



**Food and Agriculture Organization of the United Nations  
(FAO)**



*Technical Synthesis Report*  
**Strengthening Monitoring, Assessment and  
Reporting on Sustainable Forest Management  
(GCP/INT/988/JPN)**



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**Cover photo:** Forest resource survey in the lowland dipterocarp forest in Peninsular Malaysia. Courtesy of Masakazu Kashio

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## List of Abbreviations

AFIP	Academy of Forest Inventory and Planning (of China)
ASEAN	Association of Southeast Asian Nations
CBD	Convention on Biological Diversity
CIFOR	Center for International Forestry Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COFO	The Committee on Forestry
C&I	Criteria and Indicators (on Sustainable Forest Management)
CPF	Collaborative Partnership on Forests
FA	Forestry Administration (of Cambodia)
FAORAP	FAO Regional Office for Asia and the Pacific
FCT	Forest Carbon Tracking Task
FIPI	Forestry Inventory and Planning Institute (of Vietnam)
FMB	Forest Management Bureau (of the Philippines)
FMU	Forest Management Unit (FMU)
FRA	Global Forest Resources Assessment
GEF	Global Environment Facility
GEO	Group on Earth Observation
GEOSS	Global Earth Observation System of Systems
GHG	greenhouse gases
GIS	Geographic information system
GIZ	German International Cooperation
GLCN	Global Land Cover Network
ICIMOD	International Centre for Integrated Mountain Development
ICRAF	International Centre for Research in Agroforestry
IIRS	Indian Institute of Remote Sensing
IPCC	Intergovernmental Panel on Climate Change
INBAR	International Network on Bamboo and Rattan
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forest Research Organizations
LCCS	Land Cover Classification System
LOA	Letter of Agreement
MAR	Monitoring, Assessment and Reporting (of Forests)
MOU	Memorandum of Understanding
MRV	Measurement, Reporting and Verification
NFI	National forest inventory
NFP	National Forest Programme
NFMA	National Forest Monitoring and Assessment
NSC	National Steering Committee
PSP	Permanent sample plot
REDD	Reducing Emissions from Deforestation and Forest Degradation
ReFOP	ASEAN-German Regional Forest Programme
SAARC	South Asian Association for Regional Cooperation
SFA	State Forestry Administration (China)
SFM	Sustainable forest management
SOPAC	Pacific Islands Applied Geoscience Commission
SPC	Secretariat of the Pacific Community
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFF	United Nations Forum on Forests
UNFCCC	United Nations Framework Convention on Climate Change
VDoF	Vanuatu Department of Forests

## Basic Glossary

### *Monitoring*

A process of regular periodic, quantitative or qualitative measurements or observations of a set of parameters or variables for identified use (assessment).

### *Assessment*

A process of analysis and synthesis of information for identified use of information (reporting), focusing on actions, and situations and trends of stocks, goods, and services of forests along ecological, social and economic dimensions.

### *Reporting*

A process of dissemination of results for identified use (policy, planning and management actions at various levels) to achieve progress towards sustainable forest management (SFM).

### *Sustainable forest management*

The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems (MCPFE; FAO).

### *Database*

One or more structured sets of data, managed and stored as a unit and generally associated with software to update and query the data.

### *Information system*

An integrated combination of computer hardware, software and databases used to view and manage information. Information systems are also called database.

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## Executive Summary

The Japan-funded project “Strengthening Monitoring, Assessment, and Reporting on Sustainable Forest Management in Asia (GCP/INT/988/JPN)” was implemented from April 2006 to December 2010. The project aimed to facilitate harmonization of forest MAR in the Asia-Pacific region. It consisted of: (i) global activities to develop overall frameworks and guidelines, based at FAO-Headquarters from 2006 to 2007; and (ii) regional/national activities to support countries’ activities in line with the developed MAR frameworks and guidelines, based at the FAO Regional Office for Asia and the Pacific (RAP) for the whole project period.

Twenty-seven countries nominated focal points, out of which 13 countries collaborated intensively with the project for pilot MAR activities on development of national Criteria and Indicators (C&I) systems, reporting harmonization with reference to the Global Forest Resources Assessment (FRA), improvement of field inventory, database management systems, stakeholder networking, and other subjects of forest MAR. The project also collaborated with ASEAN to support development of ASEAN C&I reporting systems and formats, and the Secretariat of the Pacific Community (SPC) to build a sub-regional MAR network and elaborate field inventory techniques for Pacific Islands, building on FAO’s manual for the National Forest Monitoring and Assessment (NFMA). The project organized 14 major workshops with collaborating organizations on planning and mid-term review, reporting harmonization, forest inventories, satellite monitoring, and database management.

The project made considerable efforts to strengthen harmonized forest MAR systems in the Asia-Pacific region with a series of regional and national training workshops on MAR and pilot activities in selected countries. The countries could improve knowledge and skills on thematic MAR activities through pilot MAR activities with their own initiatives. It will be necessary to intensify follow-up efforts with other related programmes (e.g. NFMA, FRA, UN-REDD, etc.) in prioritized thematic topics. Countries will have to continue to elaborate and mainstream MAR policies and programmes into overall national forest policies and programmes with various national stakeholders and international organizations, to enhance SFM and facilitate effective budget allocation. FAO is also expected to follow up and include MAR activities in its regular programmes or other Trust Fund projects. The MAR project was aimed at overall development of MAR aspects at the initial stage, while follow-up programmes would focus on specific thematic subjects for more intensive technical assistance to countries and partner organizations.



# 1. Introduction

FAO implemented the trust fund project “Strengthening Monitoring, Assessment and Reporting (MAR) on Sustainable Forest Management” (GCP/INT/988/JPN) at the Headquarters and the Regional Office for Asia and the Pacific (RAP) from April 2006 to December 2010. This project was financed by the Government of Japan. Twenty-seven countries and two regional organizations nominated focal points for the project, out of which 15 countries and two organizations collaborated more intensively with the project through implementation of national or regional forest-related MAR programmes. These programmes focused on improvement and harmonization of forest reporting systems, development of satellite-based or field-level forest monitoring systems, and updating of forest information systems. The project also interacted with international stakeholders involved in forest MAR and other forest-related reporting processes to discuss the harmonization of forest MAR systems at the international level. The project was implemented in close collaboration with major FAO programmes involved in forest MAR processes, especially the National Forest Monitoring and Assessment (NFMA), the Global Forest Resources Assessment (FRA), Global Land Cover Network (GLCN), and recently the United Nations Programme for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD).

The MAR project has documented and analyzed forest MAR systems at national, regional, and international levels, national needs and capacities in the Asia-Pacific region, as well as trends of international level developments. A technical synthesis of these complex project activities is necessary to capture the outcomes and lessons learned for planning similar activities in the future.

This report first aims to synthesize all the work undertaken by the Project. It further attempts to review technical aspects of activities in the MAR project through analyzing outcomes of national, regional and international activities. The report analyzes the project linkages with related key international programmes, and results of individual pilot regional or national activities and their relationship with international programmes or guidelines on MAR. The report concludes with an evaluation of the effectiveness of the MAR project in achieving its overall objectives to improve and harmonize forest-related MAR in the Asia and the Pacific region.

## **2. Outline of the MAR project**

### **2.1. Background**

The United National Conference on Environment and Development (UNCED) in 1992 developed a set of “Forest Principles” that encouraged and guided the implementation of SFM globally in conformity with multiple functions and values of forest resources. The Collaborative Partnership on Forests (CPF) has followed up this task by further promoting the development of forest monitoring, assessment and reporting (MAR) for SFM, recognizing that such MAR should be simple in reporting and action-oriented both at the international and national levels. At the international level, it should provide opportunities to share experiences among countries and other stakeholders and to identify actions that could be taken at various levels to support SFM. At the national level, it should catalyze national discussions, analyses and actions that promote SFM. Finally, at all levels, the MAR should help to clarify the contribution of forests to the global environment and to human well-being (FAO/GoJ 2006).

There is a need to harmonize and improve international reporting on forests to reduce reporting burdens on countries and improve the efficiency and utility of such monitoring and reporting. Many international and regional processes, including the Global Forest Resources Assessment (FRA) of FAO, request international reporting on different aspects of forests or on the same aspect of forests but with varying definitions. The extent and quality of national responses to these efforts vary among countries as well as among the processes. In most of the countries such monitoring and reporting are not related to policy development and planning, thus reducing their utility.

Current national forest information systems in most of the Asian and Pacific countries are underdeveloped and non-robust, lacking necessary and consistent information. They do not have sufficient capacity and necessary linkages to promote SFM. The current regimes of forest management in Asian and Pacific countries do not necessarily have positive correlation with sustainability. The quality and extent of the information base (national forest inventories/NFIs) for MAR vary widely among countries in Asia and the Pacific. Forest-related MAR processes in most of the countries, therefore, are underdeveloped, poorly implemented and not linked to the development of forest policies and the national planning processes. This poor state of MAR in the region further worsens the spatial and temporal inefficiencies of the forest management regimes in Asian and Pacific countries.

## 2.2. Objectives and expected outcomes

The main objective of the project is to develop a globally harmonized forest-related national MAR system that directly contributes to the improvement of SFM. The project plans to initiate a system of regular and scientific collection, analysis, and reporting of forest-related information. This should be coupled with enhanced access and sharing with civil societies to facilitate better informed national-level decision making and improved formulation of forest policies and management planning (FAO/GoJ 2006).

Specific objectives of the project include:

- a. Develop national and regional networks to share information, experience and knowledge within and among countries in the Asia-Pacific region.
- b. Coordinate harmonization and broadening of national MAR systems in the region.
- c. Identify information needs on forests through national networks with a linkage to international policy dialogues on global issues like biodiversity, soil conservation, and climate change.
- d. Mainstream forestry at the national level through strengthening linkages among forest, environmental, social and economic policies and accounting.
- e. Facilitate the integration of SFM with overall sustainable development processes in these countries.
- f. Disseminate information on forests and forestry development to all national stakeholders.

Expected outcomes and activities at global and national levels include:

- Current status and issues to be tackled regarding MAR on SFM are identified, and measures are taken to resolve those issues.

### *Global level*

- Identifying and prioritizing key international programmes, processes, protocol and institutions that demand national reporting, which are relevant to MAR and are important for the Asia region.
- Initiating the process to develop project linkages with identified key international programmes, processes, protocol and institutions.
- Identifying and prioritizing key project countries in the Asian region.

### *National level*

- Establishment of MOUs with selected countries, including nomination of National Project Coordinators and setting up of National Steering Committees.
  - Identification of major stakeholders in MAR on SFM in the selected project countries and at the regional level.
  - Conducting studies and training workshops at regional, sub-regional and national levels for raising the awareness of relevant national personnel, developing country reports using the framework and the guidelines to review the information, and identification of issues and measures relating to MAR for SFM.
- Approaches to compile, assess and report relevant information on forest management, in accordance with internationally and/or regionally developed systems, are better understood; and steps taken to incorporate them into existing national information management framework.

### *Global level*

- Developing an international framework to review and analyze the available national, regional and global information for: (i) description of the current national status of forests, along ecological, social, economic and institutional dimensions of forests, that is appropriate to understand the interactions with national and international contexts in which forests reside; and (ii) identification and prioritization of the national issues to be tackled as regards MAR on SFM.
- Developing an internationally harmonized set of technical guidelines for establishment of national and regional MAR on SFM, that is compatible with the various international processes, including rationale, definitions of terms, alternative approaches for information compilation, and alternative approaches for policy assessment and review.

### *National level*

- Organizing regional, sub-regional and national level workshops to initiate establishment of an effective national and regional MAR on SFM with initiation of activities like: (i) harmonization of definition of terms; (ii) identification of alternative approaches for data compilation and review; and (iii) building capacities by providing alternative basic methodologies for review of forest policies and linking them with national planning processes.

- Approaches to incorporate relevant information on forest management into forest policy assessments and review processes are better understood and steps taken to implement them.

*Global level*

- Developing a set of internationally harmonized elements or variables for a database that may facilitate the implementation of MAR through appropriate description of the status and development of trends in forest management.

*National level*

- Organizing regional, sub-regional and national level workshops to promote the establishment of a national and regional database of information on internationally harmonized elements or variables that facilitate appropriate description of the status and assessment and review of trends in national forest management and policies.
- Information-sharing networks, for enhancing effectiveness and development of the MAR, are developed at international and national levels.

*Global level*

- Developing an information-sharing network for enhancing effectiveness and development of the MAR among global, regional, and national focal points of various forest-related international processes.

*National level*

- Organizing regional, sub-regional and national level workshops to facilitate the development of an information-sharing network of regional and national focal points.

### **2.3. Approaches**

The project was formulated to accomplish its objectives in two phases. The Development Phase spreads over the first two years of the project and focuses on: (a) international activities like the establishment of linkages with forest-related processes and the development of a globally harmonized framework, guidelines and database structure, including pilot testing in some countries; and

(b) a set of national activities that initiate and facilitate the implementation of the harmonized MAR on SFM.

The Implementation Phase spreads over the remaining three years of the project period and its detailed design was finalized on the basis of a review of the activities and outputs of the first phase. This phase focuses on the implementation of the harmonized MAR on SFM, including facilitation in the establishment of a database at the national level in selected project countries within the Asia and the Pacific region through training, reviews, studies, workshops and expert consultations.

### **3. Global/regional activities on forest monitoring, assessment and reporting (MAR) – International contexts of forest MAR harmonization**

This section describes the overall MAR-related processes at FAO and other international organizations, with which the MAR project was formulated drawing on their documents.

#### **3.1. Situations of MAR at the global level**

##### **3.1.1. FAO**

Programmes of FAO related to forest MAR include the Global Forest Resources Assessment (FRA), National Forest Monitoring and Assessment (NFMA), Global Land Cover Network (GLCN), and Measurement, Reporting and Verification (MRV) under the UN-REDD programme (Reducing Emissions from Deforestation and Forest Degradation). The MAR project had vital interactions with these programmes in technical orientations to countries, whereas it had to make adjustments to countries' needs and situations in national MAR development and harmonization.

##### *Forest Resources Assessment (FRA)*

The Global Forest Resources Assessment (FRA) is based on data that countries provide to FAO in response to a common questionnaire. FAO then compiles and analyses the information, and presents the current status of the world's forest resources and their changes over time. Over the years, the scope of the assessments has gradually expanded. The first assessments were focused on wood supply in response to fears of a wood shortage after the Second World War. Today, the assessments have a much wider scope, providing a holistic perspective on global forest resources, their management and uses. By addressing seven broad topics aimed at monitoring progress towards SFM, the Global Forest Resources Assessments provide valuable information to policy makers in individual countries, to international negotiations and arrangements related to forests, and to the general public.

The seven broad topics, also known as the thematic elements of SFM, are as follows (FAO/FRA 2010):

- (i) Extent of forest resources and their contribution to the global carbon cycle
- (ii) Forest health and vitality
- (iii) Forest biological diversity

- (iv) Productive functions of forests
- (v) Protective functions of forests
- (vi) Socio-economic functions of forests
- (vii) Legal, policy and institutional framework related to forests

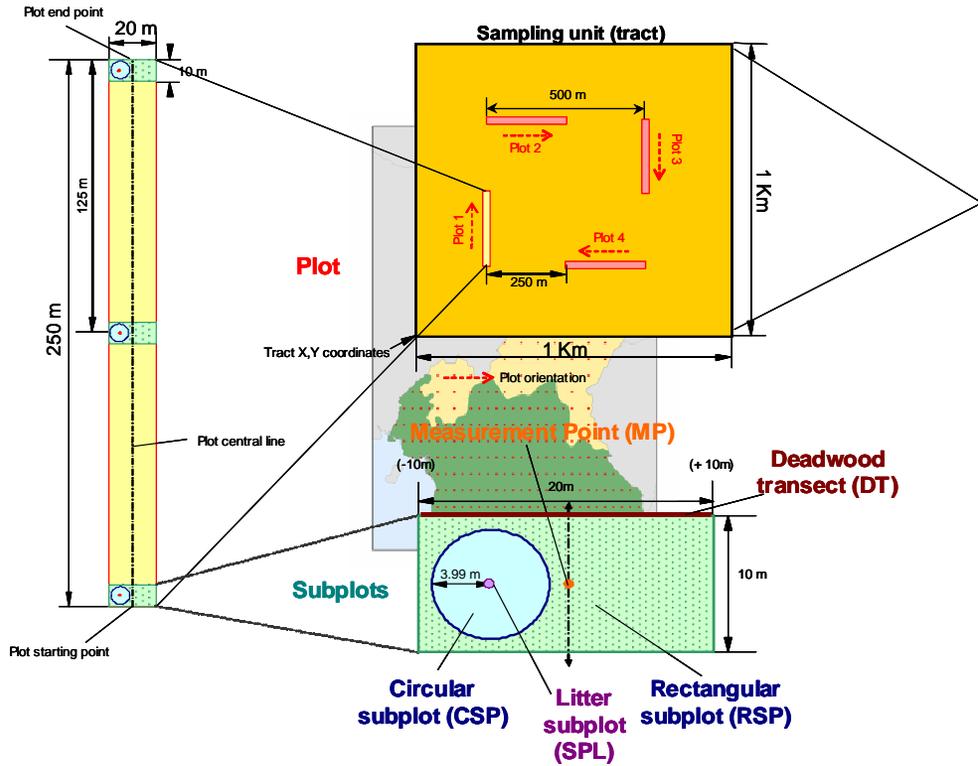
#### *National Forest Monitoring and Assessment (NFMA)*

The need for improving national forest monitoring systems is overwhelming as the demand for information has never been greater. Upon request, FAO supports countries in their efforts to close this knowledge gap by implementing field inventories and establishing forest information services. FAO's programme to support holistic and cost efficient national forest monitoring and assessment (NFMA) has been active since 2000 in a growing number of countries. What started as a series of pilot projects has now developed into a full-scale support programme for national forest monitoring and assessment (NFMA) and integrated land use assessments (ILUA) (FAO/NFMA 2010).

The NFMA provides a basis for national-level analysis and planning, broadens the knowledge base on forestry in a country, and enhances national capacities to monitor land uses and trends. Statistical rigor makes it possible to aggregate findings at the national level, thus creating new knowledge that outlines interactions and interdependencies between forests and other land uses.

The methodology is based on nation-wide sampling and field data collection. While fieldwork is the backbone of the inventory process, remote sensing is used as a complementary tool to map land uses and land use changes on full cover or a sample basis. Where feasible, ecological zoning can be used to stratify and intensify the fieldwork in critical areas. In the NFMA, a systematic sampling of a tract, a land-use section, plots and sub-plots is applied for field data collection with permanent stratification according to ecological zones. Clustered plots and nested plots are included in the sampling system. Field data are recorded on site with the help of people who have local knowledge.

The assessment method is based on systematic sampling, applying units with nested plots and subplots to inventory different parameters (**Figure 1**). Inventory data are collected in the sample units by field teams with the involvement of local people who provide information on forest resources, dependence, utilization and management. Global Positioning System and current technological tools assist the fieldwork. Some countries also include additional parameters focused on household surveys that are used to gather a range of livelihood data. This data may then be analyzed by national experts to identify policy relevant indicators that can aid national level decision-making.



**Figure 1. NFMA Sampling Design Template**

*Global Land Cover Network (GLCN)*

In 2004, FAO and the United Nations Environment Programme (UNEP), with the financial and technical support of the Government of Italy, created the Global Land Cover Network (GLCN) to develop a global collaboration for facilitating a fully harmonized approach to preparation of reliable and comparable land cover and land cover change data for use in local, national and international initiatives. Objectives of the GLCN include:

- (i) Harmonize land cover definitions, classification systems, mapping and monitoring specifications.
- (ii) Develop standards for global mapping.
- (iii) Initiate building of a global database.
- (iv) Promote outreach initiatives on development methodologies and applications of land cover data.
- (v) Provide advisory services.
- (vi) Function as an international, politically neutral and not-for-profit clearinghouse for land cover information at global and regional levels (FAO/UNEP 2010).

### *Asiacover*

The Development and Applications of a Multi-purpose Environmental and Natural Resources Information Base for Food Security and Sustainable Development in South East Asia (Asiacover) was initiated in 2002 for preparation of a regional, standardized land cover map and multi-purpose natural resource database. It was also designed to support the development of a decision support system for an integrated approach for environmental monitoring, food security, and sustainable development in South East Asia (countries participating in Phase I: Cambodia, Lao PDR, Malaysia, Myanmar, Thailand, Vietnam, China Main (Yunnan)). Furthermore, the integration of biophysical data with socio-economic information will serve as a decision aid for environmentally sound decision-making. Its immediate objectives are:

- to establish a regional network of institutions concerned with land cover mapping, land use planning, natural resource assessments, food security and environmental monitoring (in cooperation with UNESCAP);
- to define a set of common standards (land cover classification, data base structure, map geometry, cartographic standards socio-economic variables etc.) to be used for the project implementation; and
- to develop a regional Web-based GIS Information System and database at the scale of 1:250,000 or better containing bio-physical and socio-economic data relevant to food security and sustainable development.

In Asian countries, national training and harmonization workshops were held in China, India, Mongolia, and Vietnam to help elaborate national land cover maps.

### *Measurement, Reporting and Verification (MRV)*

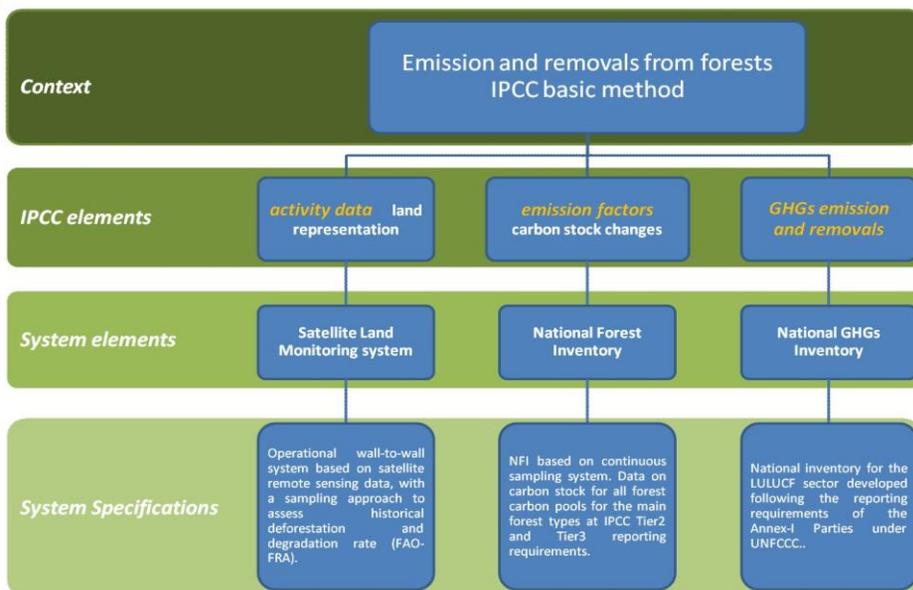
FAO supports countries on technical issues related to forestry and the development of cost effective and credible Measurement, Reporting and Verification (MRV) processes for emission reductions under the REDD+ (Reducing Emissions from Deforestation and Forest Degradation). At the international level, FAO fosters improved guidance on MRV approaches, including consensus on principles and guidelines for MRV and training programmes.

One of the key elements for REDD+ implementation is the development of transparent, comparable, coherent, complete and accurate measurement, reporting and verification (MRV) national systems. These systems are a guarantee that Parties will effectively meet their respective mitigation commitments under the new UNFCCC mechanism which would include REDD+ (UN-REDD 2010). The solutions proposed by FAO's framework proposal for national MRV systems are compliant with the requirements of the Intergovernmental Panel on Climate Change (IPCC), developed at the request

of the United Nations Framework Convention on Climate Change (UNFCCC), and reflect the most common and robust approaches currently used by Annex I countries.

The framework proposal aims to explain the concepts of REDD+ requirements under the UNFCCC and describes all the elements of a fully operational MRV system that follows IPCC guidance with the objective of guiding countries towards developing a National GHG Inventory to report on REDD+ activities. As such, the framework proposal provides the basis to strategically strengthen in-country technical capacities in relevant institutions.

Ultimately, the outcome of the MRV system will be to support countries to develop their national forest GHG inventory to report on REDD+ activities to the UNFCCC Secretariat. The IPCC’s most commonly used approach is to estimate GHG emissions by relating information on the extent to which a human activity takes place (activity data, AD) to coefficients that quantify the emissions or removals per unit activity (emission factors, EF) (**Figure 2**). In response to this, the Measurement and Reporting components of the proposed MRV system consist of the following three components: (a) a Satellite Land Monitoring System to assess activity data on forest area and forest area changes; (b) a National Forest Inventory to assess emission factors on carbon stocks and carbon stock changes; and (c) a National GHG Inventory to estimate and report anthropogenic emissions by sources and removals by sinks.



**Figure 2. The three basic carbon-related MRV components and their relation to the IPCC guidelines**

Finally, countries will each need to establish an institutional body responsible for the coordination of administrative and technical arrangements, the overall quality of reported estimates, monitoring of safeguards and the successful implementation of REDD+ policies at the national level.

### **3.1.2. Major international/regional reporting processes**

*United Nations Framework Convention on Climate Change (UNFCCC)/  
Intergovernmental Panel on Climate Change (IPCC)*

- UNFCCC reporting guidelines

The core elements of the national communications for both Annex I and non-Annex I Parties are information on emissions and removals of greenhouse gases (GHGs) and details of the activities a Party had undertaken to implement the Convention. National communications usually contain information on national circumstances, vulnerability assessment, financial resources and transfer of technology, and education, training and public awareness; but the ones from Annex I Parties additionally contain information on policies and measures (UNFCCC 2010).

- The 2006 IPCC Guidelines

The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 Guidelines) were produced at the invitation of the UNFCCC to update the Revised 1996 Guidelines and associated good practice guidance which provide internationally agreed upon methodologies intended for use by countries to estimate greenhouse gas inventories to report to the UNFCCC (IPCC 2006).

National inventories contain estimates for the calendar year during which the emissions to (or removals from) the atmosphere occur. Where suitable data to follow this principle are missing, emissions/removals may be estimated using data from other years applying appropriate methods such as averaging, interpolation and extrapolation. A sequence of annual greenhouse gas inventory estimates (e.g. each year from 1990 to 2000) is called a time series. Because of the importance of tracking emissions trends over time, countries should ensure that a time series of estimates is as consistent as possible.

The 2006 Guidelines provide worksheets to assist with the transparent application of the most basic (or Tier 1) estimation methodology. The following greenhouse gases are covered in the 2006 Guidelines, having global warming potentials (GWPs) identified by the IPCC: carbon dioxide (CO<sub>2</sub>); methane (CH<sub>4</sub>); nitrous oxide (N<sub>2</sub>O); hydrofluorocarbons (HFCs); perfluorocarbons

(PFCs); sulfur hexafluoride (SF<sub>6</sub>); nitrogen trifluoride (NF<sub>3</sub>); trifluoromethyl sulfur pentafluoride (SF<sub>5</sub>CF<sub>3</sub>); halogenated ethers; and other halocarbons not covered by the Montreal Protocol.

The 2006 Guidelines also provide information for the reporting of the following precursors: nitrogen oxides (NO<sub>x</sub>), ammonia (NH<sub>3</sub>), non-methane volatile organic compounds (NMVOC), carbon monoxide (CO) and sulfur dioxide (SO<sub>2</sub>), although methods for estimating emissions of these gases are not given here.

#### *Conservation on Biological Diversity (CBD)*

The objective of national reporting is to provide information on measures taken for the implementation of the Convention and the effectiveness of these measures, helping various stakeholders to analyze current situations and gaps and formulate adequate action plans (CBD 2010).

#### *United Nations Forum on Forests (UNFF)*

Monitoring, assessment and reporting is one of the six principal functions of the Forum. At UNFF's first session, countries identified three areas related to this function:

- (a) progress in implementation of the IPF/IFF proposals for action;
- (b) progress towards sustainable management of all types of forests; and
- (c) review of the effectiveness (i.e., of the international arrangement on forests).

Countries further agreed that voluntary reporting to the Forum would begin at the second session of UNFF with a focus on implementation of the IPF/IFF proposals for action. UNFF1 did not, however, decide upon guidelines or a format for national reports to UNFF2. At UNFF2, the Forum requested the UNFF Secretariat to develop a suggested reporting format.

Voluntary reports to UNFF are designed to be useful planning tools for countries. The reporting process is intended to help countries assess their progress in implementing IPF/IFF proposals for action, analyze lessons learned, identify gaps and obstacles that the country might wish to address, and catalyze enhanced cooperation and coordination on forests among government agencies and other stakeholders in the country. The reports are intended to help identify actions that may be taken at regional and international levels, including by UNFF, to facilitate countries' efforts to achieve SFM.

#### *ITTO Criteria and Indicators (C&I)*

The ITTO pioneered the development of criteria and indicators (C&I) for the sustainable management of natural tropical forests in the early 1990s and has

continued to provide leadership in their review and improvement in partnership with FAO and other organizations. The purpose of the ITTO C&I is to provide member countries with a tool for monitoring, assessing and reporting changes and trends in forest conditions and management systems at the national and forest management unit (FMU) levels. By identifying the main elements of SFM, the C&I provide a means of assessing progress towards SFM and the ITTO Objective 2000, which is “to enhance the capacity of members to implement a strategy for achieving exports of tropical timber and timber products from sustainably managed sources” (ITTO 2010). The information generated through the use of these C&I will help communicate more effectively the status of efforts towards SFM.

### **3.1.3. Global initiatives on forest and carbon monitoring**

#### *Group on Earth Observation (GEO)*

The Group on Earth Observations (GEO) is coordinating efforts to build a Global Earth Observation System of Systems (GEOSS). The GEO is a voluntary partnership of governments and international agencies, launched in response to calls for action by the World Summit 2002 on Sustainable Development and by the G8 leading industrialized countries. It provides a framework within which these partners can develop new projects and coordinate their strategies and investments.

The Forest Carbon Tracking Task (GEO FCT) has been established to support countries wanting to establish national forest-change, carbon estimation and reporting systems (GEO/FCT 2010). It will facilitate access to long-term satellite, airborne and *in situ* data, provide the associated analysis and prediction tools, and create the appropriate framework and technical standards for a global network of national forest carbon tracking systems. The task follows the guidelines set out by the UNFCCC. Its outputs will be available to support interested countries in their efforts to implement the Convention. The task is being carried out by a partnership of GEO member governments, key UN bodies, space agencies, the science community and the private sector.

#### *Multi-resource forest inventory: A case of CarboInvent as a reference*

The UNFCCC aims at stabilizing the concentration of greenhouse gases (GHG) in the atmosphere. The IPCC has prepared Guidelines for Parties to the UNFCCC to compile inventories of GHG emissions and removals, including in agriculture, forestry and other land-use activities. When preparing these inventories, Parties should have in place a “national system” for GHG reporting which is based on sound science and follows the principles of transparency,

consistency, and verifiability, while at the same time being “state-of-the-art”, as accurate as possible, and cost-effective.

CarboInvent provides methodologies for combining different data sources and methods towards an improved estimation of carbon stock changes in forests at the national and European levels, for the purposes of the United Nations Framework Convention on Climate Change, and the Kyoto Protocol. The methodologies obtained within CarboInvent will be useful to national inventory agencies, allowing an improved quality of national-/EU-level GHG reporting.

### *Collaborative Partnership on Forests (CPF)*

The Collaborative Partnership on Forests (CPF) is a voluntary arrangement among 14 international organizations and secretariats with substantial programmes on forests (CIFOR, FAO, ITTO, IUFRO, CBD, GEF, UNCCD, UNFF, UNFCCC, UNDP, UNEP, ICRAF, World Bank, and IUCN) (CPF 2010) (**Figure 3**). The CPF's mission is to promote the management, conservation and sustainable development of all types of forest and strengthen long-term political commitment to this end.

The CPF Portal on Forest Reporting was designed to help users find information related to national reporting on forests to various international organizations, institutions and instruments. The portal is maintained by FAO in close collaboration with other members of the CPF Task Force on Streamlining Forest-Related Reporting. To help reduce the reporting burden on countries and improve efficiency of reporting, members work to reduce and streamline reporting requests, synchronize reporting cycles, harmonize data collection methods, increase data comparability and compatibility, and facilitate the accessibility and flows of existing information. The process to harmonize forest-related definitions is closely linked to the activities of the CPF. The definitions included are highly relevant to the Forest Resources Assessment.



**Figure 3. Member organizations of CPF**

### **3.2. Activities/products under the MAR project at the global level**

With reference to the above initiatives at FAO and various other organizations, the MAR project implemented the following activities at the global and regional levels.

#### **3.2.1. Manuals/guidelines**

##### *Guidelines for national networks on harmonization of MAR*

The main objective of establishing a national network of forest-related stakeholders in a country is to enhance the capacities and efficiency of the national MAR systems. It aims at harmonizing, streamlining and improving forest-related knowledge and information management at the national level through regular, technical and thematic dialogues; and better coordination among various stakeholders, coupled with enhanced access and sharing with the civil society. Some other objectives of the national network include provision of better information on a regular basis and improvement of linkage of MAR with national forest policies and planning. The national network assumes that best contributions come from the forest-related agencies and individuals at the national level and what is needed is to connect to what is known and make it available to all. Further, that an open institutional environment stimulates and encourages improvement (FAO 2006: 19).

The principles for the national network are ownership and self-reliant maintenance by countries, efficient and economized management, open and transparent for all forest-related stakeholders, integration with ongoing programmes and activities, and regular and multidisciplinary consultations for sharing of information. The network should be established within a forest-related organization, inviting all willing national-level forest-related stakeholders. The network should take advantage of information technology such as webpages and other available media to become visible and inform about its establishment and activities. The webpage should be added to the existing forest-related country website and regularly updated for the benefit of the civil society at large. The webpage should provide links to relevant technical expertise within the network and associated agencies, technical materials, and information on opportunities for building capacities and better avenues for work. The network should organize technical and thematic meetings regularly to focus on priority topics. It should also develop and maintain its link with various forest-related national, regional and international agencies and processes, by exchanging information and expertise during meetings or other events. Network meetings should be organized in conjunction, or back to back, with other national meetings so that time and resources are economized while the presence and participation of the members are maximized.

*Manual on Deforestation, Degradation, and Fragmentation Using Remote Sensing and GIS*

After analyzing the basic concepts of deforestation, forest degradation and fragmentation as well as their agents, causes and consequences, a manual was produced that presented: techniques for remote sensing of deforestation, degradation, and fragmentation, including the availability, accessibility, and affordability of remote sensing data and their recent advances; methodology to assess and monitor deforestation, degradation and fragmentation using remote sensing and GIS; data basis and modeling; cursor operations and image display as well as magnification and overlay operations using the ERDAS imagine; and materials for hands-on exercise on opening a raster file, view menu on view window, spatial modeler to create NDVI images (**Figure 4**), image classification; and change detection of coastal vegetation (Tejaswi 2007).

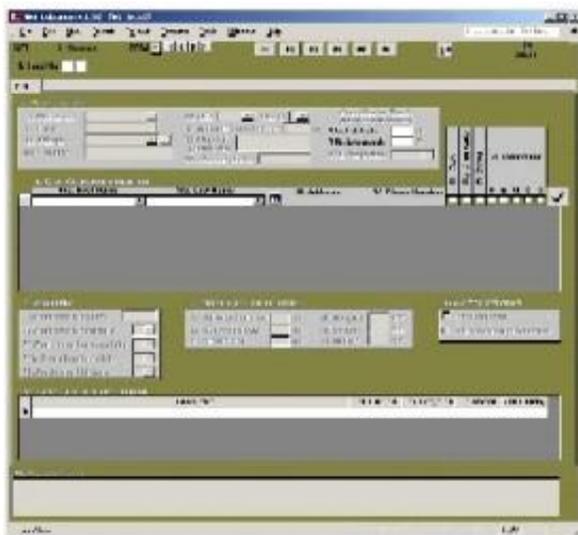
Description of the Model Maker Tools	
	Use this tool to <b>select items</b> on the Model Maker page. Once selected, these graphics (or text) can be moved or deleted. Click and drag a selection box to select multiple elements. Multiple selected elements can be dragged to a new location as a unit. You can also use the arrow to double click on any of the graphics below to further define their contents.
	Creates a <b>raster object</b> , which is a single or layer-set of raster data typically used to contain or manipulate data from image files.
	Places a <b>vector object</b> , which is usually an Arc/Info coverage or an Annotation layer.
	Creates a <b>matrix object</b> , which is a set of numbers arranged in a fixed number of rows and columns in a two-dimensional array. Matrices may be used to store numbers such as convolution kernels or neighborhood definitions.
	Creates a <b>table object</b> , which is a series of numeric values or character strings. A table has one column and a fixed number of rows. Tables are typically used to store columns from an attribute table, or a list of values which pertain to individual layers of a raster layer-set.
	Creates a <b>scalar object</b> , which is simply a single numeric value.
	Creates a <b>function definition</b> , which are written and used in the Model Maker to operate on the objects. The function definition is an expression (like "a + b + c") that defines your input. You can use a variety of mathematical, statistical, Boolean, neighborhood, and other functions, plus the input objects that you set up, to write function definitions.
	Use this tool to <b>connect objects and functions together</b> . Click and drag from one graphic to another to connect them in the order they are to be processed in the model. To delete a connection, simply click and drag in the opposite direction (from the output to the input).
	Creates <b>descriptive text</b> to make your models readable. The Text String dialog is opened when you click on this tool.

**Figure 4. Model maker tools in spatial modeler**

*A GIS Primer on How to Illustrate Spatial Data and Information Generated through National Forest Inventories*

This study shows an example of application of GIS to illustrate how data and information generated in NFIs can be managed and displayed to decision makers to better understand the outcomes of NFIs. The study was based on data and information from the NFI of Lebanon, and building on the National Forest Assessment (NFA).

The report describes empirical methods of building a GIS pilot data model based on existing NFI data and information through: identifying data for the NFI and GIS model (processed NFI data, national NFI statistics including forest cover/land use maps, and auxiliary GIS datasets); creating a GIS connection to data in NFI database application (**Figure 5**); creating NFI map features in the GIS (creating features in tracts, plots, and sub-plots; grouping, multiplying and positioning the graphics of the tract features); creating themes for tracts, plots, sub-plots, land-use sections, trees, and reference points; and linking NFI map features with NFI data tables (Salinas 2007).



**Figure 5. F1 – Tract attributes form**

#### *Survey of NFIs in Asian countries*

The project conducted questionnaire surveys on NFIs in 19 Asian countries in early 2007 (FAO 2007: 24, 29-47). Although a few countries have a long history of forest inventories since the colonial periods, most countries have relatively shorter experience in NFI. A number of countries use remote sensing data for national-level forest cover assessment. Other than the more advanced countries, few of them can obtain data regularly due to the lack of financial or technical capacities. Sampling methods, sampling intensity, tree measurements and data collection for other variables vary among countries, depending on their experiences and capacities as well as outcomes of technical assistance by other countries. Only a few countries can continue NFI at permanent sample plots, whereas many countries face limitations in intensification and increase of plot surveys. They have to strengthen capacities for collection of data for thematic variables such as carbon and biodiversity.

Based on the survey, a regional network of experts on NFI was proposed during the NFI workshop in Beijing in 2007. However, the network was not functional due to the lack of clear initiatives from countries and funds.

### *Survey of forest monitoring in Pacific countries*

The project also conducted surveys for eight Pacific countries in 2007 (FAO 2007: 50). Countries have experience in utilizing remote sensing imagery and GIS to produce forest cover maps with some thematic information, but few of them can conduct remote sensing surveys regularly. Few countries are well experienced in NFIs or field plot surveys partly due to their dispersed geographical locations. Even more advanced countries find it difficult to continue field surveys on a regular basis.

Based on the survey and initial workshop, participants recommended the development of a sub-regional network for MAR for Pacific Island countries (PICs), which is being developed through several pilot MAR programmes initiated by the SPC.

### **3.2.2. International/regional workshops**

The following are summary outcomes of regional workshops organized under the project.

#### *Inception Workshop - Strengthening Monitoring, Assessment and Reporting on Sustainable Forest Management in Asia*

An inception workshop on the MAR project was convened in Sapporo, Japan, 24–28 July 2006, in collaboration with the Forestry Agency of Japan, ITTO, INBAR, and the FAO-Norway Project. The workshop aimed at introducing objectives and approaches of the project to participating national focal points and discussing an overall work plan (FAO



**Figure 6. Field trip during the Sapporo**

2006: 2). Fifteen member countries and nine organizations participated in the workshop (**Figure 6**). The meeting covered concepts and programmes of the project, methodologies for MAR, cases on MAR in selected countries, and review of international processes. A joint open forum with the participants of the 17th Montreal Process (MP) Group Meeting and a field visit were also implemented. Discussions were combined with deliberations by the Project Steering Committee on the last day. The workshop deliberated on the establishment of national networks of all national focal points to streamline and

harmonize the reporting and to enhance the participation of major stakeholders in planning and policy processes using MAR. The project countries recognized the importance of enhancing the use of MAR information in forest planning and formulation of forest policies. They also appreciated the need for improved national and regional estimates of forest cover and its dynamics, linked to existing national monitoring systems. There was consensus on the overall focus of the project to stimulate synergies of MAR activities at the national level, based on needs defined by the individual countries participating in the project. The project promised to work with countries to develop a detailed proposal for consideration at the next regional consultation in October 2006.

*Regional Workshop on Development of a Regional Umbrella Annual Plan of Activities under the MAR-SFM Project*

A Regional Workshop on Development of a Regional Umbrella Annual Plan of Activities under the MAR-SFM Project was held with 19 countries participating to develop a plan for a regional umbrella programme (RUP) under the MAR-SFM project until the end of 2007, while sharing common understanding of situations of current MAR activities in countries (FAO 2006: 20). The RUP consisted of joint regional activities initiated by FAO and individual national activities to be initiated by willing project countries. The RUP focused on development of national networks to harmonize forest-related national MAR systems, technical development for forest MAR, and strengthening policy development and planning through better use of MAR information. After plenary sessions on the scopes of RUP and MAR, as well as national networks, participants held group discussions, identifying a need for diagnostic studies on MAR, and awareness raising and capacity building. Issues included countries' financial capacities to sustain initiated activities beyond the project period. The project was requested to allocate its resources effectively for regional and national programmes based on the countries' priorities and needs.

Based on the workshop discussions, countries submitted proposals for small programmes. The project reviewed them under FAO's guidance for later collaboration and assistance. Several representative activities are presented below.

*Training Workshop on Harmonization of Land Cover and Forest Classification in Remote Sensing - Asia Pacific Region*

A Workshop on Harmonization of Forest and Land Cover Classifications using LCCS for the Asia-Pacific Region was held with 41 participants from 18 countries in Dehradun, India. The workshop programme consisted of presentations on the Land Cover Classification System (LCCS) with affiliated

software (GeoVIS, etc.), harmonization processes, FRA and its remote sensing (RS) component, and satellite-based forest monitoring as well as group discussions on harmonization (FAO 2006: 21). The participants discussed a need for the feedback of end-users to LCCS in different languages for better integration of their needs into the programme. The resource person stressed that LCCS was a fully open and flexible system in view of national and local differences, showing examples on the LCCS software.

Forest and land cover classification systems in the AP countries were reviewed in consideration of physiognomic categories and land use value, followed by discussions with participants and their group work. Some countries have already adapted national forest land classification to international standards. However, many other countries still have problems of inconsistent or ambiguous forest classification.

Group discussions highlighted the similarity and differences of forest definitions and classifications among countries and with international organizations, raising further needs for adjustment between the LCCS and national classification systems with common understanding.

The LCCS and GeoVIS are generally useful for required harmonization using remote sensing. However, there is a need to develop a specific module for forests with countries, as the current version of LCCS does not fit all forest classes very well. FAO and other organizations are expected to support countries to build up their capacities for forest resources assessment using RS, organizing follow-up national and regional training workshops. It is necessary to harmonize forest classification at the national level first, and for that purpose, networking of national institutions on resource assessments should be strengthened.

*Training Workshop on Broadening, Harmonization and Cross-Sectoral Integration of National Forest Inventories in Asia-Pacific Region*

A Workshop on Broadening, Harmonization and Cross-Sectoral Integration of National Forest Inventories in the Asia-Pacific region was held by FAO in collaboration with the State Forestry Administration (SFA), P. R. China and the International Network on Bamboo and Rattan (INBAR) from 26 to 31 March 2007 in Beijing, China. Fifty eight participants from 19 countries gathered at the workshop (**Figure 7**). The main objective of the workshop was to enhance common understanding of national forest monitoring assessment and reporting systems in Asia-Pacific countries with the overall goal of mainstreaming forestry at the national level (FAO 2007: 25).

Results of rapid surveys on NFI that had been conducted with the participants' deep engagement were presented during the workshop. Participants learned and discussed various sampling designs, techniques for data collection and statistical analysis, biomass and carbon estimation, scenario development, and environmental accounting. Further, the workshop also dealt with management of



**Figure 7. Field trip at the plantation site** Source: AFIP (2007)

information generated from NFI and mobilization of funds to implement regular and timely implementation of NFIs. The workshop discussions and deliberations highlighted similarities, differences, strengths and weaknesses in the NFIs, as well as indicated gaps of information and provided alternative sampling designs. The discussions indicated an urgent need for capacity building on data analysis and reporting as well as the significance of information sharing among different countries and sectors.

#### *A Workshop on Long-term Database Management for Sustainable Forest Management*

A Workshop on Long-term Database Management for Sustainable Forest Management was held at FAO-HQs on 22 October 2007 with ten participants. The workshop aimed at discussing long-term preservation of high-quality data for SFM, highlighting FAO perceptions, IT capacities, the potential roles of different actors, and a work plan on database management.

An integral process is needed to maintain digital data and other digital materials for current and future generations of users, spanning processes of long-term digital archiving and preservation that are essential to good data creation and management (Kailash 2007). The state of databases, information and knowledge and their use in planning and management is almost correlated with the state of forests, their management and consequently on their flows (goods and services). Beyond passive data storage, positive data preservation processes are essential at technical registry services through identification and validation of data formats, characterization of technical properties, careful planning with risk assessment, and execution using a framework for automated deployment of migration tools. FAOSTAT aims at long-term preservation of data by

incorporating metadata and new user interface through cross-sectoral aggregation and cross-domain integration with recent tools such as SMDX ver 2.0 and GAUL codes. The UN Statistic Division is developing a coherent database system for easier exchange of data with countries and other organizations.

Meanwhile, countries still need to develop effective methods to conserve and archive tremendous data on forests through capacity building in their computerization with mapping using remote sensing/GIS. A coherent data structure will have to be developed among various sectors at national and sub-national levels for easier data compilation at local and national levels. It was suggested to hold the next workshop in an Asian country with the assistance of focal points and resource persons from international organizations for deliberations on an effective framework of database management on MAR-SFM.

*Workshop on Monitoring, Assessment, and Reporting for Sustainable Forest Management in the South Pacific Region*

A Workshop on Monitoring, Assessment, and Reporting for Sustainable Forest Management in the South Pacific Region was implemented in Nadi, Fiji, from 10 to 12 October 2007. Its main objective was to strengthen the system of forest MAR in the South Pacific countries. Twenty-five participants attended the workshop from nine South Pacific countries and five organizations.

Various technical aspects of MAR were presented and discussed, including concepts and outcomes of the MAR-SFM Project, national forest inventories (NFIs), thematic assessment (biodiversity, biomass, carbon), remote sensing/GIS, land cover classification system (LCCS), database management, National Forest Assessment (NFA) in the Philippines, other countries' or organizations' experiences, and initiatives for regional collaboration on MAR-SFM (FAO 2007: 49).

The workshop recommended the strengthening of regional collaboration with countries and related organizations for harmonizing and broadening MAR, including the formulation of a long-term umbrella plan for the South Pacific countries on MAR and development of national/regional networks. FAO was expected to update and accommodate guidelines on MAR so that the countries stay abreast of current methodologies.

*Mid-term Tripartite Review Meeting on Strengthening Monitoring, Assessment and Reporting on Sustainable Forest Management*

A Tripartite Mid-term Review Meeting on the MAR project was held at the FAO Regional Office for Asia and the Pacific (FAORAP) during 16–19 September 2008. The purpose of the meeting was to review achievements of the MAR project and elaborate a plan of project activities until December 2010 among FAO, donor country (Japan), and 18 project countries (FAO 2008: 51). Thirty persons participated in the meeting comprised of presentations and discussions on the scope, achievements and issues of the project, outcomes of collaboration with countries, and the next steps of activities. Participants generally agreed on the effectiveness of project activities, while suggesting strengthening of project implementation for the remaining period. They underlined the significance of intensive efforts to develop harmonized MAR techniques and improvement of national capacities. Coordination with related programmes of FAO and other organizations would be essential to facilitate coherent project implementation. National MAR programmes should be accelerated to enhance capacity building of government staff in close linkage with the project. Outcomes of project activities at the global and national levels should be disseminated among Asia-Pacific countries by developing regional or sub-regional MAR networks. The project was requested to take necessary action according to the recommendations made.

*Regional Workshop on Strengthening of Harmonization of National Reporting to FRA 2010 and Other International Processes on Forests in Asia*

A Regional Workshop, *Strengthening of Harmonization of National Reporting to FRA 2010 and Other International Processes on Forests in Asia*, was convened in Kuala Lumpur, Malaysia, 13–16 October 2008. The workshop aimed to facilitate harmonization and streamlining of national reporting to international processes in the Asian region and to provide technical assistance to the national correspondents of FRA 2010 to ensure high-quality reporting in line with its specifications (FAO 2009: 52). Sixty-two persons from 22 countries and five organizations participated in the meeting. Presentations and discussions were made on international reporting systems and formats, the status of countries' reporting to FRA 2010 and other international processes, and the scope of harmonization of international reporting on forests.

Coordination among different national agencies and programmes is essential to update and harmonize reporting processes effectively in each country, while maintaining the consistency in national definitions. Terms, definitions and classifications of forests should be simple and flexible in order to be easily adapted to national definitions and ensure consistency in forest area assessment within a country over time. Participants also pointed out inconsistent terms and

definitions among international processes and countries, limited reporting capacities on specific thematic aspects, dispersion of data among various agencies, and lack of communications among them. Further clarifications would be required on thematic indicators for accurate assessments. An agreement on a global forest-type classification would be useful, whereas participants highlighted a difference in forest definitions between FAO and UNFCCC/IPCC. Countries still face deficiency in updated data collection, lack of proper tools and methodologies, and lack of unambiguous definitions and terms for varied variables.

Key reporting issues on major indicators discussed during the workshop suggested a necessity for substantive efforts to collate this type of forest-related information with various organizations at the national level. Development of a joint information framework and a common format with the CPF and individual reporting processes would be beneficial for countries to facilitate consistent reporting. Positive partnerships among national and international stakeholders should be maintained to ensure optimal harmonization of international reporting processes.

#### *Regional Workshop on Development of Effective Tools for Management of Forest Information for Sustainable Forest Management*

A Regional Workshop on Development of Effective Tools for Management of Forest Information for Sustainable Forest Management was held in collaboration with the Asian Institute of Technology (AIT) in Pathum Thani, Thailand, 14–17 September 2010. Eighteen participants attended the workshop from 16 countries, facilitated by FAO officers from RAP and HQs. The workshop aimed to provide participants with updated knowledge and skills on overall forest information systems.

The workshop consisted of lectures and exercises for each session, covering topics of overall forest information systems and results of recent project work on database management systems in Asian countries; open-source software for geospatial data management; GIS and remote sensing data with MODIS for near-real time forest fire monitoring; web map services, geo-portals and spatial data infrastructures; and data storage, processing and analysis for sample-based forest field surveys under the NFMA (FAO 2010: 56). The staff of AIT presented and demonstrated training activities of the Geoinformatics Center, including database development on disaster management and the MODIS Fire Information System. Participants learned and practiced database management systems and applied tools during the workshop. They also made presentations on forest database management in their countries, building on forest inventories

and remote sensing. Countries required harmonization of database formats for common use and sharing of forest-related data.

Participants requested follow-up training and pilot activities to build up national capacities for forest information systems in thematic areas at various levels, based on countries' specific needs. They solicited technical assistance from FAO and AIT to further support countries in developing national and regional forest information systems in the form of mini-projects, case studies, regional training, distance learning, and free software distribution. Countries are expected to collaborate with each other to share experience and expertise on forest information management by developing a regional network of experts. At the same time, the countries will have to develop effective national mechanisms to better influence decision makers on development of national forest information systems. It would be useful to establish a list of e-mail addresses of national experts to facilitate distribution of software.

#### *Regional Workshop on Updated Forest and Carbon Monitoring Technologies in Asia and the Pacific*

A Regional Workshop on Updated Forest and Carbon Monitoring Technologies in Asia and the Pacific was held in collaboration with the Japan Aerospace Exploration Agency (JAXA) and the Remote Sensing Technology Center of Japan (RESTEC) in Tokyo/Tsukuba, 27–29 October 2010. Eighteen participants from 17 countries attended the workshop. The workshop aimed to provide participants with updated knowledge and skills on overall forest and carbon monitoring technologies, drawing on recent activities of FAO, JAXA, RESTEC, other organizations in Japan, and other countries. The workshop consisted of lectures, discussions, and hands-on exercises on overall forest and carbon monitoring, including the GLCN, MRV, FRA-Remote Sensing Survey, and NFMA from the FAO side (FAO/JAXA 2010: 57).

Participants received information on the recent status of activities in JAXA/RESTEC such as ALOS/AVNIR-2, PALSAR, PRISM, GOSAT, and GEO/FCT, as well as other organizations in Japan. Then they shared presentations on forest monitoring activities with RS/GIS and inventories in the countries. It was concluded that they would require more clarifications, especially on methodologies of biomass estimation using SAR from densities, types and forms of trees in combination with optical sensors. Techniques have to be further developed to improve data accuracy through fixed validation procedures.

Participants discussed the needs of high-resolution imagery for accurate forest and land cover assessment with smaller Minimum Mapping Unit (MMU),

particularly in hard to access areas. Countries require small-scale forest assessments to estimate the fragmentation of natural forests as well as the development of small patches of woodlots. Airborne LiDAR would be helpful for countries despite its high costs. Ground surveys or national forest inventories have to be strengthened to ensure comprehensive forest and GHG inventories towards development of multi-resource inventories. They are essential for estimation of emission factors in Measurement, Reporting, and Verification (MRV).

Countries expect FAO to provide technical support for assessment of forest degradation using UNFCCC/IPCC guidelines under the REDD+ process, especially in elaborating and verifying MRV to improve national capacities for forest degradation assessment. FAO is expected to ensure the continuous availability of satellite imagery with time-series data to be used by countries (e.g., Landsat data for the past decades) and develop harmonized metadata systems, as has been done in several programmes.

Participants suggested flexibility in the application of forest classification systems and monitoring technologies in countries in view of diverse ecological conditions. Minimum-level harmonization of forest definitions and classifications would still be required at the international level, beyond which each country would be able to develop its own systems. Countries need improved thematic assessments for trees outside forests, biodiversity/habitat conditions, soils (carbon, moisture, etc.) and other variables. Suitable methodologies and indicators need to be elaborated to capture environmental indicators in integrated forest and carbon monitoring.

Participants acknowledged the value of hands-on exercises for ALOS/AVNIR-2 and PALSAR. They expect follow-up collaboration with JAXA/RESTEC to further examine and apply Japan's monitoring technologies.

### **3.3. Performances of global activities under the MAR project and their linkages with other international programmes: opportunities and gaps**

This section briefly reviews achievements of the MAR project and their linkages with the international programmes described above.

#### **3.3.1. Support for harmonization of forest-related MAR**

The MAR project coordinated with various forest-related reporting processes to facilitate harmonization of reporting formats and definitions or classifications,

and introducing the current status of work to countries during workshops. The project partially overlapped with other initiatives such as the CPF. It also provided supplementary assistance in FRA reporting by countries. A consultation workshop on reporting harmonization with FRA for countries in Asia-Pacific was organized, but its scope was limited to only one region. In addition, harmonization of international reporting processes and their reporting formats went far beyond the capacities and the authority of a single MAR project. It could only document the recent progress of various reporting processes and facilitate discussions among member countries with some suggestions.

International reporting processes coordinated with each other to promote harmonization of definitions, classifications, and reporting formats to some extent, such as FRA and ITTO that accepted seven criteria and many common indicators. However, the different objectives and approaches of international reporting made strong harmonization somewhat difficult, as seen in the case of forest definitions between FAO and IPCC. The project could only recommend further technical consultations among international processes through a common coordination mechanism (e.g., CPF) to develop a common reporting format which ensures harmonization of concepts, definitions, classifications, reporting categories and variables for common aspects of forests.

Harmonization of monitoring and assessment techniques is also a future challenge. The project introduced FAO's approaches such as the NFMA and GLCN as a harmonized methodology for field-level or satellite monitoring to countries. Meanwhile, it was found through questionnaire surveys that countries shared different experiences in monitoring and assessment techniques with different organizations. It would be significant to make further consultations among the various international organizations to compare and harmonize forest monitoring and assessment techniques for coherent technical assistance to countries.

### **3.3.2. Capacity building and technical assistance in MAR: global guidelines and framework**

The project provided technical guidance to countries in harmonizing forest MAR packages through workshops and working papers, building on FAO's technical packages including LCCS, NFMA, FRA, MRV, and GLCN. Meanwhile, the MAR project was not in the position to create its own technical guidelines or frameworks separately from on-going initiatives of FAO or other international organizations. The project supplemented some technical expertise such as techniques of database management, remote sensing and GIS with

external consultants, and disseminating them to participants at several workshops.

Coordination between FAO and other technical organizations should be made in larger institutional frameworks outside single projects to facilitate harmonization of technical approaches to forest MAR among different organizations or programmes.

### **3.3.3. Way forward for forest MAR – international collaboration**

The large variety of initiatives for forest MAR (forest-related reporting, field-level or satellite monitoring and assessment) would require FAO to initiate technical coordination with related organizations for harmonization of technical packages for the regions and countries.

Based on the experiences of the MAR project, FAO would be expected to clarify particular needs for technical collaboration with other international organizations to advance harmonization of forest MAR, and design suitable programmes in particular thematic topics (e.g., development of a common reporting format on forests and environment, consolidation of guidelines for field-level or satellite monitoring and assessment for effective data collection at global and national levels, etc.).

## **4. Sub-regional/national activities on forest monitoring, assessment and reporting (MAR) – Countries' situations of forest MAR harmonization**

This section describes activities related to forest MAR under the project at sub-regional and national levels, initiated by countries or sub-regional organizations.

### **4.1. Situation of MAR at the sub-regional/national level**

#### *Analysis of MAR stakeholders in the region*

The project conducted surveys of major stakeholders involved in forest MAR activities in project countries in 2006. The main agency for forest MAR in most countries was the Forestry Department (planning/information division, resource development division, etc.), whereas the Ministry of Environment or the Natural Resources Department played crucial roles in many countries. Some countries

developed a good network among government agencies in various sectors (including statistics or mapping divisions, Ministry of Agriculture, development planning agencies, etc.) for collaboration in MAR, while many others limited their coordination to within the forestry wing due to limited organizational or financial capacities as well as different organizational mandates.

Different countries had specific priorities on MAR development, but they shared a number of common goals including strengthening of technical capacities for MAR (e.g., forest inventories, satellite imagery analysis, harmonization of reporting formats, etc.), awareness raising and capacity building of MAR-related stakeholders, and coordination among stakeholders for integrated MAR activities. The project, through the project focal point, looked into issues and recommendations on MAR for the following countries: Australia, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, Fiji, India, Indonesia, Japan, Lao PDR, Malaysia, Mongolia, Myanmar, Nepal, New Zealand, Pakistan, Papua New Guinea, Philippines, Republic of Korea, Sri Lanka, Thailand, Timor Leste, Samoa, Solomon Islands, Vanuatu and Vietnam.

## **4.2. Activities at the sub-regional/national levels**

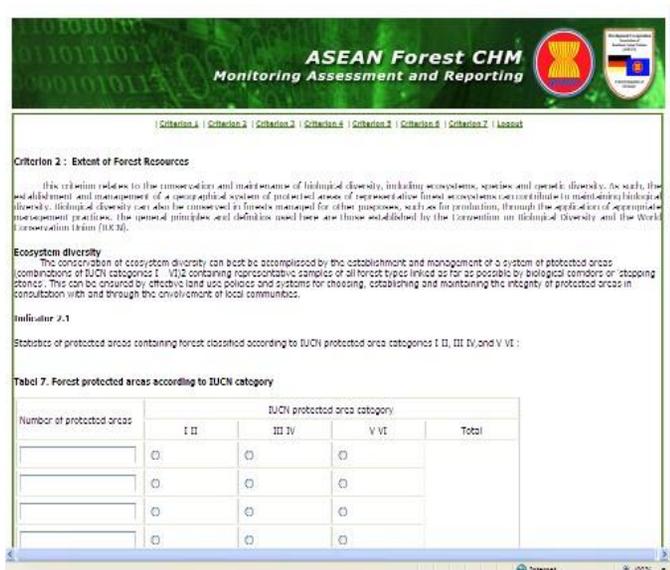
### **4.2.1. Sub-regional workshops**

In line with international/regional workshops, the project initiated sub-regional workshops to deliberate on MAR-related topics among member countries.

#### *Training Workshop on Strengthening Monitoring, Assessment and Reporting for Sustainable Forest Management using Criteria and Indicators in ASEAN*

A Workshop was held in Kuala Lumpur, Malaysia, 5-7 May 2009, where a total of 42 participants representing Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam, as well as the ASEAN Secretariat, FAO and the ASEAN-German Regional Forest Programme (ReFOP) participated. The objective of the workshop was to present and discuss the online version of the ASEAN Criteria and Indicators for Sustainable Management of Tropical Forests (ASEAN C&I) format with specified criteria and indicators, which had been developed on the basis of recommendations from the ASEAN Senior Officials on Forestry (ASOF) (Chiew *et al.* 2009) (**Figure 8**). Prior to the workshop, each member state of ASEAN (AMS) was requested to prepare a country report on the status of application of the ASEAN C&I format and respond to two questionnaires to assess whether the indicators were applicable at the national and FMU levels.

A total of 13 papers were presented at the workshop, including a synthesis paper on the application of MAR on SFM in ASEAN. From the responses received from AMS, it was found that at the national level, 20 indicators were applicable, at least partially, in Indonesia, Lao PDR, Myanmar, the Philippines and Vietnam. These



**Figure 8. ASEAN C&I online format**

cover the implementation of forest harvesting plans; silvicultural and harvesting guidelines for timber and non-wood forest products; procedures to protect endangered species; forest workers' health and safety; extent of tenure and use rights of communities and indigenous peoples; and public participation in forest management planning. At the FMU level, Lao PDR is of the view that many of the criteria and indicators are not applicable or they have been sufficiently reported at the national level, while Myanmar reported that in general the applicability of the indicators at the FMU level is the same as that encountered at the national level.

In Cambodia, 7 criteria and 59 indicators in the national MAR format had been derived from the ASEAN C&I format, but stakeholders' capacities and knowledge were not sufficient. Indonesia reported that about 80 percent of the indicators would require further analysis or were less feasible. The MAR format could not yet be fully implemented there due to the lack of standardized formats among the agencies for data collection. Lao PDR established a team within the Department of Forestry to develop national criteria and indicators, but an imminent constraint was the lack of statistical data. As such, the integration of C&I into existing monitoring frameworks would be a challenge at national and FMU levels. In Malaysia, a number of indicators in the MAR format would require data from other agencies outside the Department of Forestry. In Myanmar, 25–30 of the indicators would be fully applicable at national or FMU levels. A major constraint would be the lack of methodology for data collection. The Forestry Department, Peninsular Malaysia, shared its experiences in

reporting to ITTO using the reporting questionnaire for indicators at the national level, and in assessing progress towards the achievement of SFM and forest management certification using the Malaysian Criteria and Indicators for Forest Management Certification.

In the Philippines, the national criteria and indicators system comprised 7 criteria and 57 indicators applicable at the national level, with 52 of the indicators applicable at the FMU level. Some of the constraints included the lack of integrated monitoring, assessment and reporting systems and the absence of a national policy to enforce the C&I system. In Thailand, more than one agency is involved in undertaking SFM activities, causing dispersion of data among many agencies. The absence of a single agency directly responsible for data collection in standardized formats has impeded the full implementation of C&I reporting. In Vietnam, national standards for SFM have yet to be endorsed by the relevant authorities, though some authorities will develop forest owners' certification networks.

Hands-on training on the online MAR format was conducted. During the training, terms and definitions used in the MAR format were further clarified and the rationale as to why certain types of data were requested by some of the indicators was also explained. During the panel discussion, a few indicators were found to produce errors that might prevent users to continue data input. Participants suggested improvements of the online ASEAN C&I system such as:

- (i) further clarification of footnotes with sufficient text;
- (ii) revising texts by correcting spelling errors;
- (iii) use of decimals for numeric columns;
- (iv) inclusion of a box for remarks with scroll function for most tables;
- (v) clear coding to distinguish terms “not applicable” and “no information”; and
- (vi) resolution of syntax error problems for easier editing.

Workshop organizers and participants discussed recommendations for further development of MAR with C&I in the ASEAN region, including:

- (i) assessment of an adequate indicator set relevant to the national and FMU levels in each country;
- (ii) further organization of training for trainers and technical officers at regional, national and FMU levels;
- (iii) research in assessment of forest-dependent flora and fauna as well as endangered/rare species, quantification of NWFPs, and valuation of forest ecosystem services by securing appropriate sources of funds;

- (iv) effective coordination to provide information for indicators at a national level;
- (v) appropriate and cost-effective tools to obtain temporal and spatial data for indicators, including remote sensing and GIS technologies;
- (vi) inclusion of some critical variables in the future C&I framework, such as planted forest, resource ownership and use rights, and the role of forest in climate change mitigation and adaptation; and
- (vii) preparation of the C&I format in local languages.

It is significant for the ASEAN Secretariat to facilitate sharing of experiences among member states for the implementation of a clearing house mechanism (CHM) using the C&I format. ASEAN should also develop networking with other international organizations to facilitate harmonization of forest-related reporting with C&I. The ASEAN Secretariat was expected to periodically produce a synthesis report on the progress of application of the C&I format in member states to review and enhance the CHM with C&I for SFM in the Southeast Asian region.

*Sub-Regional Training Workshop on the Application of the Offline Monitoring, Assessment, and Reporting (MAR) Format at the Forest Management Unit (FMU) Level in ASEAN*

A Regional Training Workshop on the Application of Offline Monitoring, Assessment and Reporting (MAR) Format for Sustainable Forest Management (SFM) for Forest Management Units in ASEAN was held in Vientiane, Lao PDR, 20–22 January 2010. A total of 35 participants representing Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand and Vietnam, as well as the ASEAN Secretariat, FAO and members of the Lao PDR Organizing Committee attended (ASEC 2010).

Indicators			National Level	FMU Level	ASEAN Level
1.1	Extent (area) and percentage of total land area under comprehensive land-use plans.		+	+	+
Table 1: Extent (area) and percentage of area under comprehensive land-use plans*					
	Total land area (ha)	Total area under comprehensive land-use plans (ha)			Percentage under comprehensive land-use plans (%)
*Indicate reference year and source.					
1.2	Forest (area) of forests committed to production and protection under:				
	(a) Natural forests		+	+	+
	(i) PPF and (ii) non-PPF		+	+	+
	(b) Planted forests		+	+	+
	(i) PFC and (ii) non-PFC		+	+	+
Table 2: Extent (area) of forests committed for production and protection*					
	Natural forests, total	Production (ha)	Protection (ha)		
	- PPF				
	- Non-PPF				
	Planted forests, total				
	- PFC				
	- Non-PFC				
	Total				
	- PFC				
	- Non-PFC				
*Indicate reference year and source.					

**Figure 9. ASEAN offline format**

Each ASEAN Member State prepared a country report to elaborate the status of development and implementation of 7 criteria and 52 indicators under the ASEAN C&I for the FMU level using the offline MAR C&I format (**Figure 9**).

Brunei Darussalam adopted the ASEAN C&I, and the Forestry Department was in the process of pilot-testing the applicability of the C&I in the country. Cambodia finalized the “Cambodia Criteria and Indicators for Sustainable Management” at both the national and forest management unit levels, which were very similar to the ASEAN C&I and the ITTO C&I of 2005. The national MAR-SFM Format would be refined at both the national and FMU levels based on a review of national C&I. Then, setting-up of a management database, development of an information-sharing network; and capacity building for related officials will be undertaken in the use of the national MAR-SFM system. In Indonesia, the implementation of C&I has been mandatory since 2002; however, some of the indicators are yet to be applicable or require further studies. In Lao PDR, a draft national C&I was developed in 1999 with guidelines on SFM. Several new individual or shared databases are needed or need to be revised to provide the required data, including systems for forest cover monitoring and change detection.

All of the 7 criteria and 52 indicators of the ASEAN C&I are applicable in Malaysia in general, while indicators on productive functions are not relevant for some FMUs managed only for conservation and protection. Cooperation will be enhanced with other forest-related agencies to ensure the full implementation of the offline MAR format. Myanmar has developed and revised its own C&I since 1996, based on the 1992 ITTO C&I. Almost all of the ASEAN C&I would be applicable to FMUs in Myanmar, but Criterion 2 (biodiversity) and Criterion 7 (legal, policy and institutional framework) are not yet applicable.

In the Philippines, ITTO’s C&I framework, which is very similar to the ASEAN C&I, was basically adopted. However, there is an urgent need to develop and implement a comprehensive capacity building programme to enhance the capacities of the Department of Environment and Natural Resources (DENR) and forest managers on the application of the C&I for MAR on SFM. In Thailand, all of the criteria and many of the indicators were found to be applicable at FMUs, except for two indicators under Criterion 6: Socio-economic Functions, which would be measured at the national level. In Vietnam, the Department of Forestry issued a non-official guideline on SFM for state forestry companies. Fifty indicators would be fully or partly applicable at FMU levels.

Identified issues and challenges for the offline C&I format included: (i) a need to share understanding toward the concept of FMU among countries; (ii) the lack of information and inadequate research and development (R&D) on endangered, rare and threatened species, non-wood forest products, and values of forest carbon stock; (iii) inadequate information on non-PFE areas and inter- and intra-agency collaboration for data collection; (iv) lack of internalization in the implementation of the MAR format through national forest programmes (NFPs) processes and other integrated programmes relevant to forests; and (v) lack of a dedicated or specialized body to fully implement and achieve all the relevant indicators of the MAR format in individual ASEAN Member States.

Participants made several suggestions for technical revision of the offline format to make it more user-friendly, and for further organization of regional training for trainers and awareness raising at the FMU level in local languages, further research on thematic aspects (ecosystems, MRV, etc.), and strengthening of coordination mechanisms and information sharing networks to exchange experience and expertise among AMS. The ASEAN Secretariat was expected to produce periodic synthesis reports to track progress on the offline format.

#### *Regional Coordination Workshop on Regional and National C&I Frameworks and MAR Implementation Mechanisms*

A Regional Coordination Workshop on Regional and National Criteria and Indicators Frameworks and Monitoring, Assessment and Reporting (MAR) Implementation Mechanisms was organized by the Forestry Research and Development Agency (FORDA), Indonesia, in Yogyakarta, Indonesia, 28–29 April 2010, with the support of the ASEAN Secretariat and FAO. There was a total of 20 participants representing Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam, as well as the ASEAN Secretariat, and members of the Indonesian Organizing Committee.

Each AMS prepared a country paper on the “Similarities and Differences of National Level Criteria and Indicators for Sustainable Forest Management as compared to the ASEAN Criteria and Indicators” as well as one on “Updates of ASEAN Monitoring, Assessment and Reporting for SFM in ASEAN” by the ASEAN Secretariat.

A comparative analysis between the ASEAN C&I and each of the AMS C&I for SFM at the national level was conducted during the workshop which resulted in elaboration of the ‘Comparative Matrix between the ASEAN C&I and ASEAN Member States C&I for SFM at the National Level’ (Comparative Matrix) (ASEC 2010). In summary, 45 (76.3 %) of the 59 indicators under the 7 criteria of the ASEAN C&I at the national level can be applied by all the

member states, while the rest (14 indicators or 23.7 %) still require more information or studies for data collection under common definitions.

Participants agreed that member states should submit their first reports on fully applicable ASEAN C&I using data collected in 2009 or 2010, and on partly applicable C&I within 3 years. The workshop recommended that a review be conducted at the end of March 2011 to assess and evaluate the efficiency and effectiveness in putting information into the online MAR format, especially the quantitative information as requested by the ASEAN C&I. Participants also agreed to simplify and improve the ASEAN C&I, prepare technical instructions, document good practices of member states in C&I application, study and consider technical constraints and to support (including provision of high-resolution satellite imagery), and strengthen coordination with ITTO for sharing experiences.

#### *Pacific Regional Workshop on Monitoring, Assessment and Reporting on Sustainable Forest Management*

A workshop on the study and planning of MAR in Pacific Island countries (PICs) was organized by the Secretariat of the Pacific Community (SPC) in collaboration with the German Technical Cooperation (GTZ) and the South Pacific Applied Geoscience Commission (SOPAC). The SPC was implementing a regional MAR study programme under the support of the MAR project. Nineteen persons attended the workshop from 14 countries and 4 organizations (Mussong 2008: 71).

A consultant presented the results of questionnaire surveys on data availability, national capacities and the experiences of nine countries for MAR using 58 criteria of the FRA 2005. The results showed that Vanuatu and Papua New Guinea faced a larger gap between data needs and national capacities for data collection than other countries. Few countries could obtain data on biomass and carbon stock, non-wood forest products (NWFPs) and their value, and functions of other wooded land (Mussong 2008: 72). Based on the consultant's analysis, he prepared a priority list of important criteria for a common MAR system in PICs containing these variables. He also visited three countries to verify the results of the questionnaire analysis. He suggested that the next step of MAR activities in the Pacific region should include the designing of a common MAR system with concrete methodologies through identification of countries' specific needs and capacities.

Participants presented the progress in national MAR activities and what their next steps would be. The Government of Fiji made substantial efforts to improve national MAR after the FAO workshop held in Nadi in October 2007,

such as establishment of permanent sample plots, mapping of forest resources, and broadening of field data collection. The participant from Papua New Guinea explained that he would set up an internal network on MAR inside the Forestry Authority (PNGFA) soon, which will be gradually expanded into a national network of stakeholders. He also expressed his interest in collaboration with FAO and other organizations for the Reducing Emissions from Deforestation and Degradation (REDD) initiative and multi-resource forest inventories. The participant from Vanuatu explained the on-going study on national MAR systems under the project. The participant from Samoa introduced Samoa's current work on mapping of forest plantations through spatial and data analysis and development of a forest database using Microsoft Access and Mapinfo.

Participants discussed: (i) a need for consideration of diverse conditions in Pacific Islands for development of national MAR systems; (ii) expansion of collaboration with Pacific countries under the regional network and common umbrella programmes; and (iii) simultaneous facilitation in both international and national level harmonization of reporting systems and formats on forest resources. Many participants of the Pacific countries were still concerned about the inclusion of coconut palm in forestry trees. The participants generally agreed to develop an electronic network of experts on MAR in the Pacific. However, the resource person of SOPAC advised its careful design to ensure its sustainable maintenance with attention to its security.

*Pacific Regional Workshop on Monitoring, Assessment and Reporting on Sustainable Forest Management in Suva*

A Pacific Regional Workshop on Monitoring, Assessment and Reporting on Sustainable Forest Management was held in Suva, Fiji, 27–29 January 2010. The workshop was organized by the Secretariat of the Pacific Community (SPC) in collaboration with the Pacific Islands Applied Geoscience Commission (SOPAC) and German Technical Cooperation (GTZ), supported by German consultants. Lecture sessions and hands-on exercises for participants were held in Nadi on 25 and 26 January to demonstrate vegetation map techniques using QuickBird in Kiribati, Tonga and Tuvalu, as well as tree measurement techniques for effective reporting with a field demonstration and exercise (Mussong 2010). Participants also presented the status of national MAR activities and a proposal for vegetation surveys.

Prior to the workshop, the consultants prepared draft manuals on tree measurements for atoll island countries and big island countries through surveys, consultations, and field testing in Fiji and Kiribati. The manuals conformed to the reporting formats of the Global Forest Resources Assessment (FRA) and the monitoring techniques of the National Forest Monitoring and

Assessment (NFMA), while accommodating the various conditions of Pacific islands through simplified sampling. The plot design, as well as the field work procedure, was found to be easily understood and implemented, but some weaknesses were also identified in tree and carbon measurements, field forms, and plot layouts. These technical problems were resolved before the workshop. Updated methodologies were introduced to the workshop participants and tested jointly in several field exercises. Collected data were used for exercises on data analysis. Results of the field activities were discussed and incorporated into the system.

Field measurements were conducted in three plots: a pine plantation site; a small coconut island; and a natural forest area. GTZ had initiated pilot forest management activities with different logging practices in the natural production forest area. Tree measurements were made in various conditions of undisturbed or exploited natural forests. Measurements made on a small island would be a good example of tree resources monitoring for small island countries. Participants undertook measurements and calculations of these plots in three groups. However, their calculations of growing stock may not have been fully accurate probably due to limited tree measurements.

While appreciating these training opportunities, participants suggested further adjustments of the proposed monitoring methodology to existing national forest monitoring techniques, including plot layouts, tree measurements (e.g., tree height, etc.), and biomass estimation. They agreed that cost-effective monitoring techniques would have to be further developed for easier application by Pacific countries. The consultants suggested that the next steps of work after this workshop should include: developing a database of experts and an electronic network; finalizing the methodology for field inventory and database management; testing in one big country and one small country; planning of the next training workshops; and launching of e-learning modules.

It was recommended that field monitoring be initiated at least in a big island country and an atoll country with technical assistance from the SPC. Participants from other countries should be invited to training on field inventory activities. For storing and analyzing the collected monitoring data, a database needs to be developed to store and analyze these data, including satellite-based vegetation mapping. An expert database would also be useful for future information sharing and networking.

#### **4.2.2. Pilot sub-regional/national MAR programmes under the project**

A few countries were willing to initiate small pilot MAR programmes under the support of the project, containing studies on national MAR systems,

development of national networks for MAR harmonization, training on MAR, etc. A list of pilot programmes is presented in **Appendix 1**. This section describes the outcomes of representative programmes and reviews their linkages with the international programmes described above.

#### *MAR study in China*

The Academy of Forest Inventory and Planning (AFIP) of the State Forestry Administration (SFA) conducted a diagnostic study on forest MAR to review the current status of MAR development and consider the next steps for its improvement in China (AFIP 2008). The SFA and provincial forestry agencies have developed a national forestry monitoring system comprised of national and divisional forest inventories, national desertification and sandification monitoring, wetlands resources monitoring, wildlife investigation, long-term forest ecosystem research, forest fire monitoring, investigation of forest insects and pests, and investigation of forest resources management. These monitoring schemes are conducted every 5 to 10 years under the coordination of the SFA. The schemes provide data for national reporting to FRA, ITTO C&I, CBD, UNFF, UNCCD, UNFCCC, and CITES, applying their specific methods. A task force was organized among reporting agencies and related departments to improve the mechanism for coordination of information gathering and checking. A special investigation was also carried out on the current forest-related monitoring and statistics system to ensure the comprehensiveness of national reporting in response to international information needs.

Nevertheless, China still faces several challenges in international reporting. Firstly, data are not yet consistent on forest resource conditions, particularly forest areas and growing stock. Secondly, each national report is overloaded with multi-faceted aspects of forest management. Thirdly, preparation of national reports on forests requires a lot of coordination work, increasing the work load of responsible officers. Fourthly, national and international forest-related C&I are not consistent. Fifthly, continued expansion of reporting items and indicators in international forest-related reporting processes increase the burden on government agencies. Lastly, forest information is inconsistent under the current national forest monitoring system due to different forest definitions, indicator sets and monitoring methods.

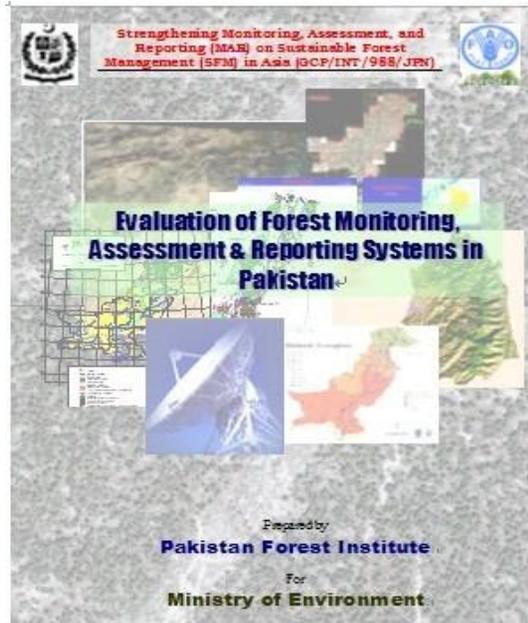
The study provided the following recommendations for harmonization of national reporting to international processes:

- (i) accelerate development of globally recognized C&I framework for SFM;
- (ii) strengthen the harmonization of international forest-related reporting with common definitions and methods;

- (iii) simplify reporting formats and indicators in international reporting; and
- (iv) continue building national capacities for international reporting with increased technical assistance.

### *MAR Study in Pakistan*

The Ministry of Environment in Pakistan initiated a study of the national MAR system with the Pakistan Forest Institute under the MAR project (**Figure 10**). The study identified major stakeholders involved in MAR, including the Ministry of Environment and Provincial Forest Departments, Ministry of Food, Agriculture & Livestock (Economic Wing), Ministry of Finance (Economic Adviser's Wing), Pakistan Agricultural Research Council (PARC), Pakistan Space & Upper Atmosphere Research Commission, Statistics Division, Pakistan Forest Institute (PFI), Forest Management Centre (FMC), University of Arid Agriculture Rawalpindi, National Rural Support Programme (NRSP), SUNGI Development Foundation, private companies and international organizations (PFI 2008).



**Figure 10. Study report on MAR in Pakistan (Source: PFI, 2008)**

The study evaluated various stakeholders' capacities as well as existing techniques and indicators for improvement of national MAR. The study addressed the need for:

- (i) standard definition and harmonized classification of forests by consultations among a national network of stakeholders;
- (ii) enhancement of satellite monitoring through: a) wide application of high-resolution satellite data like IKONOS; b) testing of different algorithms in all forest types with site-specific research; c) elimination of hill shade and shadowing with an effective method like digital elevation and rule-based classification models; d) improvement of the accuracy of remote sensing products with high-resolution imageries, field surveys of mixed pixels, and rule-based interpretations; and e)

- development of accurate low-altitude remote sensing technologies (e.g., drone flights, hydrogen balloons, etc.);
- (iii) building capacities of the Ministry of Environment to strengthen forest inventories and valuation; and
  - (iv) establishment of an authentication procedure for forest information through the national network to improve its reliability.

*Development of national forest MAR format in Cambodia*

The Forestry Administration (FA) of Cambodia collaborated with FAO to: develop an information sharing network for forest MAR; elaborate a national MAR format based on C&I; establish pilot testing sites for the developed format; and set up a database management structure.

On 20 June 2008, a national workshop was organized with 45 participants from central and local forestry offices in Phnom Penh aimed at deliberations on the Cambodian format of 2008 for SFM using C&I for its finalization. The draft format built on ASEAN and international requirements for forest MAR with the revised ITTO C&I format in 2005, but accommodated the national policy on forest management, including forest types and categories (NFMU 2008). Seven criteria and 59 indicators were reaffirmed in the national C&I framework, encompassing forest resource conditions and their changes, biodiversity conservation, land protection, harvest planning, economic benefits and institutional linkages. Participants discussed the applicability of the proposed national format. They made suggestions for clarification of technical terms (e.g., forest ownership, IUCN categories, forest categories, etc.), studying methods for collecting data on forest changes, forest boundaries, and carbon stock assessment, strengthening of capacity building, and strengthening of coordination among stakeholders.

During 2007–2008, the FA developed the national MAR format based on the framework approved by ASEAN and ITTO in 2005. Cambodia's MAR format, comprised of 7 criteria, 59 indicators, 34 tables, glossaries, and 2 annexes, has been applied at both the national and FMU levels. Its key indicators were further modified for harmonization. A consultant conducted a desk study on the national MAR format to develop a check list for consultation during field tests. Two pilot sites (Koh Kong and Kampong Thom Cantonments of FA) were established to test the national MAR format. After studies and discussions, 53 indicators were approved out of the 59 at FMU. Another consultant studied frameworks to review forestry information for establishment of a national MAR database, and prepared the offline ASEAN C&I format in a Khmer version for application at FMUs. Other consultants collected data to assess the capacities of the national MAR format and the offline C&I format. A training workshop was

held in Phnom Penh, 11–12 November 2010, to introduce MAR formats to members of the national network. They agreed that the the Khmer version of the offline C&I format would be more useful for data collection and management at national and FMU levels. Recorded data in the MAR format can be utilized to make forest management and development plans. The national format is amenable to international reporting processes (Saret 2010).

However, weaknesses were also identified in applying the MAR format. Local focal points were not clear about MAR. Moreover, most of the local FA officers are charged with many duties and share less information. Little valid data can be obtained from domestic organizations. Some indicators have not yet been adjusted to national definitions (e.g., managed primary forests, IUCN categories, forest ownership, etc.). Financial and institutional capacities are still too limited to apply the MAR format fully at national and FMU levels.

The MAR format has good potential to improve forest information systems in Cambodia; capacity building of related stakeholders is essential to enhancing its effectiveness with increased data sets.

#### *National MAR workshop in India*

The Forest Research Institute (FRI) collaborated with the project to develop a national MAR network, conduct studies on forest MAR systems in India, and hold technical consultations with related stakeholders. FRI organized a national workshop on forest MAR with central and regional officers in Dehradun, 22–23 April 2009, focusing on the national C&I system to enhance SFM. Participants presented and discussed an overall C&I framework, monitoring methodologies, institutional capacities for application of C&I and experience in C&I testing in six states (FRI 2009).

The C&I approach highlights the need for optimal utilization of forestry resources to ensure a sustained flow of goods and services for present and future generations. SFM Cells were constituted as nodal bodies for policy matters in the Ministry of Environment and Forests and State Forest Departments to deal with C&I. During the second meeting of the SFM Cell in March 2008, 8 criteria and 37 indicators were finalized on the basis of initial C&I testing in the field.

The Forest Survey of India (FSI) regularly provides data on forest cover using LISS III with intensive ground truthing. The FSI also conducts thematic studies such as inventories of trees outside forests and non-wood forest products (NWFP), demarcation of forest boundaries with differential GPS, and applies geomatics to prepare working plans. The six states collected benchmark data for

C&I at the forest management unit (FMU) level to test its feasibility. As a whole, FMU officers required training for effective application of C&I.

Participants made the following recommendations for better application of C&I in India (**Figure 11**):

- (i) sharing the outcomes of pilot studies on national C&I in the six states with other states for its finalization and implementation in the country;
- (ii) supplementing knowledge of forest inventory, including sampling techniques, statistical packages, computer sciences, etc. in order to provide better data using C&I;
- (iii) skills development for periodical surveys on flora and fauna, socio-economic variables, and fire or pests at the local level, assisted by thematic experts;
- (iv) participatory approaches to facilitate data collection for specific indicators such as biodiversity;
- (v) estimation of unrecorded removals from forests in collaboration with local stakeholders;
- (vi) geo-informatics with remote sensing/GIS and GPS to ensure more vigorous and precise data collection and mapping at the field level;
- (vii) formulation of forest management plans and guidelines (e.g., forest management codes) with C&I data;
- (viii) building up institutional capacities with proper staff and budget; and
- (ix) strengthening of the national network with various participants, accompanied by a website for easier information sharing.



**Figure 11. National MAR workshop in Dehradun** Source: FRI (2009)

### *C&I in the Philippines*

A national programme “Raising Awareness and Strengthening Capacities on the Application of the Forest Auditing System Using Criteria and Indicators (C&I) for Sustainable Forest Management in the Philippines” was implemented to

strengthen the use and application of the recently developed Philippine C&I and its audit systems for the purpose of identifying trends, analyzing the effects and outcomes of existing forest management systems, and facilitating decisions on forest management (FMB 2009).



**Figure 12. C&I audit system to enhance FMU performances: Field training in timber corridor areas** Source: FMB (2009)

The programme aimed to develop mechanisms to raise awareness and strengthen capacities of forest managers and institutions under the Department of Environment and Natural Resources (DENR) in applying the forest auditing system using the Philippine C&I. In order to ensure the effective use and application of the C&I and auditing system in the field, the project decided to train and designate top DENR frontline officials actually involved in and responsible for monitoring and evaluating the performance of FMUs. The trained officials were regarded as DENR focal points for C&I and part of the National Network (NN) of C&I focal persons for regions and provinces.

The project initially trained officials from the most critical timber corridor areas in the Philippines where the biggest tenure holders and timber producers are concentrated (**Figure 12**). The project sought to promote the use and application of the C&I and audit system at minimum costs. The project also targeted DENR top management, including the DENR Secretary, in its advocacy efforts. The DENR Secretary, as a result, advised FMB to explore the possibility of requiring all FMUs to adopt the C&I as a planning tool. The baseline data of Surigao Development Corporation (SUDECOR) timber license area (TLA), serving as the training venue, has been prepared. Results of the review/study of current C&I system achievements and limitations were incorporated in the C&I training modules. The project held a series of lectures on C&I and the audit system in La Mesa Dam Watershed Office in Quezon City and the Community-Based Forest Management (CBFM) Office in the Caraga Region. Information materials (including training modules and support materials), manuals, brochures and compact disks (CDs) were distributed to the participants.

The C&I and audit system could be applied across various types of FMUs with indicators fitted to their different types and capacities. There is still a need for continuous capacity-building and advocacy activities in most critical timber

corridor areas by qualified lecturers or resource persons using developed modules and support materials to satisfy highly technical requirements for some of the indicators. Many stakeholders believe that the C&I system could provide objective and accurate analysis, judgment, and decisions on FMUs' capacities for forest management. Local timber producers would also recognize the importance of a system and tool that certifies their products through sustainable processes. Policy support on indicators not yet included in forestry policies or guidelines (e.g., biodiversity, carbon storage, research and education, etc.) are essential to fully enforce and implement the C&I system nationwide. Training of top DENR officials that are directly responsible for field monitoring, evaluation and implementation will ensure actual and immediate implementation of the SFM strategy.

Based on these findings, recommendations were made for:

- (i) similar capacity-building and advocacy activities in other timber corridors through expansion of the National Network of Focal Points for C&I, satisfying highly technical requirements for some indicators;
- (ii) a more intensive information dissemination campaign among DENR top officials and decision makers to better incorporate the C&I system in their decision making;
- (iii) advocacy for policy formulation regarding indicators that are not presently covered by existing policies and guidelines;
- (iv) implementation of the BCMP to extract important lessons for the improvement of watershed and protected area management; and
- (v) follow-up consultations with network members to receive feedback and improve the implementation of the process in the country.

The training workshop in 2010 was the final outcome of the strategy adopted by the project, which involved a series of activities aimed at raising awareness and creating interest among the DENR field offices and FMUs, particularly those based in Regions 2, 3, and the Cordillera Autonomous Region (CAR) that comprised the most critical timber corridors in Northern Philippines (Tamayo *et al.* 2010).

One major result of the project's efforts was the expansion of the designated National Network (NN) of Focal Persons composed of DENR top frontline officials and FMU forest managers in Luzon. The NN of focal persons was effectively capacitated in the use and application of C&I and Audit System. They are now part of the pool of capable human resources to implement the C&I system in the country. Another impact was the wider acceptance of the SFM strategy among the forestry sector (both the public and private sectors). The active involvement of major stakeholders, including the DENR Regional

Directors, Regional Technical Directors, PENROs, CENROs, Senior Forest Management Specialists, FMU holders and forest managers, among others, was carefully sought during the course of project implementation through effective communication and information dissemination.

Through project implementation, the unified concept of SFM has a wider acceptance now among the DENR and FMUs through the C&I framework. The complementary capacity of field personnel and staff trained in the C&I and audit system will help the FMB to perform the task of evaluating and monitoring all tenure holders in the country. Moreover, the top management, policy makers and lawmakers will be able to formulate more effective legislation that addresses the complex forestry problems of the country.

#### *MAR study in Vietnam*

A study was carried out on the current MAR situation and national mechanisms for its harmonization in Vietnam to propose alternative methods and regulations on forest data collection (FIPI 2009: 67). In 2006, the Ministry of Agriculture and Rural Development (MARD) issued a decision on a statistical indicator system in which 18 indicators are used as a foundation for monitoring, evaluation and reporting (MER) in forestry (e.g., areas of existing or destroyed forests and forest plantations, areas of land for natural regeneration, protected forest area, volume and value of timber, etc.).

The Forestry Sector Support Programme and Partnership (FSSP) has developed 72 indicators, covering bio-physical, environmental, socio-economic and financial aspects and a database for the Forest Sector Monitoring and Information System (FOMIS), out of which 55 are currently feasible for data collection. However, considerable cost and time would be required to collect data for these indicators. Forest-related data are distributed among the ministries, but data for forest monitoring, evaluation and reporting are collected mainly by the Forestry Department, the Forest Protection Department, the Forest Inventory and Planning Institute (FIPI), local inventory and planning sub-institutes and the FSSP.

The FIPI conducts a national forest resource inventory programme every 5–10 years in compliance with the guidelines of the MARD. The FIPI also monitors changes of forest resource conditions every five years (since 1991). Local forest inventory and planning units of forest-rich provinces help local state agencies and forest enterprises in monitoring and planning of forest management.

The study identified obstacles to MER on forestry in Vietnam. Firstly, agreements have not yet been made among the various stakeholders on

concepts, definitions, indicators, and methods for forest MAR. Secondly, no agreement has been reached yet between MARD and the Ministry of Natural Resources and Environment (MONRE) on classification of forests and forest lands. Thirdly, it is very difficult to search for required forest information among the many agencies holding related data without sufficient coordination. Fourthly, forest inventory data are not accurate or objective; it is affected by specialized management agencies and local managers for their benefit or due to shortage of time and budget. Data is often collected using old methods with low reliability. Fifthly, it is difficult to buy high-resolution satellite imagery due to budget limitations and regulations by the MONRE for procurement. Lastly, there are differences in the measurement of some indicators like forest definitions and classifications between the country and international organizations (FIPI 2009: 68).

The study proposed improvement of a national forestry MER system which is more consistent with the FAO system through the development of a principal indicator set, linking a national indicator set with FAO's indicators under FRA2010. The indicators should focus on forest status, forest management owners, forestry activities, institutional aspects (e.g., policy, labor, training, etc.), and forest investments. The proposed indicator set would have to be tested to verify its viability. The study recommended restructuring of the MER system using a modular model with appropriate database software in which monitoring and evaluation methods would be supplemented and updated by related ministries and other stakeholders to improve the consistency of forest information. The study also advocated modification of regulations for more effective collection of data in the national MER system by improving forest indicators, data collection and analysis procedures including inventory surveys at central and local levels, and building institutional capacities for data collection and analysis through mutual collaboration.

#### *MAR Study in Pacific with SPC*

The SPC collaborated with the project in two phases:

- Study on MAR in the Pacific by SPC

The SPC, in collaboration with FAO and coordination with GTZ and SOPAC, initiated a study on MAR in Pacific Island countries (PICs) in 2008, following up the outcomes of the workshop held in 2007 (Mussong 2008: 72). A questionnaire was distributed to determine the availability and importance of the MAR criteria relevant for the PICs. The main outcome of the questionnaire was a list of criteria defining the "least common denominators" on forest-related information significant for all PICs and as basis for a harmonized MAR system.

Verification visits were carried out in Fiji, Papua New Guinea and Solomon Islands to verify the results of the questionnaires. Structured interviews were held with national MAR focal points. Information provided in the questionnaires was largely confirmed. Besides the lack of most of the MAR relevant data, the main challenges were monitoring work in the field and data transfer from the field.

a. Fiji

Two national forest inventories have been carried out since 1991 with permanent and trained staff in the main fields as well as up-to-date equipment and software for analyzing, mapping and storing of MAR-relevant data. Assessment gaps were visible in land tenure (with landowner involvement), non-timber forest products (NTFPs), agroforestry, and carbon. A communication platform with forest research institutes was recommended as a regional MAR network.

b. Papua New Guinea

Due to restructuring of the forestry administration, the upcoming structure of the current directorate was unclear. Staff and equipment in the related division seemed to be appropriate for MAR, but data were outdated. Existing data were not shared among different organizations.

c. Solomon Islands

As a result of restructuring the Forestry Administration from 2009, staff were increased at MAR-related divisions. Equipment and technical resources were available, whereas applications for modern equipment were forwarded to the EU office. At the provincial level some MAR-relevant data (mainly wood and NTFP removals) were collected and disseminated in hard copies. The significant gaps in data (e.g., environmental aspects, carbon, plantations) should be covered with a new NFI and through improved monitoring measures. A regional MAR network with research institutes would be supported.

The findings of the MAR survey and verification visits were presented and discussed, and the following conclusions were made during a workshop (Mussong 2008: 71):

- Regional network: The SPC would be in charge as regional coordinator. The MAR network communication platform should be open to experts only. The SOPAC would provide technical assistance to construct the network and design a database on experts.
- List of MAR-relevant criteria: A criteria list representing a least common denominator for all PICs was agreed on.
- Regional partner institution for technical assistance: All participants support the proposal to ask SOPAC for technical assistance in the

field of remote sensing and GIS-related activities. Further discussions between SPC and SOPAC might be necessary to clarify details.

The following were recommended as next steps at the workshop:

- A concrete MAR design together with PICs and partner organizations.
- Identification of specific restrictions and needs in PICs in terms of technical, human and financial resources.
- Provision of region-wide high tech equipment and sophisticated expertise through a qualified partner institution.
- Identification and development of adapted and cost-effective methodologies for MAR on the agreed criteria.
- Demonstration and discussion on the most important methodologies during a regional workshop.

- **Proposal for Terrestrial Monitoring Methodologies**

Based on the recommendations at the workshop in November 2008, terrestrial monitoring methodologies were identified throughout 2009 (Mussong 2010). The basic monitoring plot design drew on the NFMA design proposed by FAO, adapted to PIC requirements. Through prior assessment of NFMA methodology, several difficulties were identified in directly applying it to PICs, particularly time-consuming plot establishment and surveys.

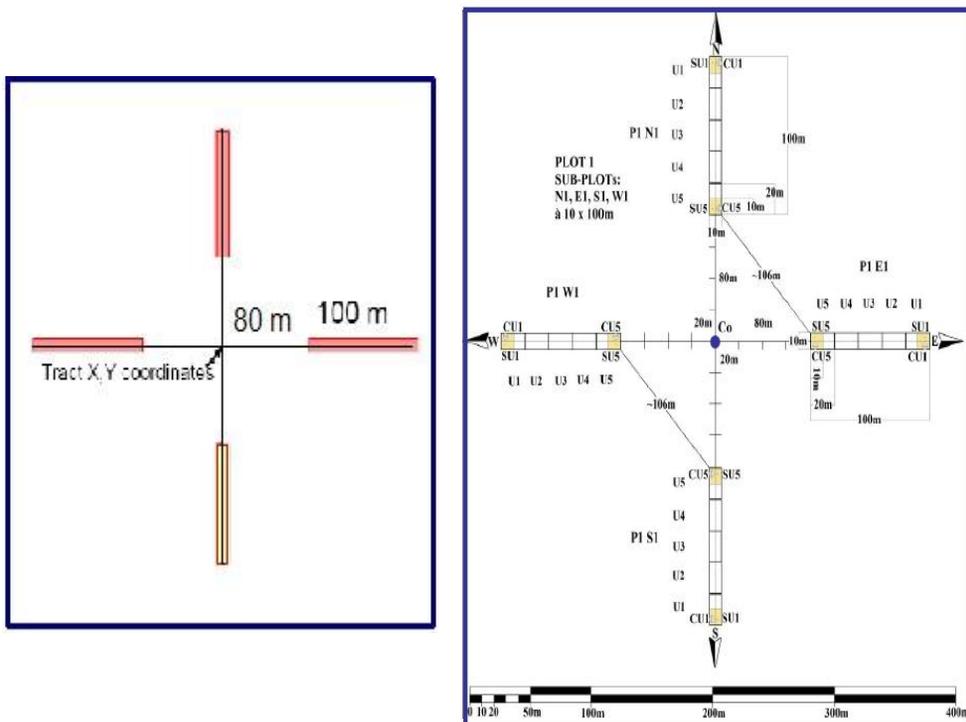
The first step to adapt the FAO design to the PIC countries was to simplify the layout for carrying out surveys to shorter times and at lower costs, reducing plot dimensions and increasing recording levels (dbh limits).

The following modifications were proposed for NFIs in PICs:

- Start the measurements as close as possible to the determined coordinates.
- Reduce the width of the strips to 10 m (5 m left and 5 m right of the centre line).
- Reduce the length of the strip to 100 m and keep a minimum distance between two strips of 100 m.
- Reduce the number of subplots (level 1) from 3 to 2.
- Reduce the circular plots (subplot level 2) to a radius of 2.00 m (measurable with a stick - even in steep terrain) and move the plot away from the centre line.
- Establish systematic recording units along the centre line (putting pegs every 20 m) which may lead to (slightly) more “staking out” time, but will save time due to better overview during plot establishment and data collection.
- Lift up the recording level for main plot trees from 20 to 25 cm dbh.

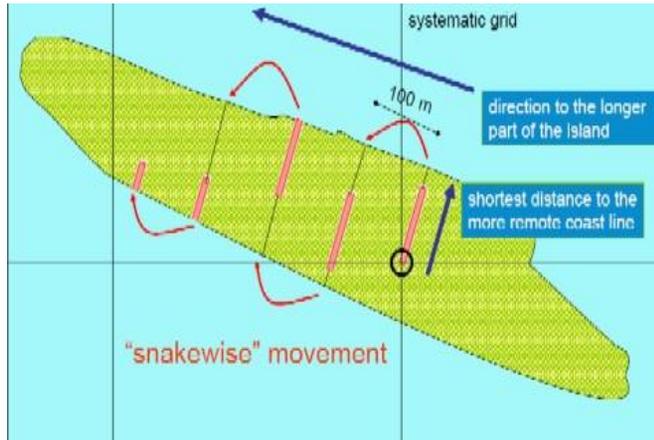
- Introduce a small circular plot (radius= 0.3 m) for collecting “ground carbon” (litter, grass, ferns, etc.) and counting regeneration (up to 1.3 m height).
- Introduce a sampling procedure for lying deadwood.
- Reduce the number of required staff to 3–4 persons (line cutter, surveyor, team leader/recorder, assistant).

A square layout of the NFMA was modified to a cross-layout (**Figure 13**) to keep the minimum distance between two strips at 100 m and ensure easier work for activities such as plot identification during re-measurements. In many cases for atoll situations, the cross-design is not suitable due to the fact that on many islands, the distance from one coast line to another coast line is less than the required 360 m. In addition, most often there is a zonal distribution of vegetation and land use parallel to the coastlines. Therefore, an optimal layout for narrow islands should crosscut the zones to create a representative sampling.



**Figure 13. Modified plot design prepared for a “normal” (bigger island) situation (left: basic structure; right: complete design)**

For such atoll situations, the “cross” is changed to a sequence of four parallel strips (10 m x 100m), maintaining a distance of at least 100 m between the strips (Figure 14). Coordinates of a pre-established systematic grid act as the starting point. The moving direction is the shortest distance to the more remote coast line. If the strip (or the 100 m distance in between) ends in the water, the distance over water will be measured and will continue in the parallel line/strip running in the opposite direction. Due to the same shape and size of the strips and the distance between the strips, (at least 100 m), the “snake-design” is statistically comparable to the cross-design. All methods of measurements in the plot are identical to those of the cross-design.



**Figure 14. Plot design and procedure for narrow atoll situation**

It was recommended to use the cross-design wherever possible and to switch to the snake-design in cases where the islands are too narrow (Figure 15). To minimize confusion regarding which design to choose, detailed planning (grid – design – direction) is necessary before beginning the field work. Current maps, aerial photos or satellite images are required.



**Figure 15. Cross- and snake-design on an atoll island (map source: Google Earth)**

Field tests were carried out (November 2009) at several locations in Fiji (example of a large forest-rich country) and Kiribati (example of an atoll country). The plot design as well as the field work procedure was found to be easy to understand and easy to implement for a team of 3 to 4 persons. No high-

tech equipment is required and it seems possible to establish one plot (4 strips) per team during one working day. Some weaknesses became apparent, especially regarding the dbh limits, tree height measurements, field forms, and subplot layout for estimating the amount of “ground carbon” (litter, grass, ferns, etc.).

Up through the following workshop in January 2010, most of the technical problems were able to be solved. The updated methodologies were introduced to the workshop participants and thereafter jointly tested in several field exercises (pine plantations, indigenous rain forest, small island forests) (**Figure 16**). The collected data were used for exercises on data analyzing. The results of the field activities were discussed and incorporated into the system.



**Figure 16. Field training on inventory surveys (SPC 2010)**

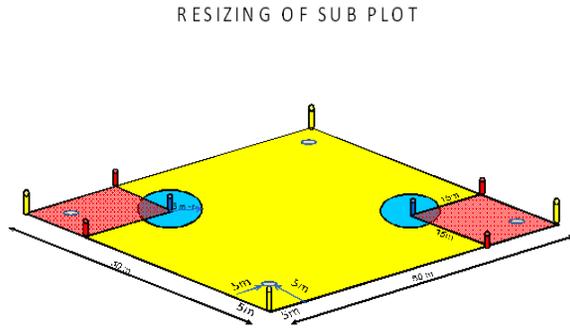
For the next steps of the project it was recommended that field monitoring be started at least in one big island country and one atoll country. Technical assistance should be sought from SPC. Other countries should be invited to take part in ongoing monitoring inventories to get on-the-job training. For storing and analyzing the collected monitoring data, a database needs to be developed and implemented. Furthermore, it

is vital that the regional expert database, as well as the satellite-based vegetation mapping, continually be further developed.

#### *Development of Permanent Sample Plots for National Forest Inventory in Solomon Islands*

The Forestry Division (Planning Section) of the Ministry of Forests, Environment and Conservation initiated collaboration with the MAR project to set up permanent sample plots (PSPs) for forest inventories in pilot provinces (Irokete 2010). Technical designs of the PSPs were adopted from the guidelines introduced during the regional training workshop in Fiji in January 2010, organized by the Secretariat of the Pacific Community (SPC), with a main plot dimension of 50m x 50m. It is comprised of two sub-plots of 15m x 15m and two circular plots of 3m radius (**Figure 17**). There are biomass plots of 30cm radius at four corners at the right angle of 5m.

The compass direction establishment of North, South, East and West is used with permanent pegs of PVC pipe placed at the four corners. The corner pegs were about 2 feet high and were painted with red oil paint to provide better visibility to avoid human disturbance. The other plot positions of the subplots 15m x 15m were indicated with wooden pegs. The perimeter of the plots was traced using a Bush Knife so as not to seriously disturb the vegetation.



**Figure 17. PSP layout**

The biomass plots were temporarily located according to the dimensions of 5m x 5m from the four corner pegs. The 3m radius circular plots were measured using a tape measure to confirm the perimeter of the circular plot. With the recommended recording levels for this design consideration was given to the criteria in **Table 1**.

**Table 1. Forest variables to be recorded**

Plot level	Forest variables to be measured
Plot (all sub-plot units)	$\geq 25$ cm DBH $\geq 25$ cm DBH standing deadwood $\geq 25$ cm diameter lying deadwood
Subplot level 1 (10 m by 10 m subunit)	10 cm – 24 cm DBH 10 cm – 24 cm DBH standing deadwood 10 cm – 24 cm diameter lying deadwood
Subplot level 2 (circular plot)	$\geq 1.3$ m height and $\leq 9$ cm DBH $\geq 1.3$ m height and $\leq 9$ cm DBH standing deadwood
Subplot level 3 (biomass plot)	All vegetation up to 1.3 m height, litter and deadwood $\leq 10$ m diameter count regeneration

A training workshop was held from 30 August to 3 September for 23 participants with fair regional representation throughout the country and with basic technical expertise from the provincial staff who have made significant contributions to long-term management of PSPs. The training workshop was geared mainly towards plot establishment and



**Figure 18. PSP permanent corner peg**

Source: FD/MFEC (2010)

mensuration and other topics related to MAR and PSPs that would provide better understanding on the significance of improving PSPs from various technical aspects in the field (**Figure 18**).

The development phase of the PSP establishment programme has covered Malaita and Guadalcanal Provinces. The total number of PSPs for Malaita was 10 plots, out of which 2 PSPs were initially established during a training workshop and 8 PSPs were to be set up soon after that. There should be about 10 EAPs (Easy-Access Plots) for Guadalcanal, although it was initially planned for 14.

#### *Development of MAR systems in Vanuatu*

Vanuatu has collaborated with the project in two phases from July 2007 to December 2010 to strengthen national MAR systems.

- **Activities for Development Phase I**

The Department of Forests in Vanuatu (VDoF) has developed a national network (NN) on MAR-SFM that has been in operation since November 2006 to bring together all key stakeholders for its development and harmonization, building on the existing user group of the Vanuatu Resource Information System (VANRIS) (Kamasteia 2009). The VDoF also established a national steering committee therein to manage a national MAR programme. A preliminary meeting in 2006 highlighted the urgent need for updating forest cover/land use maps, NFI, and VANRIS with detailed forest classifications in collaboration with the Department of Lands, Survey and Records (DLSR) that was collecting data using radar and LANDSAT 7 imageries.

The first NN meeting in November 2007 brought out some more issues to be addressed, including:

- (i) improved accessibility to information from other government agencies;
- (ii) integration of data collection systems by unifying units with related institutions for easier reporting;
- (iii) enhanced utilization of remote sensing and GIS for regular detection and fast detection of forest cover change;
- (iv) strengthening of training to GIS user groups on remote sensing and GIS technologies, including data processing, following up past projects.;
- (v) centralized storing and management of data for easier access, retrieval, and updating (the DLSR is establishing an information center.);
- (vi) establishment of permanent sample plots to meet international reporting and policy development needs; and
- (vii) revitalization of GIS user groups.

During the meeting, various stakeholders presented their own reporting systems and shared different techniques on how their data were collected, analyzed. The National Statistics Office was not yet satisfied with the quality of data provided from government departments, including the Department of Forestry. It was caused by the lack of officers' capacities for analysis and reporting. Information sharing between some major governmental departments is restricted. Accessibility of information was very limited due to its confidentiality.

A study on forest monitoring, assessment and reporting (MAR) was conducted in Vanuatu. The objectives of the study were to assess the technical capacity of the Department of Forests (DoF) to capture and process data and information in comparison to international and national needs for reporting on forests; assess the usefulness of the equipment and tools used; and discuss future activities. The study was carried out through review of available documents and interviews with various government staff.

The study provided general recommendations on future implementation of a forest MAR programme in Vanuatu by increasing the capacities of DoF, including: (i) a field inventory of forest resources combined with satellite imagery analysis and ground truthing to reduce costs; (ii) assistance to the DoF in completing the current forest resource information system (FRIS) integrated with Mapinfo and revised VANRIS, supporting the loading of new land survey maps into the system and updating of all other layers of data so that users can select them as needed; (iii) training for five technical officers on interpretation

of satellite imagery with upgraded equipment; and (iv) a workshop to review various data categories of different government organizations to elaborate standard sets of forest definitions and classifications that meet all departments' needs (Corrigan 2009). This could involve changes in the database system of the DoC so that the DoF is able to retrieve relevant forest-related data for reporting.

The National Statistics Office recommended that management of all forestry data be centralized and updated regularly on a quarterly, monthly or annual basis. It would be best to use simple database formats, and NSO would help the DoF to create simple database formats. The VANRIS would have to be updated. The DoF should develop better data collection and storage methods with reference to reporting systems in FRA and ITTO. During the second NN workshop in 2009, the development of a national forest inventory was suggested through satellite imagery analysis with some ground truthing.

- **Activities for Development Phase II**

The second round of the MAR programme in Vanuatu started to assess and reclassify vegetation by developing a remote sensing (RS)/geographical information system, GIS monitoring system and preparing the Vanuatu vegetation map (**Figure 19**). An implementation plan was developed based on a study report that was compiled in the first MAR programme, whereby all the major stakeholders in the national MAR network were consulted to identify existing information and database components that were operated by the respective stakeholders (Viranamangga 2010).



**Figure 19. Creation of unsupervised vegetation classification** Source: VDoF (2010)

The second MAR programme was expected to facilitate coordination with the DLS and other stakeholders to develop a harmonized MAR system in Vanuatu. Assessment and classification of the Vanuatu vegetation should be the baseline information to update its national forest inventory, which would include an inventory of timber, carbon stock and biodiversity. Furthermore, it would help Vanuatu to give effective reporting to all processes on forest resources and other natural resources. The following activities were conducted during January – July 2010:

- Activity 1 - Interpretation of GIS & RS and creating an unsupervised vegetation classification.
- Activity 2 - Field check of the unsupervised vegetation classification on the islands of Efate, Santo, Malekula, Erromango and Aneityum.

Activity 1 was undertaken by a consultant to interpret the GIS & RS and create the unsupervised vegetation classification with radar images from the DLS and the Landsat 7 TM from the Carbon Credit Project and various websites on the internet. The unsupervised vegetation was classified for Efate using radar images with various images.

Intensive field checks of vegetation (Activity 2) were conducted in Efate and the offshore islands to obtain a good knowledge of the type of vegetations observed from satellites images. Original vegetations on Efate that were accessible had changed to other land uses and, due to the current population pressure, the remaining interior forests were slowly disappearing.

Similar to Efate, most of the forests along the eastern and southern parts of the islands had been destroyed and converted to various land uses. The mid-height open forest in the eastern islands were heavily logged and covered by *Meremia peltata* and pioneer trees species and shrubs such as *Magaranga*, *Hibiscus tilliacies*, *Trema orientalis*, etc. Logged-over areas were converted into agricultural land (including coconut plantations), grazing land, and shifting cultivation.

### **4.3. Sub-regional/national activities**

This section briefly reviews the outcomes and lessons of sub-regional/national MAR activities in comparison to global activities.

#### **4.3.1. Outcomes and challenges of sub-regional/national MAR**

Several countries as well as regional organizations actively initiated forest MAR programmes in the fields of field-level and satellite data collection (forest inventories, medium- (Landsat, etc.) and high-resolution (IKONOS, etc.) imagery analysis), common reporting systems (building on C&I, etc.), and numerical or visual database management (using Excel, Access, ArcView, Mapinfo, Erdas, etc.), as well as stocktaking studies, stakeholder networking and capacity building. Countries and organizations share their technical expertise and resources with other partners within or outside the countries. There is some form of organizational structure to facilitate national MAR processes at the central levels. Pilot small MAR programmes contributed to

clarifying current national or sub-regional capacities for MAR and the need for further MAR development, and provided some support to strengthen MAR systems in the countries or sub-region.

Nevertheless, countries still face limitations in technical and financial capacities to fully develop and implement national MAR systems. There is a great need to assist local-level organizations (FMUs) to fully adopt national MAR systems, and to introduce and elaborate technical guidelines for advanced data collection and management, including carbon monitoring. Governments have to allot sufficient funds to support national MAR activities, including technical development and pilot testing, field operations (e.g., monitoring and data collection, etc.) and central-level activities (e.g., data analysis and management, dissemination and reporting), capacity building, stakeholder networking, and policy development. The project initially supported national and sub-regional network development for harmonization of MAR, but only a few countries could prepare budgets to sustain such MAR networks.

The development process for MAR is quite long because countries need to arrange for technical, organizational, and financial resources in collecting, managing, and reporting forest-related information. The project supported partner countries in implementing small pilot MAR programmes, but these countries need to follow up and enhance such programmes within their budgets or seek alternative external resources.

#### **4.3.2. Linkages between sub-regional/national MAR and global MAR**

Many of the pilot sub-regional and national MAR programmes were built on international technical sets, including C&I, FRA, and NFMA. In particular, many of the project countries and sub-regional organizations are highly concerned with the application of C&I to promote and measure SFM. ASEAN strongly supports the regional C&I reporting process to make the forest management capacities of member states more visible and transparent. The countries also pay attention to effective reporting to FRA in its harmonized format in coordination with other reporting processes including the ITTO C&I, CBD, UNFCCC, etc. The SPC studied the NFMA package to examine its applicability in the Pacific region, and proposed adaptive field monitoring methodology by modifying the NFMA tool. Countries are trying to harmonize forest definitions and classifications to these international reporting processes and monitoring programmes.

Despite such linkages and interactions, countries still have their own specific needs to develop and improve national MAR systems. In particular, there are various data collection or monitoring methodologies with different tools and

expertise in various forest conditions. A single monitoring methodology cannot be applied to all countries but it is not easy to find a procedure for harmonization of data collection and management approaches in different countries.

Forest definitions and classifications also vary among countries and do not always rely on international standards such as the LCCS. The countries require an effective methodology to assess carbon stock while the MRV is being tested in some pilot countries. Top-down introduction of international packages to countries would be less feasible under various ecological and socio-economic conditions, and countries require a degree of flexibility in developing national MAR systems.

#### **4.3.3. Harmonization of MAR at sub-regional/national levels**

Project countries are quite aware of the need for harmonizing national MAR systems among national and local stakeholders, which led to the development of national networks. It is also effective to consolidate several technical packages that have been received from different technical or donor organizations within countries. Participating countries promoted harmonization of MAR systems under pilot programmes with reference to international and national methodologies. However, there are still tendencies for different government agencies and other organizations to utilize different approaches or methods without mutual coordination for harmonization. It is often pointed out that government agencies involved in MAR processes lack mutual communication and coordination, and that they keep their own data for different purposes. Even the project cannot easily break through such institutional barriers in harmonizing national MAR, depending on the political will in these countries.

It appears that harmonization among countries at the regional level would be more difficult due to diverse forest resource conditions among countries. However, sub-regional coordination would be feasible among neighboring countries that share similar characteristics. In fact, sub-regional forestry organizations (e.g., ASEAN, SPC, SAARC-Forestry Centre, ICIMOD, etc.) motivate member countries to coordinate forest-related activities, including MAR. It would be easier to promote harmonization of forest MAR systems among countries through these sub-regional organizations.

#### **4.3.4. Way forward**

The MAR project provided assistance to participating countries or organizations in studying and implementing MAR systems during the period 2006 – 2010. In

order to build on the initial outcomes of pilot activities, countries will have to further elaborate the MAR approaches. Development and improvement of the overall MAR methodologies, including advanced monitoring technologies, strengthening of MAR harmonization among national and regional stakeholders, and coordination between countries and international organizations on harmonized MAR should be a continuous process, supported partly by external organizations. On the other hand, international organizations are requested to clarify minimum levels of MAR harmonization while supporting the countries' initiatives for their specific development to suit their special needs.

## 5. Terminal evaluation of the MAR project

The independent evaluation team conducted a terminal evaluation of the MAR project during 7–27 November 2010 with country visits to Cambodia, Indonesia, Philippines and Vietnam, as well as at FAO Headquarters and the Regional Office for Asia and the Pacific. They held meetings and interviews with relevant stakeholders, and conducted questionnaire surveys with project focal points. The evaluation team was impressed with the active collaboration by project countries and suggested a need for a comprehensive technical analysis of outcomes and lessons gained through the MAR project for future implementation of similar activities by countries and international organizations.

The evaluation team made the following points about the MAR project:

- Project objectives and design: Although the objectives were relevant to addressing the issues, the project objectives were too wide and general. The number of participating countries and issues were too large to fully achieve all the expected outcomes within the limited timeframe and budget. Although its design appeared logical and efficient, the project faced several institutional bottlenecks, ambiguity and communication issues during its implementation.
  
- Project implementation and efficiency: The guidelines and database were not developed by the project itself at the international level, but contributed to improving and harmonizing FRA guidelines. It is important to note that other FAO programmes at HQs were supporting the development of global guidelines. Along with the REDD process, the scope of forest-based MAR and the data needs were undergoing many changes at the international level. Quantification of project outputs in isolation is a complex issue regarding harmonization, networking, and awareness raising for MAR. According to the interviews and meeting results, the project made important contributions to enhancing forest MAR systems at international, regional and national scales. Although a considerable amount of funds were disbursed to cover administrative costs, the project substantially supported operational activities including workshops, training, and pilot programmes. Expected outputs and impacts were directly visible to the evaluation team in the three countries visited (Cambodia, Philippines and Vietnam), where remarkable achievements in formulating and applying national-level MAR frameworks could be seen. Contributions from other projects and countries were also valuable in project implementation. In addition, recipient countries mobilized resources efficiently and effectively to achieve expected goals.

- Effects and impacts: The effects of the project were manifest in the participation of 27 countries in the forms of meetings, workshops, working papers, newsletters, etc. The general impression was that the project made significant contributions to motivating planners and policy makers. As a result, policy and planning institutions in several of these countries had begun to use MAR for forestry planning, decision-making and international reporting.
- Sustainability: Seeing that all project activities aimed to improve forest resources and indirectly the environment, their impacts will be visible only on a long-term basis. Interactions with the REDD process would be significant to support the activities for a long period with considerable funds.
- Major factors affecting project results: The limited capacities of the project in terms of budget and staff hampered full-scale implementation of activities to achieve its very ambitious objectives. Furthermore, there were other related programmes of FAO also developing technical MAR specifications, with which project activities were restricted in technical aspects and thus were a great limitation for the project. Moreover, there is an on-going debate on the synergy between MRV and MAR at international and national levels under the evolving REDD process.
- Conclusions: The project was very ambitious in its objectives, scopes, target area and expected results. The project design appeared logical, but many institutional bottlenecks, ambiguity and communication issues were experienced during the project's implementation. The complexity of these issues was underestimated. Although global-level activities were not completed for the first two years, the project contributed to upgrading and implementing international and regional frameworks and guidelines. As a whole, national-level activities in core countries were successful in achieving the expected objectives. Harmonization and standardization of MAR is a complex task and a continuously evolving process. Although the project contributed to improving the MAR system at international and national levels, institutionalization of the MAR system still needs to be followed up in the Asia-Pacific region.
- Recommendations:
  - The project has gathered and produced a lot of information and documents on MAR, but they are scattered and not easily accessible. Preparation of a comprehensive report on project achievements would be useful to assemble the enormous mass of information collected by the project.

- The overall MAR-related activities should be handled by strengthening existing mechanisms of FAO. Further interventions are required to institutionalize MAR at the national level.
  - FAO should take a leading role in upgrading the existing framework of MAR-SFM and the methodology of NFIs as the requirements of MRV.
- Lessons Learned:
- The institutional setting of the project was multifaceted and fragmented, and this created a number of ambiguities during the project execution. The efficiency and the effectiveness of the project were often limited due to the vast scope and complex institutional arrangements.
  - It is clear that the outputs and impacts of a project are directly proportional to available resources and inputs. Forest-based MAR is a system of information management that is a continuous process. Considerable efforts will be required for capacity building and technical backstopping with sufficient funds and staff to improve forest MAR in the Asia-pacific region.

## **6. Conclusions and recommendations**

This section compiles the conclusions and recommendations of the MAR project.

### **6.1. Summary of activities**

The following descriptions summarize the results of the MAR project with reference to its initial concept.

#### *Institutional frameworks*

The project has evolved institutional frameworks at international, regional, and national levels in forest MAR activities. The project identified a number of international programs or processes, including COFO, CPF, FRA, UNFCCC/IPCC, CBD, UNFF, UNCCD, etc. Project linkages were also enhanced with CPF, NFMA, FRA, UN-REDD, UNEP, CBD, ITTO, GLCN, INBAR, IIRS, ASEAN, and the SPC. National focal points were nominated in 27 countries as well as sub-regional focal points in ASEAN and the SPC. National MAR programmes were initiated in 13 countries (Bangladesh, Bhutan, Cambodia, China, India, Mongolia, Myanmar, Pakistan, Philippines, Papua New Guinea, Solomon Islands, Vanuatu, and Vietnam) and sub-regional programmes with ASEAN and the SPC. Through workshops and meetings, the project undertook networking with MAR stakeholders, baseline studies and pilot testing on MAR methodologies and capacity building of relevant officers. Thirteen countries and two sub-regional organizations implemented studies and development of vegetation mapping, forest inventories and associated database systems and elaboration of C&I reporting systems with focus on harmonized reporting.

The project facilitated identification of major stakeholders for forest MAR with national focal points, concerned government agencies, research institutes, universities, NGOs, private companies/associations, donor organizations, and committees. The role of information gathering agencies is primary to strengthening forest MAR, such as forest survey institutes, mapping agencies, remote sensing agencies, and national statistic offices. Contributions from the private sector and local stakeholders are essential to increasing data collection capacities.

### *Harmonized technical guidelines*

The project conducted questionnaire surveys on NFI in 19 Asian countries, for which country NFI briefs were prepared. The questionnaire surveys highlighted a high diversity of NFI systems in Asia, although their technical capacities are not yet sufficient to deal with a variety of forest and environmental indicators. It was suggested from the survey that the process of harmonizing, broadening and integration of the systems into the overall national forest monitoring systems be developed through collaboration with international organizations during the NFI workshop in China in 2007. The workshop on reporting harmonization and FRA2010 in Malaysia in 2008 highlighted the necessity for substantive efforts to collate forest-related information with various organizations at the national level. Coordination among national agencies and international organizations needs to be strengthened to promote harmonization of forest-related reporting. Development of an international MAR framework requires extensive time in connection with other related programs.

The workshop on LCCS and remote sensing in India in 2006 clarified the outcomes and challenges of the harmonization of forest and land cover classification in the Asia-Pacific region. Participating countries required more efforts for harmonization with coordination and networking mechanisms at national and regional levels. Furthermore, the project developed a manual on deforestation, degradation, and fragmentation by comparing various remote sensing and GIS tools, and a GIS primer on the illustration of spatial data through NFI with reference to NFMA database packages. The project required intensive coordination with FAO-HQs programs concerned with forest MAR for synergistic technical development. The project's workshop on remote sensing in Japan in 2010 illuminated the effectiveness of utilizing advanced forest and carbon monitoring with ALOS and PALSAR, while raising technical issues to further adjust technologies with FAO monitoring programs.

### *Sub-regional and national workshops on MAR*

Six sub-regional workshops were held on overall MAR and its harmonization, C&I, and NFI. It will be necessary to further adjust the regional online and offline C&I framework to the national C&I schemes with minor improvements. A Pacific network of experts for MAR will have to be strengthened for harmonization of forest MAR and proposed forest inventory techniques.

Various national workshops were held to facilitate development of national MAR systems in major project countries, focusing on harmonization of the existing MAR systems, networking of stakeholders, improvement of NFIs and vegetation mapping, elaboration of national C&I systems with training, etc. Many of the focal points and other stakeholders are still concerned about

national- and international-level harmonization of forest-related reporting, and strengthening of capacities for data collection and management through forest inventories and remote sensing. Application of national C&I systems in whole territories through capacity building of national and local stakeholders is considered essential in many countries.

#### *Database systems on MAR*

The 2007 workshop on long-term database management for SFM at the FAO-HQs, co-funded by the Republic of Korea, reaffirmed the need for follow-up training on database management in Asia, while reviewing the existing tools. The training workshop in 2010 on database management in Thailand reviewed the current technical development of FAO and other organizations and introduced simple and visualized database management techniques using open-source software, combined with GIS packages.

The project supported country initiatives to develop a database structure to manage forest MAR data in collaboration with ASEAN and SPC, building mainly on C&I sets. ASEAN provided training to countries for further elaboration and adjustment of regional and national C&I systems. The SPC proposed modified and simplified data sets for field-level forest monitoring and database management in large and small Pacific islands, building on NFMA forms. It is further necessary to examine these proposed data sets for coherent data collection at the international level in connection with FRA and other reporting processes.

Some countries (e.g., Cambodia, India, Philippines and Vietnam) studied and elaborated national C&I frameworks and their database systems in comparison to other reporting mechanisms and discussed measures to further harmonize national reporting systems on forest and environmental indicators. Despite existing national guidelines and training modules for C&I, these countries still required capacity building for further improvement of national database systems. Vanuatu and Papua New Guinea initiated updating of GIS techniques and database systems associated with NFIs.

#### *Information sharing networks*

The project promoted cooperation between information sharing networks and other networks of FAO and other international processes, including FRA. The project proposed a network of experts on NFI in Asia during the workshop in China in 2007, but its activities will need to be reconsidered by the countries. Sub-regional networks on MAR were reinforced in conjunction with existing sub-regional forestry networks. These networks were fully utilized to facilitate

MAR-related activities. National networks on forest MAR were developed or reactivated in 17 countries. Network meetings addressed issues on the improvement and harmonization of national forest MAR systems with thematic focuses such as C&I.

The size and membership varies among these national networks, but they are usually limited to the forestry administration and its partner organizations due to lack of the budget to maintain larger networks. Conflicting situations on forest and land management among government agencies hampered the extension of networking efforts in some countries. It will be crucial to mainstream the national networks into overall national forestry programs and policies to ensure their sustainable management.

## **6.2. Overall conclusions**

The MAR project introduced global MAR packages developed by FAO and other organizations to countries and sub-regional organizations, while supporting regional and national initiatives for harmonization and development of forest MAR systems. Some countries or sub-regional organizations tested these packages in their pilot activities for further adaptation. The project made considerable efforts to strengthen harmonized forest MAR systems in the Asia-Pacific region with a series of regional and national training workshops on MAR and pilot activities in selected countries. Participating countries could improve their knowledge in thematic MAR techniques through pilot activities with their own initiatives, although their administrative capacities were limited within government organizations or with FAO in program management.

Countries promoted the initial process of MAR harmonization with international communities and regional/national stakeholders under the project, but their efforts were not yet completed. Advanced technical development and capacity building of national and local stakeholders would be essential to further improve MAR processes. The MAR project could support countries and sub-regional organizations at the initial stage, whereas the outcomes and lessons would have been better captured and applied in other ongoing MAR-related programmes and policies. Global technical MAR issues beyond the capacity of the MAR project will have to be addressed in a more global setting.

The project could incorporate international-level technical guidelines and manuals with other partners for its activities, while the elaboration of overall MAR frameworks and guidelines required more time in synergistic and evolutionary processes. The project by itself was not in a position to accomplish complete comprehensive MAR frameworks at the global level, but close

coordination with other related programmes required more extensive time than expected for this purpose.

The latter stage of the project tried to balance synergistic development of MAR techniques at the central level and their flexible application or innovative MAR development with country initiatives. It was important for the project to build on existing technical development at FAO and other international organizations, and support the development of national or sub-regional MAR systems in view of national and sub-regional situations. It is further necessary to consider the adjustment of global, regional, and national MAR systems in future technical development.

### **6.3. Recommendations**

While the project encouraged the initial development and application of forest MAR systems in Asia-Pacific, its activities will need to be followed up at the global, regional, and national levels. Project countries will have to continue activities related to MAR after the project is closed, referring to its outcomes. They are encouraged to continue MAR activities with their own budget for sustainable programme development and management, although they may take advantage of external funding opportunities. They will have to make efforts to further elaborate and mainstream MAR policies and programs into overall national forest policies and programs to enhance SFM, while facilitating sufficient budget allocation. Linkages with public and private stakeholders should be strengthened to mutually support MAR development processes.

Close collaboration between countries and international or regional organizations, as well as among countries, will be crucial to improve national MAR systems with mutual technical inputs. Optimal collaboration should be ensured among these entities to catch up with the latest technical development on MAR with various training programmes and better incorporate national initiatives and expertise into global guidelines.

FAO is expected to follow up MAR activities in its related programmes. The MAR project was aimed at overall development of MAR aspects as the initial stage, while follow-up programs would focus on specific thematic subjects for more intensive technical assistance to countries and partner organizations.

Follow-up MAR activities in countries would be recommended on priority issues, including C&I development and reporting harmonization, NFI development and harmonization, updated satellite monitoring and verification technologies, monitoring of climate change and other environmental indicators, and MAR database management.

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## Appendix 1. List of sub-regional and national pilot MAR programmes supported under the MAR project

Country	LOA/FBA programmes (TORs)	Duration	Budget	Outcomes	Issues
Bangladesh	(i) Develop a national network (NN) /national steering committee (NSC) for MAR-SFM (ii) Assess needs and capabilities of NN members (iii) Develop recommendations for harmonization/standardization of MAR systems (iv) Develop methodologies and tools for a harmonized MAR system (v) Build capacities of NN member institutions and policy makers on MAR-SFM (vi) Raise awareness among the public on MAR-SFM	3 May 2009 – 31 December 2010	754,350 taka (US\$ 11,029) FBA from RAP to FAOR-Bangladesh; LOA between FAOR and the Forest Department	Initial NN meeting was held	Implementation largely delayed due to internal procedures and administration with FAO Reports hardly received (discussed with focal point during the workshop)
Bhutan	(i) Set up a NN/NSC for MAR-SFM (ii) Assess needs and capabilities of NN members (iii) Formulate recommendations on harmonization/standardization of MAR systems (iv) Develop methodologies and tools for harmonized MAR system (v) Implement capacity building activities on MAR-SFM for NN member institutions and policy makers (vi) Raise awareness among the public on MAR-SFM	3 January 2008 – 31 December 2010	445,548 BTN (US\$ 11,294)	The NN was organized A workshop was held to discuss development of NN NFI is being reviewed (hire of consultant was cancelled)	Delayed programme implementation Synthesis of technical review on MAR
Cambodia	<u>Phase I:</u> (i) Establish a NN of focal points on forest-related MAR-SFM and/or a NSC to develop a national mechanism of harmonized/ standardized MAR-SFM (ii) Conduct study on current situations of MAR-SFM and measures to harmonize collection, analysis, and reporting of forest-related MAR information (iii) Develop better methodologies and tools for the harmonized MAR system on the basis of the C&I framework (iv) Assess needs and	4 May 2007 – 21 January 2009	US\$11,000	The NN/NSC were organized A study was made with a consultant on national C&I set Based on study results, the national C&I format was proposed A national workshop and NN meeting was held to	Completed, though implementation was prolonged

	<p>capabilities of the NN members to elaborate training programmes on MAR-SFM</p> <p>(v) Organize a training workshop to the NN members on the harmonized MAR-SFM system elaborated in the activities</p> <p>(vi) Disseminate information on MAR-SFM to the related stakeholders and the general public to raise their awareness.</p>			<p>discuss the proposed C&amp;I format for finalization</p> <p>The proposed C&amp;I format was authorized</p> <p>The C&amp;I format was shared with other organizations</p>	
	<p><u>Phase II:</u></p> <p>(i) Facilitate review and further development of the national MAR-SFM format at both national and Forest Management Unit (FMU) levels</p> <p>(ii) Promote establishment of MAR by setting up a database management structure</p> <p>(iii) Develop a national information sharing network to enhance effective MAR activities at the national and FMU levels</p> <p>(iv) Strengthen capacity building to NN members on the MAR-SFM system.</p>	<p>21 July 2009 – 31 December 2010</p>	<p>US\$ 27,080</p>	<p>Pilot testing sites were established in Kampung Thom District</p> <p>Database systems were studied.</p> <p>Online MAR systems were developed</p> <p>Data collection was made to test developed MAR C&amp;I format.</p> <p>National training workshop was held during 11-12 November on C&amp;I.</p>	<p>Activities were done well, though it is necessary to be further followed up.</p>
China	<p>(i) Identification of stakeholders related to the activities;</p> <p>(ii) Diagnostic study to review current forest-related national MAR systems and propose recommendations for harmonization of international reporting;</p> <p>(iii) National workshop to deliberate on the results of the diagnostic study and propose action for the harmonization of international forest-related reporting;</p> <p>(iv) Formulation of policy recommendations to the State Forestry Administration, based on recommendations of the</p>	<p>29 April 2007 – 7 July 2008</p>	<p>85,580 Yuan (US\$11,000)</p>	<p>Stakeholders were identified</p> <p>Diagnostic studies were made, clarifying issues/ recommendations for harmonization such as needs for international reporting harmonization and technical support to</p>	<p>Follow-up activities could not be organized.</p>

	workshop; (v) Formulation of a proposal for activities under the project for harmonization of the national MAR system and international reporting;			national agencies A workshop was organized to discuss harmonization of MAR systems	
India	(i) Strengthen a NN/NSC for MAR-SFM (ii) Review the current MAR-SFM systems to propose methods for their harmonization and broadening (iii) Assess needs and capabilities of NN members for MAR-SFM (iv) Identification of approaches to Sustainable Forest Management in India's perspective (v) Organize a workshop on harmonization of MAR information systems (vi) Propose recommendations for harmonization/standardization of MAR systems (vii) Raise awareness among the public on MAR-SFM	16 July 2007 – 28 August 2009	Rs. 798,245 (US\$19,579)	National MAR network was established and maintained with regular meetings to discuss harmonization and other technical issues Studies were made on the national MAR system, particularly the national C&I system A workshop was held to present results of pilot C&I testing and other MAR technologies and discuss recommendations on next steps of harmonization and capacity building.	The second LOA was proposed to support SAARC Forestry Centre, but it was not accepted.
Mongolia	(i) Develop a NN and a NSC through identification of their members (ii) Assess the needs and capabilities of NN members for MAR-SFM (iii) Organize a workshop on harmonization of MAR information systems (iv) Propose recommendations for harmonization/standardization of MAR terms (v) Develop methodologies and	4 May 2007 – 18 December 2009 (discontinued)	19,206,936 MNT (US\$16,500)	NN/NSC were established NN meetings were held to plan MAR activities and recruitment of consultants Studies were conducted on overall reporting systems,	The programme could not be continued after restructuring of the government, resulting in dismissal of the focal point.

	tools for harmonization/standardization of the MAR system (vi) Develop a communication strategy to raise awareness of MAR-SFM among the public through a website on MAR-SFM in Mongolia.			harmonization of MAR, and C&O formats A national workshop was organized to discuss results of these studies	
Myanmar	(i) Develop a NN of stakeholders on forest-related MAR to strengthen a national mechanism of harmonized/standardized forest MAR (ii) Conduct studies on desirable methodology for harmonized forest MAR through reviewing the current national C&I framework, including a national forest inventory, a database management system, and reporting harmonization. (iii) Elaborate better methodology for the harmonized MAR system based on results of the studies. (iv) Assess needs and capabilities of NN members to elaborate training programmes on forest MAR (v) Organize a training workshop to NN members on forest MAR techniques elaborated through the activities (vi) Establish/develop a National Forest Management Information Unit in the Forest Department and organize a training workshop on forest information management. (vii) Improve a national mechanism of harmonized MAR in linkage with international/ regional processes on MAR (viii) Disseminate information on forest MAR to the related stakeholders and the general public to raise their awareness.	23 July 2009 – 31 December 2010	US\$ 24,050	NN is being developed	Activities were largely delayed due to internal problems (change of personnel, etc.)
Pakistan	(i) Strengthening of NNs for MAR-SFM (ii) Study on “Appraisal of the current forest assessing, monitoring and reporting systems in use of provincial	2 July 2007 – 12 June 2008	Pakistan Rs. 679,000 (US\$11,268)	NN was established and maintained NN meetings were held	Follow-up activities could not be initiated after the study Political instability disturbed

	and federal institutions and MAR-SFM strategy for the future” (iii) National Workshop on MAR-SFM			MAR study were conducted to comprehend MAR stakeholders and issues on harmonization A workshop was held to discuss the study report and next steps for MAR harmonization.	collaboration.
Papua New Guinea	(i) Make improvements to the existing forest Inventory related database systems including testing and commissioning of improvements (ii) Resurrect use of the above-mentioned database systems and ensure that the systems add value to PNGFA research and operations and also to all other stakeholders that have an interest in Forest Inventory data and information.	1 February 2010 – 31 December 2010	30,000 Kina (US\$11,858)	A new database system and software were tested and improved. A workshop was held to discuss application of the new database system (planned)	Need further follow-up assistance
Philippines	<u>Phase I:</u> (i) Identify and designate DENR regional/field staff as focal points for C&I; (ii) Review the current C&I system (achievements and limitations) at the national and Forest Management Unit (FMU) levels to clarify training needs; (iii) Organize NN meetings on C&I with the designated focal points; (iv) Conduct an awareness campaign for staff of the DENR Field Offices and FMUs; (v) Prepare training modules and other background materials; (vi) Facilitate logistic preparations for the training; (vii) Select FMU site(s) for the C&I and Forest Audit hands-on exercises to update baseline data/information of the selected	28 December 2007 – 15 July 2009	PHP 513,260 (US\$10,567)	A NN of C&I focal points were established. NN meetings were held to discuss application of national C&I framework Study and formulate guidelines for national C&I Develop a training module for C&I Conduct awareness campaign Conduct training on C&I at two pilot sites Synthesize	

	<p>FMU(s);  (viii) Conduct actual training at DENR Field Offices and FMUs on the use and application of the C&amp;I and Audit System for SFM; and  (ix) Prepare and submit final and other pertinent reports.</p>			<p>results of C&amp;I training, requiring further capacity development for thematic indicators</p>	
	<p><u>Phase II:</u>  (i) Conduct an awareness campaign for the DENR Field Offices and FMU staff and designate DENR regional officials as focal points for C&amp;I in Regions 01, 02 and CAR in Luzon;  (ii) Identify pilot FMU(s) to adopt the C&amp;I and Audit system in actual management, planning, monitoring and assessment of forest management activities;  (iii) Conduct baseline data/information gathering of the selected FMU(s) prior to the conduct of C&amp;I Audit exercise;  (iv) Conduct training of FMU(s) and DENR officials/focal points on the use and application of the C&amp;I and Audit System for SFM;  (v) Integrate the C&amp;I and Audit system in the actual management, planning, monitoring and assessment of forest management activities;  (vi) Conduct regular monitoring of the FMU's actual application of the C&amp;I system;  (vii) Conduct an in-depth study on the applicability and limitations of the full integration of the C&amp;I system involving FMU officials and field staff;  (viii) Conduct validation on FMU adoption of the C&amp;I system in actual operation (management, planning, monitoring, etc.); and  (ix) Prepare and submit final and other pertinent reports.</p>	<p>5 February 2010  –  27 November 2010</p>	<p>PHP 1,511,700 (US\$32,433)</p>	<p>Conducted awareness campaigns at target areas  Conducted studies and training to selected FMU and DENR regional offices.  Facilitated validation of C&amp;I systems  Made overall synthesis of training/studies</p>	<p>Need further follow-up, while coordinating with other programmes (ASEAN C&amp;I, etc.)</p>
Solomon	<p>(i) Establish a Pilot PSPs (Permanent Sample Plot) in Guadalcanal with a recommended design under training for Forestry officers to</p>	<p>16 June 2010  –  31 December</p>	<p>S.I. \$395,477 (US\$49,871)</p>	<p>Pilot PSPs were established in pilot provinces</p>	<p>Need follow-up assistance and monitoring</p>

	<p>adopt all necessary skills for the successful implementation of objective</p> <p>(ii) Examine permanent sample plots (PSPs) for data collection on the forests resources</p> <p>(iii) Develop additional components to the current database of Forest Resources Information System (FRIS)</p> <p>(iv) Strengthen the technical capacity of the staff through training</p> <p>(v) Raise awareness of forestry stakeholders on the significance of PSPs</p> <p>(vi) Elaborate of a mechanism to manage and maintain PSPs after the project support.</p>	2010		(Malaita, Guadalcanal)	
Vanuatu	<p><u>Phase I:</u></p> <p>(i) Establish a NN/NSC for MAR-SFM</p> <p>(ii) Conduct a case study on MAR SFM in the following subjects:</p> <p>(a) Data collection and updating process</p> <p>(b) Alternative methodologies for data capturing</p> <p>(c) Data harmonization/cross check</p> <p>(d) Policy development for SFM with MAR data</p>	20 June 2007 – 23 July 2009	550,000 Vatu (US\$5,202)	NN/NSC were established NN meetings were held A baseline study was conducted and a report was prepared, recommending updating of Vanuatu information system and forest cover assessment.	
	<p><u>Phase II:</u></p> <p>(i) To assess and reclassify Vanuatu vegetation through the use of GIS and RS</p> <ul style="list-style-type: none"> <li>• Purchasing of GIS and RS equipments and software</li> <li>• Interpretation of GIS &amp; RS and create unsupervised vegetation classification,</li> <li>• Field check of the Unsupervised vegetation classification,</li> <li>• Creating the supervised vegetation classification,</li> <li>• Presenting the final product to the Vanuatu Government.</li> </ul>	3 February 2010 – 27 November 2010	8,834,480 Vatu (US\$90,508)	Vegetation analysis technologies were reviewed and proposed through collaboration with a German consultant Equipment was supplied Training was conducted for technical staff Field checks were conducted in selected islands	Need further follow-up for finalization and full application of proposed techniques.

Vietnam	<p><u>Phase I:</u></p> <p>(i) Establish a NN of focal points on forest-related MAR-SFM and/or a NSC to develop a national mechanism of harmonized/standardized MAR-SFM</p> <p>(ii) Conduct study on current situations of MAR-SFM and measures to harmonize collection, analysis, and reporting of forest-related MAR information</p> <p>(iii) Develop better methodologies and tools for the harmonized MAR system on the basis of the C&amp;I framework in corresponding with national standard</p> <p>(iv) Collection and revising of the MAR method and regulation of Vietnam follow up the MAR of FAO</p> <p>(v) Assess needs and capabilities of the NN members to elaborate training programmes on MAR-SFM</p> <p>(vi) Organize a training workshop for the NN members on the harmonized MAR-SFM system elaborated in the activities</p> <p>(vii) Disseminate information on MAR-SFM to the related stakeholders and the general public to raise their awareness.</p>	7 August 2008 – 4 August 2009	US\$14,500	<p>NN was established</p> <p>Studies were conducted on different reporting systems (C&amp;I, FOMIS, &amp; FRA) and their harmonization, legislative systems for MAR</p> <p>Based on study results, recommendations were formulated to conduct an in-depth study on harmonized reporting formats</p> <p>A workshop was organized to endorse study results and suggest next steps</p>	
	<p><u>Phase II:</u></p> <p>(i) Elaborate guidelines for calculation indicators which have not been available in Vietnam such as volume stock of dead wood, volume stock of other wooded land, carbon stock and data on education, data on forestry labor.</p>	28 January 2010 – 27 November 2010	US\$16,000	<p>A technical guideline was formulated to prepare data for indicators required in national reporting systems</p> <p>A workshop was organized to discuss the guideline</p>	Further follow-up is required to test and disseminate the guideline
ASEAN	<p><u>Phase I (with FRIM):</u></p> <p>(i) Pre-assessment on the progress in the application of MAR Format for Sustainable Forest Management (SFM) in ASEAN after the introduction of online MAR format through ASEAN Forestry Clearing</p>	12 September 2008 – 23 July 2009	RM 177,169 (US\$ 53,521)	<p>Online MAR format was elaborated/improved by consultants after being reviewed</p> <p>A regional</p>	

	<p>House Mechanism (CHM);</p> <p>(ii) Organize a regional training workshop in Malaysia on the application of MAR format for SFM in ASEAN, and learning from Malaysia national experience; and</p> <p>(iii) Formulate recommendations on follow-up activities for identification of capacity building needs of ASEAN Member States on the application of MAR</p>			<p>training workshop was held to present and discuss ASEAN online C&amp;I format at a national level</p> <p>Recommendations were made, including follow-up improvement of ASEAN formats and training workshops</p>	
	<p><u>Phase II:</u></p> <p>(i) Improvement of online and offline MAR formats and application in ASEAN region;</p> <p>(ii) Organize a Regional Training Workshop (Vientiane, Lao PDR) on the application of offline MAR format for SFM for Forest Management Units (FMU) in ASEAN;</p> <p>(iii) Organize a Regional Coordination Workshop (Yogyakarta, Indonesia) to conduct a comparative analysis between regional and national C&amp;I frameworks and MAR implementation mechanisms; and</p> <p>(iv) Provide recommendations on follow-up activities for identification of capacity building needs of ASEAN Member States on the application of MAR.</p>	<p>2 October 2009 – 15 October 2010</p>	<p>US\$ 73,010</p>	<p>Online/offline formats were improved/elaborated (not complete)</p> <p>Training workshops were held in Lao PDR and Indonesia</p> <p>Synthesis was made</p>	<p>Further follow-up is required to finalize ASEAN C&amp;I formats and packages with countries</p>
SPC	<p><u>Phase I:</u></p> <p>(i) Conduct studies on MAR systems for SFM in the Pacific countries</p> <p>(ii) Elaborate a draft long-term umbrella plan on forest-related MAR for Pacific countries</p> <p>(iii) Develop a regional network on MAR</p> <p>(iv) Organize national focal point meetings to discuss and endorse findings and recommendations from the studies</p>	<p>15 January 2008 – 11 February 2009</p>	<p>US\$ 46,753</p>	<p>Studies were made on national reporting capacities for FRA 2005, information sharing networks, and vegetation assessment techniques</p> <p>A workshop was held to</p>	

				present and discuss study results and propose next steps such as study of inventory techniques for criteria indicators Regional network was discussed among workshop participants, using electronic techniques	
	<p><u>Phase II:</u></p> <p>(i) Conduct studies on methodologies for the five (5) priority criteria identified by the Pacific MAR Workshop in November of 2008</p> <p>(ii) Support development of a vegetation monitoring system for Pacific atoll island countries, starting with Kiribati</p> <p>(iii) Organize national focal point workshop in Nadi, Fiji to discuss and endorse findings and recommendations from the criteria methodological studies for monitoring on the priority criteria</p>	9 July 2009 – 26 August 2010	US\$ 67,750	<p>NFMA technologies were studied in the context of Pacific island countries</p> <p>A manual was elaborated to propose inventory techniques for large and atoll island countries by modifying NFMA</p> <p>A training workshop was held with field exercise to try and discuss the proposed inventory techniques</p> <p>Final synthesis was made</p>	Further follow-up will be required to finalize the inventory techniques and support countries to apply them.

## **Appendix 2. FAO staff that managed or supported the MAR project**

- (a) Officers
  - (i) Project-based officers
    - Chief Technical Advisor: Dr Kailash Chandra Govil  
(April 2006 – October 2007), FAO-HQs
    - Regional Technical Advisor: Mr Masahiro Otsuka  
(May 2006 – December 2010), FAORAP
  - (ii) Budget holders
    - Dr Peter Holmgren (April 2006 – December 2007)  
FAO-HQs (Forest Resources Development Division)
    - Mr Patrick B. Durst (May 2006 – December 2010)  
FAORAP (Forestry Department Group)
  - (iii) Lead Technical Officers
    - Dr Jim Carle/Mr Dan Olof Altrell  
FAO-HQs (Forest Management Unit/ NFMA)
  - (iv) Backstopping Officers
    - Ms Mette Loyche Wilkie  
FAO-HQs (Forest Assessment and Reporting  
Division/FRA)
    - Mr Adam Gerrand  
FAO-HQs (Forest Assessment and Reporting  
Division/FRA)
    - Ms Monica Garzuglia  
FAO-HQs (Forest Assessment and Reporting  
Division/FRA)
    - Mr Jonsson Örjan  
FAO-HQs (Forest Assessment and Reporting  
Division/FRA)
    - Mr Marco Piazza  
FAO-HQs (Forest Management Unit/NFMA)
    - Mr Mikko Leppanen  
FAO-HQs (Forest Management Unit/NFMA-Finnish  
Programme)
    - Dr Kim Hyunkwang  
FAO-HQs (Forest Management Unit/NFMA-Korean  
Programme)
    - Mr Danilo Mollicone  
FAO-HQs (UN-REDD Programme)
    - Dr Alberto Sandoval

FAO-HQs (UN-REDD Programme)  
Dr John Latham  
FAO-HQs (Natural Resources and Environment  
Division/GLCN)  
Mr Masakazu Kashio  
FAORAP (Forestry Department Group)  
Dr Appanah Simmathiri  
FAORAP (Forestry Department Group)  
Mr Petteri Vuorinen  
FAORAP (UN-REDD Programme)

(b) Consultants (project-based)

Dr Giri Tejaswi (Remote sensing/GIS, October 2006 - March 2007)  
Ms Cecilia Alarcón Salinas (GIS/NFMA, October 2006 – March 2007)  
Ms Serena Fortuna (NFMA, January – June 2007)  
Dr Anders Wellving (database management, March – September 2010)

(c) Evaluation mission

Mr Giuliano Soncini (Team Leader)  
Mr Prem Kandel (Technical specialist)  
Mr Rikiya Konishi (Donor representative)  
Ms Akie Kutsukake (Observer)

(d) Secretaries

Ms Fatiha Moussaid, Forest Resources Development Service  
FAO-HQs (April 2006 - October 2007)  
Ms Antonella Sorrentino Varanese, Forest Resources  
Development Service FAO-HQs (April 2006 - January  
2010)  
Ms Emma Foti, Forest Assessment and Reporting  
FAO-HQs (January 2008 - June 2009)  
Ms Kallaya Meechantra, Forestry Department Group  
FAORAP (May 2006 - December 2010)  
Ms Supaporn Daophises, Forestry Department Group  
FAORAP (project-based, May 2006 – August 2007)  
Ms Alisa Wacharasetkul, Forestry Department Group  
FAORAP (project-based, January 2008 – May 2010)  
Ms Ratchadaporn Sommaneevan, Forestry Department Group  
FAORAP (project-based, August 2009 – December 2009,  
June 2010 – December 2010)