Forest Resource Assessment in Nepal

An Assessment of Data Needs

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July, 2010

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Abbreviations

CBOs	Community Based Organizations
CBD	Convention on Biological Diversity
CBS	Central Bureau of Statistics
CFs	Community Forests
CFUGs	Community Forestry User Groups
CTA	Chief Technical Advisor
DBMS	Database Management System
DDC	District Development Committee
DFO	District Forest Office / District Forest Officer
DFRS	Department of Forest Research and Survey
DSCO	District Soil Conservation Office
DoF	Department of Forests
DPR	Department of Plant Resources
DSWM	Department of Soil Conservation and Watershed Management
FAO	Food and Agriculture Organization
FRA	Forest Resource Assessment
GBIF	Global Biodiversity Information Facility
GDP	Gross Domestic Product
GIS	Geographic Information System
GoN	Government of Nepal
GPS	Geographic Positioning System
ICT	Information and Communications Technology
LiDAR	Light Detection and Ranging
LFP	Livelihood Forestry Programme
MFSC	Ministry of Forests and Soil Conservation
NFI	National Forest Inventory
NGO	Non-Governmental Organization
NPC	National Planning Commission
NTFPs	Non-Timber Forest Products
PSP	Permanent Sample Plot
REDD	Reducing Emissions from Deforestation and Forest Degradation
R-PP	REDD Readiness Preparation Proposal
RS	Remote Sensing
STA	Senior Technical Advisor
SD	Survey Department (SD)
TA	Technical Assistance
TOF	Trees Outside Forests
ToR	Terms of Reference
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
VDC	Village Development Committee
WB	World Bank

Summary

Forestry sector of Nepal requires reliable, accurate and updated forestry information for strategic planning, policy and management decisions. However, forestry information management system in Nepal is poor due to scattered data in different organizations, lack of periodic data updating policy and the respective actions, and insufficient institutional capacity for data management. The last National Forest Inventory (NFI) was carried out in early nineties in Nepal. Since then, forests data have not been updated yet at national level and early nineties data do not represent present situation and growing demands of national/international data needs.

Forest Resource Assessment (FRA) Nepal project (2010-2014) has been designed to facilitate NFI in Nepal. The project is a bilateral cooperation between Government of Nepal (GoN) and Government of Finland (GoF). The objectives of the project are to improve the provision of adequate forestry data and its processing for national forest policy development and international reporting. Forest data users are wider and diverse at large extent. Data needs are different and vast at varied ranges. Therefore, finding out the data need is the initial point for planning forest inventory and to spell out the limitations of FRA project. For the purposes, a study was conducted to analyze the national and international data needs by using different tools and techniques. Previous NFIs were also reviewed to understand the methods and results.

The result reveals that forestry stakeholders and organizations demand for forest data at several levels and scales. The Constitutional Assembly (CA) has also a mandate to formulate constitution for Nepal and that requires high resolution precise map of natural resources (also including forest cover) to facilitate the national restructuring processes. The full coverage of data of forest attributes including forest carbon estimates are needed for the Reducing Emission from Deforestation and Forest Degradation (REDD) purpose. In addition to information on the traditional forest and tree characteristics, data are anticipated on dead wood, forest and soil carbon, river basin mapping, Trees Outside Forests (TOFs), human impacts, and biodiversity.

The forestry professionals suggest producing forest maps and statistics applicable for the district level forest management. However, it is important to note that FRA project has been designed to support for NFI not for district forest inventory. Methods and materials used by NFI could be scaled up later for district level forest inventory. Community based forestry organizations and concerned civil societies are asking to generate data applicable for management regimes. But it should be noted that small scale inventory (management level) with higher sampling intensity is needed to generate data for confined area. In NFI, data are obtained from entire country by using the same methodology. Therefore, information generating on each forest management regime is beyond the scope of the FRA project.

Country reporting variables developed by Food and Agriculture Organization (FAO) are guiding framework to generate forest data at national level. Moreover, FAO variables are compatible and can harmonize with most of the international conventions. International reporting systems demand data on socio- economic dimensions but FRA project has limitations to go away from its stipulated scope.

In addition to data needs for traditional users, this study specially recommends to address the data needs required for CA and REDD mechanism. Protected Areas (PAs) should be included in mapping and ground based inventory processes. The data on Non Timber Forest Products (NTFPs), TOFs, biodiversity, river basin and soil characteristics should be generated at national scale. Previous NFIs should be the subset of ongoing FRA to make it compatible and comparable. Country reporting variables developed by the FAO for the global FRA should be taken as the guiding principle during inventory design phase. Although data needs for each organization are separately presented in the main text of the report, glance of data needs is presented in summary table below.

Summary table: A glance of data needs

SN	Thematic elements	Variables
1	Extent of forest and shrub	• Area of forest and shrub at national and sub national levels
		• Forest types and species composition
		• Forest condition (crown/canopy and stem density)
		• Changes in forested & shrub areas
		• Area of reachable and non reachable forests
		• Extent (area) and percentage of total land area under each forest type
		• Extent (area) of forest establishment/rehabilitation and reforestation
2	Growing stock	• Total volume and volume per hectare (ha)
		• Volume of major species and forests
		• Total volume of broad leaved and conifer species
		• Number of stems per ha and status of development class
		• Total and species wise volume in each stratum (physiographic region)
3	Biomass	• Total live biomass in forest
		• Aboveground biomass
		• Belowground biomass
		• Deadwood biomass
4	Carbon stock	• Carbon in aboveground biomass (stem, stump, branches, bark, foliage)
		• Carbon in belowground biomass (carbon in all biomass of live roots)
		• Carbon in dead wood (carbon in all non-living woody biomass)
		• Carbon in litter
		• Soil carbon (Organic carbon and organic soils to a specified depth)
5	Soil and watershed	• Mapping of major river basins (Koshi, Narayani, Karnali and Mahakali)
		• Land use /cover map of Siwalik and all physiographic zones
		• Soil characteristics (soil porosity, permeability, texture, density, soil p^H content)
		• Land capability class and land system unit
		• Conditions of river basins and major watersheds
		• Slope susceptibility mapping and hazard data
		• Drainage density
6	NTFPs and Plant resources	• Vegetation maps at least up to ecological regions
		• Habitat mapping of major NTFPs
		• Availability of key NTFPs
		• Methodological framework for major NTFPs inventory
		• Chemical contents of main NTFPs according to their habitat types
		• Baseline information of NTFPs (status, availability, commercial/local uses)
7	Tree outside forests (TOFs)	• Pattern and distribution of TOFs at national and sub-national levels
		• Biomass modeling and estimations
		• Value, functions and use
8	Biodiversity	• Ecosystem and habitat types
		• Forest types and species composition
		• Mapping and biodiversity assessments of PAs
		• Biomass and carbon stock in PAs
		• Habitat specific indicators (soil, climate, vegetations, large mammals)

9	Forest ecosystem health	• Encroachment, degradation and disturbance of forests
		• Incidence of forest fires, forest pests and disease
10	REDD	• Changes in forest cover over time (1978, 1990, 2000, 2005, 2010 and 2015) at national and sub national scales
		• Change in forest density over time (1978, 1990, 2000, 2005, 2010 and 2015) at national and sub national level
		• Change in forest carbon stocks over time (1978, 1990, 2000, 2005, 2010 and 2015) at national and sub national level
		• Crown/canopy density into classes 10-40%, 40-70% and 70-100%
11	Community Based Forestry	• Separate data of Community Forests (CFs)and government managed forests
		• Comparison between CFs and government managed forests (condition, volume, density)
		• Carbon stock and biodiversity in CF
		• Contribution of CF in climate change mitigation
12	Others	• Extent/condition of wetland ecosystem and resources
		• Invasive species
13	District Level data needs	• Update forest cover and land use maps of each district
		• Fresh data of forest and tree resources
		• TOFs data
		• Encroachment area
		• Biodiversity
		• Data of key NTFPs

1 Background

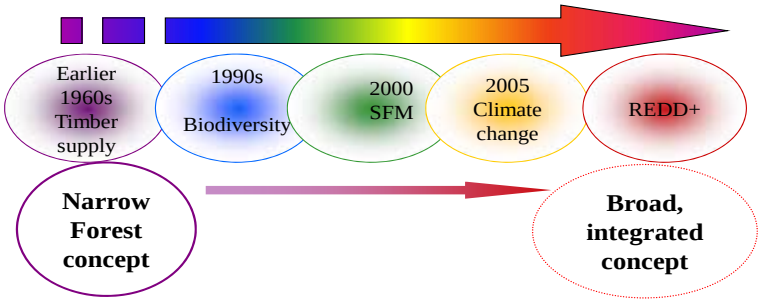
National forest inventory is to produce data on forest of whole country. The last NFI was carried out in early nineties in Nepal. The inventory revealed that forest and shrub together cover 39.6% of the total land area of the country, but the statistics manifested an alarming rate of deforestation (1.7% per annum during 1978/79 to 1994). Micro level studies and visual interpretations have revealed that Nepal's forest coverage and condition has significantly improved in Middle Mountain due to the Community Forestry (CF) intervention. Forest and forestry data have not yet been updated at national level and data from early nineties do not represent existing situation.

The purposes of the Forest Resource Assessment (FRA) Nepal project are to assess forest resources and tree resources outside forest and to provide fresh data on the state, use, management and trends of these resources. The assessment covers a large range of biophysical areas and provides a broad and holistic view of land use for the country as a whole. In particular, the information will be used to plan, design and implement national and international policies and strategies for sustainable use and conservation of forestry ecosystems, and to understand the relationship between resources and users of the forest and tree resources. During the five years time period (2010-2014), project will produce national and sub-national level forests resource information.

2 Data needs

Forest data are needed at different levels and scales for different objectives and uses. On the basis of coverage and scale, FRA is carried out at global, national, sub-national and forest management levels. Besides, forest inventories should not be seen as an end in itself, they normally follow specific objectives. The objectives and scale of inventories should be set and known before the inventory planning starts. Moreover, objectives and scales depend mainly up on the user of the data and result. The group of users comprises the ones who traditionally use the inventory data and also the potential users who might have to be identified first.

Figure 1: Trend of forestry Evolution



Traditional data such as growing stock, biomass, extent of area etc. are always required for forestry agencies and other traditional data users. However, the roles of forests are changing

users' focus from wood production towards a course around broader social, environmental, economic and cultural extents. In corresponding with change in the forest landscape, forestry stakeholders have also changed significantly, whilst their range of interests has expanded and diversified. Forestry stakeholders are now recognized to include forest dependent communities, forest based industrial societies, sophisticated global carbon market investors and a vast array of parties and individuals in between. Demand of forests for goods and services significantly differs between these diverse stakeholders. As the reasons, forestry concept is becoming wider and wider. In this backdrop, forest and forestry data needs are changing and therefore, FRA should be designed to address changing demands.

2.1 Objectives of data need assessment

The main objectives of data needs assessment are to identify and comprehend the data needs of key forestry organizations/stakeholders for planning forest inventory and, to spell out scopes and limitations of FRA project.

3 Data needs assessment

3.1 Rationale

The forest data users build a wide spectrum in forestry sector. The key data users are all the departments under the Ministry of Forests and Soil Conservation (MFSC), government organizations, National Planning Commission (NPC), forestry INGOs/NGOs, academic institutions, researchers, forest managers and international conventions. FRA Nepal project is to generate national level forest data/information, which is required for national level policy decision and international reporting. It is necessary to conduct a data need assessment campaign to guide for an appropriate inventory design and, point out its scopes and limitations. Hence, the starting point of FRA project was the assessment of nationally and internationally important data needs and identifying data sources required for forest resource inventory. This report analyzes the key national and international data needs to direct NFI in Nepal.

3.2 Methods applied for data needs assessment

A study was carried out by the FRA Nepal project for data needs assessment. The key methods applied during data needs assessment process were:

3.2.1 Organizing a national stakeholder workshop

A national level stakeholder workshop was organized on 4th of March 2010 to discuss on data needs assessment. More than 90 forestry organizations and individuals participated in the workshop. A conceptual framework was presented in the forum about the process of data needs assessment. The invaluable comments and inputs were taken from the participants about the present data needs.

3.2. 2 Conducting data needs assessment campaign

On behalf of the project a National level data needs assessment campaign was carried out. A data inquiry format (Annex 1) prepared by the project was refined from the national stakeholder

workshop. The formats were circulated to more than fifty forestry organizations and stakeholders to specify their nationally important data needs.

The Senior Data Management Advisor (SDMA) of the project was involved for the data need assessment campaign. Representatives of several departments and organizations have been interviewed and discussed about their data needs. Interactions, meetings and individual interviews were done with the head of organizations and personnel. The R-PP (REDD Readiness - Preparation Proposal) prepared by REDD is taken as the guideline to assess its data needs.

3.2.3 Reviewing of international data needs

The international data needs were assessed by reviewing of Inter-governmental Panel on Climate Change (IPCC) guidelines and reporting format of the Food and Agriculture Organization (FAO) for global FRA, Convention on Biological Diversity (CBD), International Tropical Timber Organization (ITTO) and others.

3.2.4 Assessing of district level data needs

A study was done in Rupendehi and Palpa districts to assess district level data needs. The aim was for complementing data need assessment processes and, to specify the scopes and limitations of the project. Both districts lie in west region of Nepal. Adjoining with India, Rupendehi is situated in southern most Terai and Northern part of district is bordered by Siwalik zone. Southern part of Palpa is in Siwalik but most of the area lies in Mid Mountain region. District Forest Office (DFO) and District Soil Conservation Office(DSCO) of Rupendehi are supported by Livelihood Forestry Program(LFP) for district level activities but Palpa district has no any project support but running by government budget. Data needs and management of DFO and DSCO were evaluated from both districts by using different methods.

4 Result and discussions

4.1 Overall picture

Out of total 50 data needs inquiry forms sent via email, very few responses were received from the organizations. Even departments of the MFSC did not send their national level data needs. Direct interactions and meetings were conducted with those departments. Although new types of data are required for the REDD purpose, the data need inquiry form was not filled up by the REDD cell.

However, interviews led the impression that there are urgent needs for data on several levels and scales. The most of the forestry professionals suggest for the up to date forest maps and statistics applicable for the district level forest management. The maps needed are detailed maps on a small scale. District level data needs assessment result reveals that DFO and DSCO are mostly working on more than 30 years old LRMP maps and also 1990s Topo maps. Besides, the projects working in the districts are preparing data management system and use Remote Sensing (RS) and Geographical Information System (GIS) as the data generation and management tools. It is important to indicate that FRA project has been designed for facilitating *NFI* but not for

conducting District Forest Inventory (DFI). Whereas methods and materials used for NFI could be scaled up later for DFI as well.

The data and information on technical and management levels are needed to the community based forestry organizations and concern civil societies. However, this type of information is only possible by the management level inventories. FRA project has its own limitations and thus, small scale inventory is beyond scope of the project.

The information about state of forest and changes in the forest conditions has great implications for the forestry and infrastructure development activities. An actual need exists for reliable, accurate and affordable data on a national scale. The data available are now about 15-20 years old. A certain updates have been made at few districts and regional levels. However, no consistent, comprehensive and actual information are available about the forest resources at national scale.

The Protected Areas (PAs) system was excluded in the nineties NFI. However, PAs networks cover about 23% of the country's total area. Without estimating the forest cover, biodiversity and carbon stock inside the PAs, the NFI in Nepal is always incomplete. The Department of National Park and Wildlife Conservation (DNPWC) has shown its great interest and recommended to carry out the detail inventory inside the Protected Areas (PAs) system to generate data on biodiversity related matters.

Nepal has four big river systems, which are Koshi, Narayani (Sapta gandaki), Karnali and Mahakali. Now the river basin management is becoming a viable approach for linking up and down stream interactions. River basin mapping is highly demanded by the Department of Soil Conservation and Watershed Management (DSCWM).

REDD has become the key policy instrument in mitigating climate change when the 13th Conference of Parties (COP) of United Nations Framework Convention on Climate Change (UNFCCC) approved the mechanism in December 2007. The REDD mechanism will be useful particularly to the developing nations like Nepal when the policy will able to provide incentives to reducing emissions from deforestation and forest degradation.

Nepal is one of the REDD countries within Carbon Partnership Facility (CPF) program of the World Bank (WB). MFSC is taking lead role to implement REDD related activities in Nepal. As a result, the Ministry has already submitted Nepal's Readiness Preparation Proposal (R-PP, 2010-2013) to the WB. To achieve the vision of REDD, the R-PP will provide Nepal's roadmap for developing and implementing the REDD strategy, based on certain underlying principles agreed by forest sector stakeholders. The success of REDD mechanism depends up on availability of reliable data of historic dataset for reference scenario and mechanism of Monitoring, Reporting and Verification (MRV) to look at forest cover and biomass changes in different scales, extent and time periods.

The data needs on a national level are also being seen in an international context. Moreover, there are numbers of forestry related international conventions and agreements (Table 2) which demand country level progress report in annual and periodic basis. Broadly, this report presents data needs into national and international categories. Data needs of national organizations and international conventions are further described as follows.

4.2 National data needs

Forestry sector in Nepal comprises government institutions, civil society, forest-based private sector and large network of community-based forestry organizations. Those institutions demand reliable and updated forestry information for policy formulation, management planning and decision making. The NFI generates national level data useful for macro level planning and policy making. MFSC is the apex institution and there are five departments under the Ministry. The regional offices represent the Ministry at regional level while the district level offices are under the concerned departments.

During the data needs assessment campaign, data needs of national level government organizations, civil societies and other concern national stakeholders were assessed. The results are presented in following way.

4.2.1 Department of National Park and Wildlife Conservation (DNPWC)

Organizational objectives

DNPWC is one of the departments of MFSC. DNPWC administers a vast network of the PAs which covers about 23% of the country's total area. The organizational goal of the Department is to conserve and manage the rich and diverse biological diversity of Nepal with much emphasis on wildlife and protected areas. The primary objectives are to conserve the country's major representative ecosystems, unique natural and cultural heritage, and give protection to the valuable and endangered wildlife species. It also encourages scientific research for the preservation of wild genetic diversity.

Activities

With the early emphasis on species conservation, present priority of the department stresses a conciliatory approach with participatory management of biodiversity. The specific activities of the department are:

- Conservation of endangered and other wildlife species;
- Scientific management of habitat for wildlife species;
- Creation of buffer zones in and around parks and reserves for the sustainable management of forest resources;
- Regulated eco-tourism to improve socio-economic condition of local communities and
- Creating awareness about importance of wildlife conservation.

Data need

To strengthen the decision support system in biodiversity conservation and protected area management, the department has submitted following (Table 1) list of its data needs. The list reveals that key data needed are on land cover/land use of protected areas, types of ecosystems and species. The department needs those data for national and management levels uses.

Table 1: Data needs for DNPWC

Particulars	Measurable Variable (s)
• Land cover/Land use	• Category of land cover • Extent of each land cover type
• Ecosystem	• Vegetation/forest types • Unique and special habitats (Riparian zones, caves, snag, tuff etc) • Species richness (Tree/shrub/herb) • Biological hotspots • Critical bottlenecks
• Flora	• Biomass • Species diversity (Types of species) • Species richness (Number of individuals) • Invasive alien species
• Fauna	• Species diversity • Species abundance
• Wetland	• Types • Extent (Area)
• Others	• Sites of development projects (such as mining, industry etc) • Fire incidents • Level of disturbance (signs of poaching. grazing, lopping, illicit tree felling) • Encroachment sites and area • Slash and burnt areas

Recommendations from the DNPWC

- It would be better if these data are segregated for protected areas.
- Sample design should include all protected areas.
- The capacity of DNPWC should be built to collect, store, analyze and interpret data.

4.2.2 Data needs for Department of Forest (DoF)

Mandate and functions of DoF

The main mandate of DoF is to manage the country's forest resources for the conservation of the natural environment and to supply the forest products to the people. It is the largest department in term of its coverage and functions. There are 74 District Forest Offices (DFOs) under the department. The specific functions of the department are as follows.

- Protection, management and utilization of forests and conservation of natural resources;
- Planning, implementation and coordination of forestry development activities;

- Support and facilitate the Ministry of Forests and Soil Conservation on policy formulation;
- Increase people's participation in forest management; particularly in plantation and resource conservation in forests;
- Contribute to the economic development of the country through revenue generation from forest products and
- Improve the livelihood of the community through implementation of effective forestry programs.

Data needs

DoF is one of the biggest users of forest data and information. According to the feedback and comments received from DoF, all examples given by the FRA project in the data need inquiry form (annex 1) are the data requirements of the department. Besides, variables specify in the data table are the fundamental important for forest planning and development. However, DoF has submitted following specific data requirements:

Specific data needs

- Forest categorization on the basis of
  - Physiographic.
  - Ecological.
  - Forest management (Government, community, protected areas etc.).
  - Ownership (National and private forests).
  - Forest types.
  - Species composition.
- Mapping
  - Forest cover map needed with clear boundary at:
  - National level ;
  - Sub-national level (ecological, physiographic, federal states, regional, four river basins etc) and
  - District level (this is the management unit; the department needs maps and data up to this level).
- Biomass and carbon content
  - Stem biomass;
  - Branches biomass;
  - Foliage biomass;
  - Underground biomass and carbon stock and
  - Soil carbon.
- Categorization of NTFPs on the basis of:
  - NTFPs produced by tree species;
  - Aromatic herbs;
  - Medicinal herbs and
  - Others (bamboo, rattan etc.).
- Mapping of major NTFPs areas
  - Under the biodiversity Grassland and Rangeland ecosystem should be included.
- Recommendations of DoF
  - The first and foremost, definitions of forest and forest degradation should make compatible with national and international contexts.

- Criteria should be set to define inaccessible and accessible forests.
- Establish permanent sample plots (PSPs) to represent all ecological regions and forest types.
- Make a policy and strategies to ensure PSPs measurement in periodic basis.
- DoF should be involved in the FRA process and PSPs measurement.
- Mechanism should be developed in DoF for DFI.

4.2.3 Data Needs for REDD purpose

REDD has been seen one of strategic options to contribute to reducing Green House Gas (GHG) emissions, conservation of existing forests and enhancing forest carbon stocks. Broadly, historic rates of deforestation, forest degradation and enhancement of forest carbon stocks are the key data needs for REDD. Deforestation is conversion of forest to other land uses. It can be analyzed by using high resolution satellite image and GIS technology. The analysis of temporal forest cover change is possible by using time series dataset. However, analysis of forest degradation is not easy. Measurement of carbon stock is possible by using ground base forest inventory and using RS technology like LiDAR (Light Detection And Ranging).

Nepal's REDD Readiness Preparation Proposal (R-PP, 2010-2013) was reviewed to know the data needs, approach of data acquisition for historic reference scenario and Monitoring, Reporting and Verification (MRV) system. It was quite clear from the review on R-PP that FRA project has been referenced as one of the key sources for their data need. Approaches to determine historic scenario and MRV for REDD purpose are as follow.

- **Historic Scenario**

Reference data on forest cover and degradation, and biomass stock are needed to assess the temporal changes in those attributes. Then the question is the reference year, which is internationally accepted for REDD mechanism. The most of the REDD countries are proposing 1990 and onward as the reference year. However, it depends upon country's context and available dataset. Most of the historic forest inventories of Nepal have been geared towards assessing forests to generate traditional data and understanding the extent of forest cover. Major forest inventories carried out in Nepal are presented in Table 3.

Table 3. History of Forest Assessments in Nepal

Inventories' Name	**Targets of NFI**	**Years**	**Coverage**	**Key methods applied**
Forest Resources Survey	Generating data mainly of commercial forests	1963-67	Terai and Hills	Interpretation of aerial photography (Indian of 1953-58 Indian and 1963-64 fresh aerial photography) and combined with field inventory for commercial forests
Land Resource Mapping Project (LRMP)	Land use cover and use mapping	1977-79	Whole of Nepal	Analysis of aerial photographs from the period 1977-1979,complemented by ground truthing, surveys and topographic maps

Master Plan for Forestry Sector	Forest/forestry data generation for strategic planning	1989	Whole of Nepal	LRMP information with updating.
National Forest Inventory (NFI)	Forest cover and change analysis and forest data generation of accessible forest	1994	Whole Nepal but Ground survey only in 51% area of the country	Combination of 1990 Landsat image analysis, aerial photographs and field measurements collected between 1990 – 1999
Japan Forest Technical Association information System Development Project	Forest cover mapping	2000	Whole of Nepal Very less ground truthing done	Indian Remote Sensing (IRS) data from 1999-2000
Forest Cover Change Analysis of the Terai Districts	Analysis of forest cover change of Terai	2005	20 districts of Terai Very little ground truthing done.	Analyzing satellite images (Landsat 1990/91 and 2000/01), supported by ground verification
FAO Global Land Cover Network (GLCN) LCCS for Nepal	Mapping of global forest to know the extent.	2009	Whole of Nepal	Segmentation of Landsat 2000 imagery
Forest Resource Assessment in Nepal	Information generation on forest, biodiversity, tree resource outside forests, NTFPs and soil.	2010-2014 (on going)	Whole Nepal	Analysis of high resolution satellite images, Light detection and ranging (Lidar) and ground sampling with high intensity.

Analysis of historic dataset

REDD cell has analyzed the existing datasets and made the conclusion that the Land Resource Mapping Project (LRMP) carried out in the late 1970s is the most wide-ranging forest assessment available. It reveals to be the best available dataset because of the following reasons:

- it is a wall to wall assessment using a consistent methodology;
- mapped forest and scrub separately;
- within the forest, classification of canopy density into three classes: 10-40%, 40-70%
- and 70-100%;
- each forest zone was classified according to dominant forest type and the presence of dominant species.

However, R-PP has clearly stated that the 1994 NFI is less useful for the purpose of determining a reference scenario for REDD in Nepal. The reasons given are:

- predominantly it was a low resolution;
- different sapling exercise and
- different survey types from different dates in different regions.

Moreover, LRMP classified detail canopy density classification, which could be useful dataset for a biomass viewpoint. However, the LRMP datasets are more than 30 year old and more recent data might be required for REDD purpose

Recently, the Finnish funded FRA Nepal project has started in Nepal for next five years. The project is conducting forest resource assessment over the whole country and planning to generate national level baseline data on diverse variables including extent of forest, status of

present forest cover, growing stock, wood and non-wood products, forests in the protected areas, tree resources outside the forest, biological diversity, biomass above the ground and soil carbon. Nepal's REDD R-PP suggests that ongoing FRA should ensure compatibility with the LRMP.

Approach for MRV

R-PP proposes to use IPCC tier II for the present context and after the enhancement and capacity building Nepal will go for tier III (the details on different tiers are presented in below). The monitoring system need to design to look at changes in carbon stocks. In the beginning, the methodology will use general assumptions for parameters such as biomass expansion factor and root-to-shoot ratios. However, at once the appropriate data become available it is expected that Nepal and species specific factors will be developed together with allometric equations.

In general, data collection will be based on a combined method using RS data and periodic ground inventories measurements throughout all major forest types of Nepal. This will be based on the methodology used in the FRA. One of the intended outcomes of the FRA is an analysis of the most efficient combination of RS and ground sampling for Nepal, also taking into account the possible future availability of high resolution data at lower prices. The result of this analysis will then be used to plan future data collection activities.

FRA Nepal project is planning to establish more than 2500 Permanent Sample Plots (PSPs) over the country to monitor the change in forest and biomass. However, GoN should formulate policy and programs to order and safeguard periodic monitoring on the plots, which eventually will facilitate to REDD mechanism for MRV through change analysis.

IPCC guideline 2006 and Tiers system

The guideline provides methods for estimating greenhouse gas emissions and removals due to changes in biomass, dead organic matter and soil organic carbon on Forest Land and Land Converted to Forest Land. The Guidelines provide methods for estimating and reporting sources and sinks of greenhouse gases for forests. Countries should consistently apply national definitions of managed forests. There should be a national cover of all forests subject to human interventions. Those include the full range of management practices from protecting forests, raising plantations, promoting natural regeneration, commercial timber production, non-commercial fuel wood extraction, and abandonment of managed land. The guideline:

- Addresses all five carbon pools (aboveground biomass, belowground biomass, dead wood, and litter and soil organic matter);
- identifies and transfers carbon between different pools within the same land areas;
- includes carbon stock changes on managed forests due to human activities such as establishing and harvesting plantations, commercial felling, fuel wood gathering and other management practices, in addition to natural losses caused by fire, windstorms, insects, diseases, and other disturbances and
- provides simple (Tier 1) methods and default values and outline approaches for higher tier methods for the estimation of carbon stock changes.

Tier systems

For estimating biomass gain and loss, it requires reliable data on different carbon pools. IPCC has provided guiding framework and methods for estimation of those variables at different reliability and accuracy under the different tiers. The tier 1 is simple and most estimation done on the basis of default values whereas tiers 2 and 3 demand more accurate and county based data. Because FRA Nepal project is conducting NFI to generate country based data, Nepal has made its target to meet tier 2 by 2015. Description of different tiers is as follows:

Tier-1 Method (Biomass Gain-Loss Method)

Tier 1 is feasible even when country-specific estimates of activity data and emission/removal factors are not available, and works when changes of the carbon pool in biomass on *Forest Land Remaining Forest Land* are relatively small. The method requires the biomass carbon loss to be subtracted from the biomass carbon gain. The annual change in carbon stocks in biomass can be estimated using the gain-loss method, where the annual increase in carbon stocks due to biomass growth and annual decrease in carbon stocks due to biomass losses are estimated:

The annual increase in biomass carbon stock is estimated where area under each forest sub-category is multiplied by mean annual increment in tons of dry matter per hectare per year. Since the biomass growth is usually in terms of merchantable volume or above-ground biomass, the below-ground biomass is estimated with a ratio between the below-ground biomass and the above-ground biomass. Alternatively, merchantable volume (m3) can be converted directly to total biomass using biomass conversion and expansion factors (BCEFI). If BCEFI values are not available, and if the biomass expansion factor (BEF) and basic wood density (D) values are separately estimated, then the following conversion can be used:

BCEFI = BEFI ● D

Biomass estimates are converted to carbon values using carbon fraction of dry matter

Tier 2 Method

Tier 2 can be used in countries where country-specific estimates of activity data and emission/removal factors are available or can be gathered at reasonable cost. Tier 2, likewise the Tier 1, uses equations. Species-specific wood density values permit the calculation of biomass from species-specific forest inventory data. It is possible to use the stock-difference method at Tier 2 where the necessary country-specific data are available

Tier 3 Methods

Tier 3 approach for biomass carbon stock change estimation allows for a variety of methods, including process based models. Implementation may differ from one country to another, due to differences in inventory methods, forest conditions and activity data. Transparent documentation of the validity and completeness of the data, assumptions, equations and models used is therefore of critical issue at Tier 3. Tier 3 requires use of detailed national forest inventories when the

stock-difference method is used. They may be supplemented by allometric equations and models for the calibrated to national circumstances that allow for direct estimation of biomass growth.

Data needs

Key data needs for REDD mechanism are:

- Change in forest cover over time
- Biomass Gain-Loss over time.
- Forest degradation and or rehabilitation.

Carbon pools

The following carbon pools related data are required

- Biomass (above-ground and below-ground biomass)
- Dead organic matter (dead wood and litter)
- Soil organic matter
- Change in forest cover (at national and sub-national level*)*
    - Rate of positive and or negative changes in forest cover (1978, 1990, 1995, 2000, 2005, 2010 and 2015).
    - Change in forest density (1978, 1990, 1995, 2000, 2005, 2010 and 2015)
- Biomass Gain loss (at national, sub-national and management levels)
    - The annual/periodic increase and decrease in biomass carbon stock.
    - Emission and removal due to biomass loss and gain.

4.2.4 Departments of Plant Resources (DPR)

General

The institutional objective of DPR is to explore plant resources and NTFPs for sustainable management and use. The department has selected 30 NTFPs for commercial harvesting and domestication, sustainable management, and use. Besides, the department has also a laboratory to analyze the chemical constituent of NTFPs.

Specific data need

- Vegetation maps at least up to ecological regions;
- Habitat mapping of major NTFPs;
- availability of key NTFPs;
- Methodological framework for major NTFPs inventory;
- Chemical contents of main NTFPs according to their habitat types.

4.2.5 Department of Soil Conservation and Watershed Management (DSCWM)

General

The department is working at sub-watershed (15-25 km2) level to increase the water quality and land productivity. However, approach is shifting from micro watershed to river basin level management to link between downstream and upstream and cover the whole country. Thus, the department needs data at national, sub-national and watershed levels.

Specific data needs

- Detailed land use and land cover related data of Siwalik.
- Maps of four river basin (Koshi, Narayani, Karnali and Mahakali rivers) and their condition.
- Soil characteristics (soil porosity, permeability, soil cohesion texture, density, nutrients, soil PH-content).
- Land capability class (based on LRM or may be USDA)
- Land system unit
- Conditions of river basins and major watersheds.
- Soil carbon contents and organic matters
- Slope susceptibility mapping and hazard data.
- Drainage density.
- Vegetation composition shift
- Water hole
- Land use

4.2.6 National Trust for Nature Conservation (NTNC)

General about NTNC

The NTNC is a NGO governed by NTNC act and regulation. Objectives of the organization are to support the DNPWC for the conserve and management of biodiversity, and conducting research activities. The NTNC is managing two conservation areas (Manaslu and Annapurna) of Nepal. Besides, Central zoo is under the management of NTNC.

Data need

The NTNC has suggested following additional data need for their organization:

- Tree crown cover and crown diameter
- Leaf area (might be useful for carbon sequestration measurement)
- Root area (coverage)
- Regeneration of trees, shrubs, herbs, grasses and climbers
- Amount of leaf litter
- Invasive species distribution and coverage
- Information on wildlife (Mammals, Birds, Reptile/Amphibians, Insects) - direct/indirect observation species and numbers
- Soil moisture
- Anthropogenic pressures

4.2.7 Nepal Forester Association (NFA)

The NFA is a NGO having members from involving forestry professionals. The association recommends following variables:

- Delineation of major river basins and their conditions;
- Physiographic wise forest data;
- Carbon sequestration inside and outside the PAs and
- Forest covers change over time in each physiographic region.

4.2.8 Federation of Community Forest User Group of Nepal (FECOFUN)

To date there are approximately 14500 Community Forest User Groups (CFUGs) in Nepal managing about 21.5% country's national forest as the Community Forest (CF). The CFUGs are the community based organizations. According to approved forest operational plan, CFUGs are autonomous to manage and use their CFs.

The FECOFUN is an umbrella organization of CFUGs. The aim of the organization is to build a network of CFUGs and make advocacy to enhance CF in Nepal. Thus, data needs of the FECOFUN are the need of CFUGs as well. During the interactions with the President and General Secretary of the FECOFUN recommended following data needs for the CFUGs and their organization as well.

- Separate data of community and government managed forests;
- contribution of CFs to mitigate climate change;
- Comparative data between CFs and government managed forests;
- NTFPs related data;
- Contribution of CF in the GDP;
- Role of CF in poverty alleviation;
- Information on private forest and
- At least physiographic wise forest and forestry map and data.

4.2.9 World Wildlife Fund (WWF) Nepal program

WWF is an INGo working to stop the degradation of the planet's natural environment and to ensure living planet for future. The objectives of WWF are:

- conserving the world's biological diversity.
- ensuring that the use of renewable natural resources is sustainable.
- promoting the reduction of pollution and wasteful consumption.

Nepal has been a key country for WWF ever since the organization first provided support to conserve the Greater one-horned rhinoceros (*Rhinoceros unicornis*) and the Bengal tiger (*Panthera tigris tigris*) in the late 1960s. Today, the endangered rhino in Nepal is no longer on the brink of extinction, and is in fact, the second largest population in the world. The Rhino Census of 2008 recorded 435 individuals of rhino found in Nepal. Nepal also has an estimated 121 adult Bengal tigers distributed in the lowland protected areas.

Working areas

At present, WWF Nepal is concentrated in the 4 Global 200 eco-regions and link WWF's global priority to the conservation needs of Nepal. The TAL (Terai Arc Landscape) consists by two eco-regions namely Eastern Himalayan Broadleaf and Conifer Forests, Terai- Duar Savannas and Grasslands and the Sacred Himalaya Landscape (SHL), which is formed by Eastern Himalayan Alpine Meadows and Western Himalayan Temperate Forests eco-region. The TAL spreads over Nepal and India. However, SHL extends to India and Bhutan. Within the landscape WWF Nepal is working in following thematic areas to contribute for the stipulated objectives:

- Species;
- Forests;
- Freshwater and
- Climate Change and Energy.

In addition, WWF works in the following areas as a support program;

- Policy and Advocacy;
- Conservation Education;
- Business and Industry and
- Sustainable livelihoods.

Data needs

WWF Nepal is working at landscape level for the conservation of biodiversity and to enhance the livelihood of people. Therefore, this organization requires regional and sub national levels information for landscape planning and decision making. Key data needs for WWF Nepal program are as follows:

- Land use and cover maps of TAL and SHL areas;
- Habitat types mapping (forest types, grasslands);
- Biodiversity (type, abundance, and status);
- Forest carbon stock in protected areas and landscapes;
- Biodiversity and livelihoods linkage;
- NTFPs;
- Potential threat to biodiversity and ecosystem;
- Ecosystem types;
- Vegetation regime/snow line/tree line;
- Invasive species coverage;
- Potential area for forest/grassland restoration;
- Forest encroachment;
- Deforestation rate disaggregated by districts/forest types;
- Extent of various forest management modes (community, collaborative, leasehold).

4.3 International data needs

There are number of forest related international organizations, conventions and agreements (Table 2). Member countries require submission of national report on periodic basis. The report from member countries is official document to show their position on the conventions.

The purposes of national reporting are to provide data and information on how the conventions are being implemented, provide member countries to be accountable against their obligation and provide proper tools for monitoring the progress applicable for formulating future policy formulation. For the purpose of national reporting, fresh, reliable and updated data are required.

Table 2: Forest related international conventions

SN	International organizations Conventions	Objectives of convention	National reporting Period
1	FAO- Global Forest Resource Assessment (GFRA)	Analyzing the trend of forest resource.	Five years
2	Ramsar convention	Wise use of global wetlands.	Two years
3	Convention on Bio diversity (CBD)	Sustainable management and use of biodiversity.	Four years
4	Convention on International Trade of Endangered Species (CITES)	Regulating trade of endangered floral and faunal species.	Annual and biennial
5	Millennium Development Goal (MDG)	Progress assessment on eight goals, targets and indicators set	Five years
6	International Tropical Timber Organization (ITTO)	To enhance sustainable management of tropical forest.	As per required
7	UNFCCC/ IPCC	Minimizing, adopting and mitigating the impacts of climate change	
8	UNFF	A discussion forum on forest within the UN system	Two years
9	INBAR	Conservation of bamboo and Rattan	Country report as per required
	GTF	A forum for conservation and its habitat	Country report each year
11	GEF	To generate resources and global partnership for environment protection	Country report as per required

4.3.1 FAO

FAO, in cooperation with its member countries, has monitored the world's forests at 5 to 10 years intervals since 1946. These global assessments provide valuable information to policy-makers in countries, to international negotiations, arrangements and organizations related to forests and to the general public. FAO has been recently published key findings of Global Forest Resource Assessment 2010 (FRA 2010) report, which covers all seven thematic elements of Sustainable Forest Management (SFM): The seven thematic elements are as follows:

- Extent of forest resources;
- Forest biodiversity;
- Forest health and vitality;
- Productive functions of forest resources;
- Protective functions of forest resources;

- Socio-economic function of forests and
- Legal, policy and institutional framework.

FRA aims to provide information UNFF, CBD and other forestry related conventions. FAO has developed 17 tables for the purpose of country reporting. The outline of country reporting tables and their key corresponding variables are presented in Table 4.

National FRA2010 report

Nepal is regularly submitting national FRA report to FAO. However, National FRA2010 report submitted on behalf of Nepal was incomplete. The reason for this is that forest and forestry data have not been updated at national level and the data from early nineties do not represent present situation.

Although questions were been raised on reliability of National FRA2005 report, estimation and extrapolation from outdated data for FRA2010 will make another big mistake. Thus, new tables have been filled up from available data for FRA2010; however forest and forestry related primary data have not been changed. As a result, several tables were not filled up. Besides, processes of calibration and estimation from outdated original data have not been followed. Most importantly, Nepal promised to provide updated data when fresh data will be generated at National scale. As a reason, FAO accepted Nepal's FRA2010 report. Thus, FRA Project has an important opportunity to generate fresh data for international reporting.

Table 4. Tables and key country reporting variables developed by FAO

Table No	Key reporting variables
T 1	Extent of forest and other wooded land
T 2	Forest ownership and management rights
T 3	Forest designation and management
T 4	Forest characteristics
T 5	Forest establishment and reforestation
T 6	Growing stock
T 7	Biomass stock
T 8	Carbon stock
T 9	Forest fires
T 10	Other disturbances affecting forest health and vitality
T 11	Wood removals and value of removals
T 12	Non-wood forest products removals and value of removals
T 13	Employment
T 14	Policy and legal framework
T 15	Institutional framework
T 16	Education and research; and
T17	Public revenue collection and expenditure

4.3.2 International Tropical Timber Organization (ITTO)

ITTO Criteria and Indicators (C&I) are designed to carry on SFM. The C&I are the policy and monitoring framework for SFM. The member countries should submit national progress report in given template. ITTO reporting framework for SFM is as follow:

C&I reporting format

Criterion 1: Enabling conditions for sustainable forest management

- Policy, legal and governance framework
- Economic framework
- Institutional framework
- Planning framework

Criterion 2: Extent and condition of forests

- Extent (area) and percentage of total land area under comprehensive land-use plan
- Extent (area) of forests committed to production and protection
- Extent (area) and percentage of total land area under each forest type
- Percentage of PFE with boundaries physically demarcated
- Changes in forested area
- Forest condition

Criterion 3: Forest ecosystem health

- Extent and nature of forest encroachment, degradation and disturbance caused by humans and the control procedures applied
- Extent and nature of forest degradation and disturbance due to natural causes and the control procedures applied

Criterion 4: Forest production

- Resource assessment
- Planning and control procedures.
- Silvicultural and harvesting guidelines.

Criterion 5: Biological diversity

- Ecosystem diversity.
- Species diversity
- Genetic diversity
- Procedures for biodiversity conservation in production forests

Criterion 6: Soil and water protection

- Extent of protection
- Protective functions in production forests

Criterion 7: Economic, social and cultural aspects

- Socioeconomic aspects
- Cultural aspects
- Community and indigenous peoples' rights and participation

4.3.3 Convention on Biodiversity (CBD)

For the purposes of communicating to stakeholders at various levels, member counties should prepare national report that provides an overview of:

- Overall status and trends in biodiversity, and major threats;
- Key actions taken in support of the convention's three objectives and to achieve the 2010 target and goals and objectives of the Strategic Plan of the Convention;
- Areas where national implementation has been most effective or most lacking;
- Major obstacles encountered in implementation;
- Future priorities.

To date Nepal has submitted the fourth National Report to CBD. The report indicates that lack of national data on biodiversity is one of the key bottlenecks for reporting. Thus, a comprehensive national level inventory is demanding to assess the status of biodiversity.

4.3.4 Millennium Development Goal (MDG)

MDG is the 25 year (1990-2015) development road map to the world for reducing poverty and ensuring environmental sustainability. There are eight goals of MDG but goal 7 (ensuring environmental sustainability) is directly related to the forestry sector. For the progress reporting purpose, following forest data are required:

- Extent of forests and forest condition.
- Proportion of land area covered by forest
- Proportion of terrestrial and marine areas protected
- Proportion of species threatened with extinction
- Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss

4.3.5 Ramsar

Ramsar is a convention for wise use of wetlands and their resources. The convention demands following key areas to be reported:

- Extent/condition of wetland resources
- Review/improvement of national policies/legislation
- Value of wetlands for water/costal management
- Integration of policies into conservation and wise land use
- Priority wetlands for restoration
- Guidance on prevention of invasive species

4.4 District level scenario

Nepal has 75 districts which are local level political and administrative units. DFOs and DSCOs are established in the district as the key natural resources management units. Altogether there are 74 DFOs and 56 DSCOs throughout Nepal for forest and watershed management respectively. Although there are more than 30 network of the Protected Areas (PAs) over Nepal to conserve representative ecosystems of the country, district level boundary has not been considered for PAs establishment and management.

FRA project has been designed for NFI in Nepal however, district level data needs assessment were carried out to know the district level forest resource data management system and, spell out the scopes and limitations of the project.

The study discloses that Palpa DFO and DSCO are using more than 30 years old LRMP maps for land use analysis, forestry and watersheds planning. In addition, Topo maps produced by Survey Department (SD) in 1996 are widely utilized as the mapping materials. During the course of time district level land use and cover have been dramatically changed, however DFO and DSCO are still using same data for district level forestry and watershed planning. However, specific mapping and new forest inventory has been done for the management level planning on the basis of management level inventory guideline.

Forest Resources of Rupandehi District was assessed in 1992 by the DFRS during second NFI period. Besides, Department of Forest analyzes the forest cover changes of 20 Terai districts in 2005. Forest cover and change maps were produced by using Landsat Thematic Mapper (TM) images of 1991 and 2001. LFP has supported to formulate district forestry sector plan in Rupendehi, Nawalparsi and Dang districts. Topo Map and AlOS (Advanced Land Observation Satellite with spatial resolution 10 m and spectral resolution 1-4) image data of 2007 were used as the mapping materials. Thus, forest cover map of Rupendehi district has been updated in the support of LFP, whereas districts like Papla which have no project support are compel to use outdated data during district level forestry planning and decision making.

5 Scopes and Limitations of FRA project

5.1 Scopes

The project is to strengthen the provision of adequate forestry data and its processing for national forest policy development and forestry sector decision making. FRA project has great scope to generate forest resource baseline information at national scale. National level information on the forest resources and their development is also needed for country reporting to international initiatives and processes. FRA project has wider scope to deliver data on the forest of entire Nepal.

Reliable and updated national data on forest and tree resources are necessary for proper policy formulation. The project will produce fresh data to address present data needs. It is to provide information for strategic and higher level planning. In addition to data needs for traditional users, the project supports to produce data required for REDD mechanism. Protected Areas (PAs) are included in mapping and ground based inventory processes. The data on NTFPs, TOFs, biodiversity, river basin and soil characteristics will be generated at national extent. Previous NFIs will be the subset of ongoing FRA to make it compatible and comparable.

Eventually, FRA project has enormous scope to generate national level forest information in Nepal. The baseline data produced by the project will be useful for forestry development of Nepal through rational forestry.

5.2 Limitations

FRA works vary from global, National to management levels on the basis of scales, objectives and coverage. The objectives of forest inventory are different and case specific. FRA project is to support NFI for obtaining forest resource data of entire Nepal. Therefore, project does not consider district and management level boundaries for the forest cover mapping and data collection. However, sub national, regional and district boundaries could be superimposed on the national level forest cover map.

A management inventory is to reveal information about the concrete management of the forests in a limited area. The inventory must be more detailed than a NFI as it should provide guidance for the management for every spatial unit of forest. It is to note that different inventory method should be designed with higher sampling intensity to generate data at district and management levels. Thus, information generating for each district and forest management unit is beyond the scope of the FRA project. It is important to note that FRA project is using high resolution (up to 0.5 m) RS image for forest cover mapping. Methods and materials used by FRA can be scaled up later for district and management level forest inventory works.

6 Conclusions and recommendations

6.1 Conclusions

The study on data needs assessment concludes that there is urgent need for forest data at several levels and scales. Outcomes of the study provide basis for rational inventory design and explicit the scopes and limitations of the project. Instead of information on the traditional forest and tree characteristics, data are anticipated on dead wood, forest and soil carbon, TOFs, human impacts, and biodiversity. Although FRA project is to support NFI, data are demanded for district and management levels forestry activities.

Furthermore, forestry has become one of the most dynamic entities due changes in social, political, economical and environmental dimensions. Forestry policies require to reform for responding the new demands. Reliable and updated national data on forest and tree resources are necessary for proper policy formulation.

The earlier inventories focused on estimating timber volumes and partly to biomass of the forest trees. Limited efforts were made to generate the information on NTFPs and biological diversity of forests and, trees species, for instance, PAs were even excluded from the inventory.

FRA Nepal project is to generate national level baseline data of forest resources required for national forest policy development and forestry sector decision making. National level information on the forest resources and their development is also needed for country reporting to international initiatives and processes. FRA project has wider scope to deliver data on the forest of entire Nepal. It is to provide information for strategic and higher level planning. However, generation of district and management levels data are beyond its objective and scope. But materials such as high resolution satellite images and inventory methods used by FRA project could be scaled up later for district and management level inventories.

6.2 Recommendations

The study on data needs assessment was carried out to know the national level data needs required for designing inventory and spell out the scopes and limitations of FRA project. On the basis of findings and gaps, following specific recommendations have been made for effective planning of FRA to generate reliable and accurate forest data required for forestry organizations of Nepal.

1. Nepal is heterogeneous in south-north and east-west in physiographic configuration, ecosystems types and species compositions. Thus, country should be divided into different strata to make it more homogeneous. The physiographic/ecological regions could be one of the basic criteria for the stratification. However, separate study is needed to decide the number of strata and criteria of stratification.
2. Measurable variables used by previous NFI should be included in ongoing FRA to make it comparable and compatible. But new themes such as forest biomass, carbon stock, biodiversity, TOF, NTFPs and river basin should be incorporated to address present data needs.
3. Canopy classification made by LRMP on the basis of crown density (10-40%, 40-70% and 70-100%) should be followed.
4. Assessment of biodiversity is an extremely complex work. The assessment should concentrate on ecosystem level and habitat types. Forest ecosystem should be described on forest types and vegetation composition. Habitat specific criteria and indicators should be formulated and incorporated in the field inventory guideline.
5. A high resolution precise forest cover map should be immediately produced to facilitate the national restructuring process.
6. NTFPs are diverse in nature, value and uses. Inventory of NTFPs has not been done yet at national scale. National level baseline information of NTFPs should be generated (status, availability, commercial uses, local use etc).
7. TOFs make a remarkable resource of fodder, fuel wood, timber and fruits. However, this part was excluded in previous NFI. TOFs inventory should be designed and data should be generated at national extent.
8. Accurate National level baseline data should be generated for REDD+ to meet upper level Tiers (e.g. Tiers 11) designated by IPCC.
9. Watershed management policy is shifting from sub watershed to river basin approach. Thus, mapping of major river basins should be carried out.
10. Adequate number of permanent sample plots should be established over the country and policy should be formulated to ensure periodic monitoring.
11. District forest inventory should be carried out by scaling up materials and methods used by FRA project to update district level forest map and forest data. The responsibility of district level inventory should be taken by the DoF and DFOs.

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Annex 1: Letter written to the organizations

March 2010

ASSESSMENT OF NEEDS OF NATIONALLY IMPORTANT DATA

The Forest Resource Assessment in Nepal, FRA Project is launching an inquiry for stakeholder organisations to specify their nationally important data needs. We are kindly requesting you to read the following general information, instructions for specifications and see the schemes and examples given in annexes. Based on those we would like to request you to fill up the table(s) in **Annex 3** focusing on such data (variables) you anxiously need and wish the FRA Project to collect and process for your use.

We are kindly requesting you to submit your filled-up data specification table(s) within next two weeks (deadline on 12 April 2010).

If you need assistance and additional clarifications you may contact our office (tel. 01 422 6944) or use our email-connection (fra@franepal.org)

With kind regards,

Tuomo Kotimaki
Tuomo Kotimaki
CTA
FRA Nepal Project

Annex 2 : General information about FRA and data needs

The Forest Resource Assessment (FRA) in Nepal Project is a bilateral co-operation between Governments of Nepal and Finland for next five years (2010-2014) to conduct forest resource assessment over the whole country. The objectives of the FRA project are strengthening institutional capacity in building and maintaining forestry sector information systems and data sharing among forestry organizations. The purpose of the project is to improve the provision of adequate forestry data and its processing for national forest policy development and for national level forestry sector decision making. The project is planning to generate national level baseline data on variables such as extent of forest, status of present forest cover, growing stock, wood and non-wood products, forests in the protected areas, tree resources outside the forest and biological diversity. The focus will be given in collecting forest related floral data though multi-source data collection scheme.

- **General Data Collection Procedures**

Nationwide baseline data will be collected through satellite images, data through LiDAR Technology and field measurements of sample plots, equalling to 4000-5000 sample plots, from which around one third will be established as permanent sample plots. The first level data acquisition (1st phase sample) will be carried out through satellite images (medium and very high resolution satellite images), mostly focusing on stratification of areas for second level data acquisition (2nd phase sample) and assessing a large number of clusters (sample points) on images to classify broad land use classes (e.g. forest, other wooded land, other land with tree

cover, treeless land, built up land, etc.) and grouping them as clusters for 2nd phase sample to be measured in field. The needed data should be specified (Table in **Annex 3**).

Data Needs in Organisation

The general scheme of data use and needs in organisation is shown in **Annex 4**. Every organisation has stipulated functions to produce outputs. To have the outputs produced, task management system is needed. Through resources, skills and data all necessary outputs could be produced. Therefore, data needs per output should be defined.

Direct and Indirect Variable

While specifying data needs, directly measurable data and indirectly measurable data should be defined. The directly measurable data (Direct Data) are tree height, diameter, stand volume, degree of slope, etc. The indirectly measurable data (Indirect Data) are mostly produced through models based on measured variable (Direct Data). Such examples are tree biomass, stand growth, etc.

Specification of Nationally Important Data

Organisations are requested to analyse their nationally important or otherwise significant outputs and the need of data for producing such outputs.

Specification of Variables to be Measured or Described

Generally, the measured and described variables are categorised as follows.

- Site/Soil Specification
- Individual Tree
- Stand
- Biodiversity
- Trees Outside Forests, TOFs (if not the same as “Individual Trees”)
- Non-Timber Forest Products, NTFPs

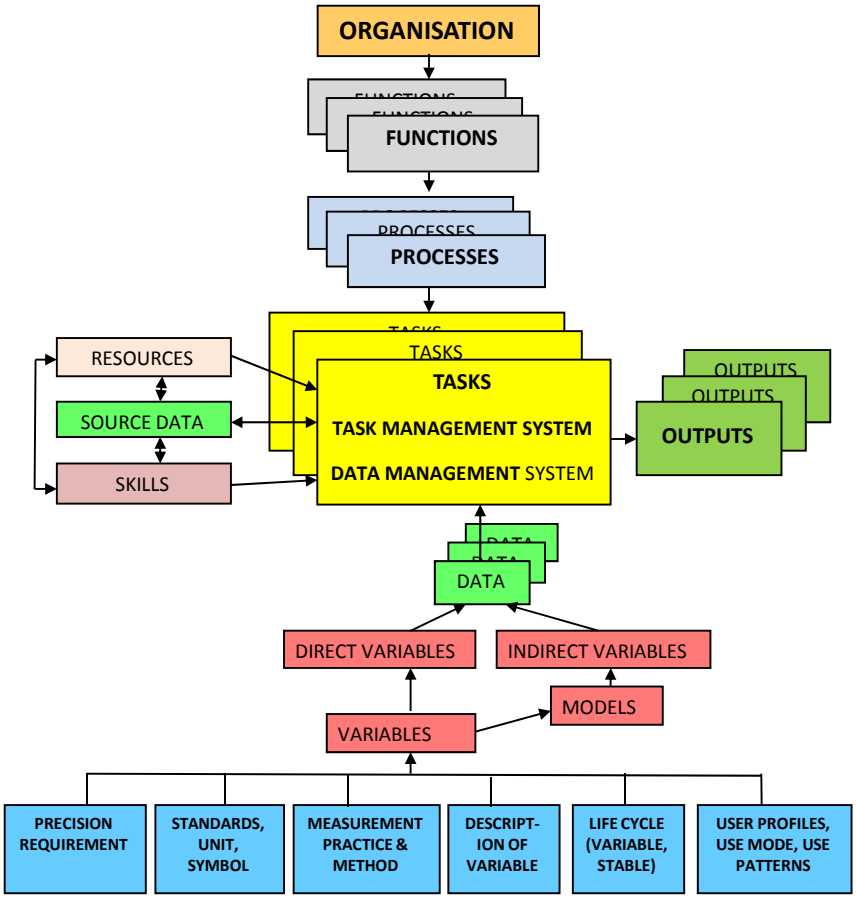
Data Collected from Permanent Sample Plots

During the FRA data collection process, around 2500 permanent sample plots will be established and measured. If your organisation has special needs of data (variables) to be measured from permanent sample plots to be later after 5 year intervals re-measured, please, indicate and describe your wishes on such data and variables in Table (Annex 3).

Annex 3: Data Specification Table (with examples)

Variable Name	Symbol	Unit, Accuracy	How to Measure	Life Cycle	Direct/ Indirect Use	Other Use Specifications	Remarks
Site/Soil							
Soil type	ST	type class	representative vegetation	stable	both direct/ indirect use	Soil type maps	
Trees							
Height (total tree height)	h	1,0 m	distance from ground level to tree top	variable (height growth)	direct use, Indirect use in models	as raw data, thematic maps	
Stand							
Amount of Dead Wood	ADW	1,0 m3	tree species, tree diameter, tree height	variable	direct use	as raw data, thematic maps	standing trees and laying down trees
Biodiversity							
Species	Sp	Number	Counting the number	Variable	both direct/ indirect	Refine existing data	Also useful for wildlife diversity
Wetland type	WT	Type class	Running or standing water	stable	both direct/ indirect use	Wetland type map	
Trees Outside Forests (TOF)							
TOF types (distribution of trees)	TOF	type class	tree distribution, grown areas	Variable	both direct/ indirect use	as raw data, thematic maps	trees in government and private lands
TOF types (use value)	ToFU	type class	FGD, key informants survey	variable	both direct/ indirect use	importance of ToF	
Non-timber Forest Products (NTFPs)							
NTFPs types (use value)	NTFPs	types	FGD, key informants survey	variable (spatial distribution)	both direct/ indirect use	Listing of new use value	
Morphology	T, Sh, Cl, H, E, P	Type class	Eye observation	Variable	direct use	Morphological diversity	
Data/variable Specifications for Permanent Sample Plots							

Annex 4: A data management model for an organization



Examples of classifications and definitions of variables and their divisions are given in Annex: 5

Annex 5: Examples of important variables

5.1 : Key variables for soil assessment

- Soil type
- Soil layers (soil depth)
- Size of soil grains (particles)
- Organic soil (Humus)
- Mineral soil
- Soil alkalinity, salinity
- Porosity (total porosity, aeration porosity, water-holding porosity)
- Water carrying capacity
- Infiltration rate
- Soil carbon content
- High resistance to compaction
- Stoniness
- Slope
- Aspect

5.2 Biomass

A tree could be divided into various parts.
What concerns measurements the following division is the most usual:

- stem
- bark
- stump
- root system
- branches
- needles or foliage
- cones, fruits, flowers

All these parts can be measured to specify tree or wood volume, but also tree biomass (green or oven-dry) or stand biomass

Defining the Biomass

In case of biomass, we should define, which type of biomass do we have an interest:

- total green biomass of tree or stand per ha (kg or metric tons)
- total air-dry biomass
- total oven-dry biomass
- above-ground biomass
- underground biomass
- wood biomass only or needle/leaves biomass in addition
- bark biomass
- biomass of branches/tree top (canopy) separately
- biomass divided into each tree species

Biodiversity

If we are interested on Habitat diversity, which characteristics should be defined (measured)

- Forest types
- Scrubland types
- Grassland types
- Wetland types
- Steppe types
- Alpine meadows
- Cliffs, rocks
- Desert

Biodiversity

If we are interested on Ecological niches, which characteristics should be defined (measured)

- Habitat occurrence
- Species compositions
- Rare species and/or Endangered species
- Amount of deadwood (laying down)
- Amount of dead wood (standing),
- Burnt areas/ Fire cultivation areas
- Virgin/ Untouched areas
- Edges of habitats (ecosystems)
- Herb-richness
- Number of epiphytic plant
- Number of parasitic plant
- Phenology of plants