and institutions are able to provide technical, financial and material assistance in developing their plantations.

In terms of the existence and application of appropriate technology (Indicator 1.9) concerning the efficient processing and utilization of forest produce, it was found that smallholder tree planters employ less efficient technology than the large corporate tree planters. They have to process roundlogs in the forest into fitches so that these can be transported to the nearest road by carabao. This practice leads to too much waste material which is left in the area. The mechanisms used for planning sustainable tree plantations management have been adequately described by the different tree planters (Indicator 1.10). However, they have difficulty describing their monitoring and evaluation system as well as the feedback mechanisms. They agree that this indicator is necessary and important in assessing the sustainability of smallholder tree plantations.

Criterion 2. Forest resource security

Criterion 2 is concerned with the extent and percentage of land under plantation forests that can sustain the production, protection and other environmental needs of present and future generations.

The identified indicators under this criterion are available and measurable at the management unit level. These indicators are readily provided by the forest managers and tree planters. However, the reliability of the information is questionable because no ground verification has been conducted. Data are based on reports and interviews with the stakeholders.

Indicators 2.1 and 2.2 determine the extent of tree plantations and the length and percentage of external boundaries demarcated on the ground. Information is based on interviews and reports by the tree planters. Ground verification can be conducted to check the reliability of the information gathered. Information about Indicator 2.3 on the area of tree plantations converted to non-forest use is also available and applicable.

In general, indicators on existence of procedures relating to control of encroachment by illegal settlers, fire, unregulated grazing and illegal extraction of forest products, and pests and diseases (Indicator 2.4), as well as for the proper use of chemicals (Indicator 2.5) are provided in the plans prepared by the smallholder tree planters. Procedures for the identification and demarcation of

sensitive areas for the protection of soil and water (Indicator 2.6) and for proper road or trail layout, including drainage requirements and conservation of the buffer strips along streams and rivers (Indicator 2.7) are likewise indicated in their plans. Regarding the conducting of harvesting procedures (Indicator 2.8) to protect the soil from erosion and nearby existing residual stands, selective cutting is being practiced and the harvested area is immediately replanted. The tree planters also hire skilled tree cutters from the surrounding communities to ensure minimal damage to the plantation.

Criterion 3. Forest ecosystem, health and condition

This criterion deals with the conditions of the area as affected by a variety of human actions and natural causes. Data on Indicators 3.1 and 3.2 are generally available and measurable at the management unit level. Since the area is manageable in terms of size, the information on the extent and area of damage is generally available and based on actual survey estimates. Within the tree plantation, the most common damage caused by human actions are encroachment, unmanaged fire, grazing, timber poaching and gathering of forest resources, construction of communication and power facilities and other forms of damage (Indicator 3.1). The most common damages caused by natural causes (Indicator 3.2) are wildfire, drought, storms and pest and diseases.

Criterion 4. Flow of forest products

This criterion relates to the application of sound management practices to maintain the potential of forest plantations to yield the full range of benefits to society. The information that will be gathered by applying this criterion will not only indicate the level of yields that may be harvested but also the types and quality of forest produce that may be extracted if the resource is managed effectively and sustainably.

The field testing shows that indicators relating to inventory and survey procedures to define the quantity and quality of the main forest products and resource rights ownerships (Indicator 4.1) are available from both the tree planters and the DENR. This is in compliance with the DENR policy requiring the tree planters to register their plantations to the nearest DENR office with accompanying documents and with information including land ownership title, species planted and year, plus an inventory of individual trees planted by species. Estimates of level of the sustainable harvest for wood and non-wood forest products (Indicator 4.2) are also available at the tree planter level, including the volume and age of trees harvested (Indicator 4.3). Some tree planters have prepared their area development plan depending on the use of the plan such as for obtaining loans, for registering their plantations and for securing cutting permits (Indicator 4.4). Based on interviews, it became obvious that the tree planters have a clear scenario in mind of the future of the established plantations. They have existing projections, strategies and plans for production (Indicator 4.5).

In terms of management guidelines and monitoring and evaluation procedures for assessing harvesting damages to residuals, measures for enrichment planting and post-harvesting survey (Indicators 4.6, 4.7, 4.8 and 4.9), it was determined that this information is readily available and applicable to smallholder tree plantations.

Criterion 5. Soil and water conservation

Criterion 5 deals with the protection of soil and water in smallholder tree plantations. It is important to protect soil and water for the maintenance and improvement of soil productivity and to reduce flooding and sedimentation both on-farm and off-farm. Two indicators were identified under this criterion.

Although this criterion is not the primary concern of smallholder tree planters they also acknowledge that soil and water conservation should be integrated in plantation management. Thus there are areas – especially steep portions of their farms – that are being planted mainly for harvesting but they employ harvesting and management techniques that simultaneously allow soil and water conservation (Indicator 5.1). At the same time, the farmers recognize that existing policies require protection of river banks. Most of them indicated that river systems are clearly delineated in their management plan and that these are being planted with bamboo and other long-term tree species (Indicator 5.2). The plans are prepared by the tree planters in close consultation with the surrounding communities and the DENR. This is usually prepared as may be required by funding institutions and as part of the documentation for securing various permits.

Criterion 6. Economic, social and cultural aspects

This criterion deals with the economic, social and cultural benefits of the established plantations, apart from those mentioned in the other criteria. Existing literature suggests 19 indicators under this criterion. While data on some of the indicators of this criterion are readily available and provided by the tree planters, some information is difficult to obtain. Also, a few variables are not measurable, including the contribution of the tree plantation to the local economy, the quantity and value of wood and non-wood products for subsistence use (including fuelwood and donations to communities and LGUs as part of community service), and the extent of people dependent on forest for subsistence. These indicators were therefore not included.

The rest of the indicators are available and measurable. Most of the products – both wood and non-wood – are traded in the domestic market (Indicator 6.1). The indicator relating to the ratio of domestic production of forest products to the processing capacity of forest-based industries in the region (Indicator 6.2) can also be determined by computing beforehand the processing capacity of forest-based industries in a particular region and expressing the farmers' production as a ratio of this figure. Mechanisms for distribution of incentives in sharing costs and benefits generally exist in smallholder tree plantation management (Indicator 6.3). However, the procedures to ensure the health and safety of forest workers (Indicator 6.4) are very limited. They usually include provision for wearing hard hats and also raincoats during rainy season. In terms of employment generated (Indicator 6.5) and peace and order problems (Indicator 6.6), these are readily available and can easily be gathered from the forest manager. Indicator 6.7 measures the number and extent of tree plantation areas available for research, education, recreation and for direct use and benefit of local communities. The data required to estimate this indicator can be provided by the tree planters themselves but not all plantations have areas for these purposes.

Community participation is also highlighted in all tree plantation management. Tenure and user rights (Indicator 6.8 and 6.9) are considered as legal and customary rights by the tree farmers as well as by the government. Local communities and indigenous people are allowed by tree farmers to participate in their key activities (Indicator 6.10).

ISSUES AND RECOMMENDATIONS

1. There is some difficulty in assessing information on private investment and reinvestment because of business confidentiality. It is necessary that during the process of ascertaining this indicator the researcher should develop a questionnaire that would lead to the determination of the amount of investment and reinvestment. DENR may also require the smallholder tree plantation owner to submit an annual report for easier monitoring of this indicator.
2. Some indicators require prior research with other agencies before their values can be determined. For instance, the indicator of the ratio of domestic production of forest products to the processing capacity of forest-based industries in the entire region would need prior research on the number of processing mills and their rated capacity. This indicator cannot be collected directly from the tree plantation owners so it is necessary that the researcher conduct more intensive data gathering from other concerned agencies to be able to compute indicators such as this.
3. The study indicates that biological diversity as a criterion of sustainability is not applicable in smallholder tree plantations. The purpose for which plantations are being developed is mainly for business and in most cases the species selected for planting do not promote biodiversity. This criterion, therefore, should be required as an indicator of sustainability among tree planters. However, they may be encouraged to monitor biological species within their plantation area that could provide a basis for future inclusion of this criterion in the C&I for assessing sustainability of smallholder tree plantations.
4. Due to limited funds, the results of the study have been presented among members of the association of tree planters in Caraga region only. The association has adopted and endorsed the C&I to the Regional Development Council but the applicability of the identified C&I in other regions is still uncertain. Therefore, there is a need to validate or replicate the study in other regions to come up with a national C&I for assessing sustainability of smallholder tree plantations.
5. The tree planters favourably endorsed the use of C&I as a self-assessment monitoring tool but the tree planters are concerned about the high cost that will be involved once the identified

C&I are used for certification purposes. The individual tree planters stated that they could not shoulder the cost associated with certification using the identified C&I. It is imperative, therefore, to develop a system for certifying tree farmers by integrating individual tree farm areas into one management unit for single certification purposes.

CONCLUSIONS

Based on the results of the study, the following conclusions can be drawn:

1. Six criteria and 41 indicators as shown in Table 1 may be applied C&I for assessing sustainability of smallholder tree plantations.
2. A participatory approach is necessary in developing, determining and identifying sustainable C&I for smallholder tree plantations. By involving the different stakeholders including the tree planters, People's Organizations, furniture makers, wood processors, and DENR it is possible to gain an idea of the situation in the area which to stakeholders may not be important but nonetheless is relevant in project planning, implementation and monitoring.
3. C&I can be used as an effective monitoring tool in describing or assessing the sustainability of smallholder tree plantations, particularly with regard to socio-economic and bio-physical conditions.
4. C&I can be used as a tool in addressing the increasing problem of inadequate wood supply, rural poverty and continuous forest destruction.

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