

# Monitoring Steps

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The following inventory and monitoring steps are used by the National Inventory and Monitoring Applications Center (NIMAC) of the Forest Inventory and Analysis (FIA) program, US Forest Service. These were developed in collaboration over the years with The Nature Conservancy, NatureServe, and the Food and Agriculture Organization (FAO) of the United Nations. For more information, contact Chip Scott, 610-557-4020, [ctscott@fs.fed.us](mailto:ctscott@fs.fed.us) or Carla Ramirez [Carla.Ramirez@fao.org](mailto:Carla.Ramirez@fao.org).

## A. Planning Component

1. Information needs and priorities
  - a. Identify the customers and their related activities
  - b. Set broad objectives (consider multiple sources, scales, and sectors)
  - c. Select the monitoring questions and other information needs
  - d. Select attributes
    - i. Identify and prioritize the attributes
    - ii. Select terms and definitions for attributes from regional or international standards, else specify terms and definitions
    - iii. For any modified terms and definitions for attributes, such as land use change and forest type, harmonize them with other partners and countries.
2. Assemble and evaluate existing data and other information to answer the questions
  - a. Identify the gaps in terms of spatial and temporal resolution and of attributes
3. Set time/cost and precision constraints
  - a. Specify other requirements, such as time scale.
4. Outline the main components of the monitoring system
  - a. Define the system components or modules (Remote Sensing/GIS, Greenhouse Gas (GHG) inventory for forestry sector, National Forest Inventory (NFI) Sustainable Forest Management (SFM), NFI-biodiversity, Socioeconomic, governance, etc).
  - b. Components for REDD+ often include remote sensing for classification and stratification, forest inventory, associated socio-economic survey, allometric models for volume, biomass or carbon; and carbon prediction models for different management options.
  - c. Identify the needs to cover the gaps within and between these components
  - d. Evaluate existing data systems by component for processing and reporting

## B. Remote Sensing Component

1. Analyze the availability of remote sensing sources, and their spatial and temporal resolution
2. Remote sensing methodologies
  - a. Determine the remote sensing methods to support forest classification and stratification

- b. For forest monitoring, evaluate whether to use wall-to-wall imagery or sampling methods (based on costs and spatial-temporal resolution).
  - c. Determine methods and imagery to evaluate historic deforestation to support Reference Emission Level (REL) and Reference Level (RL)
  - d. Determine methods to evaluate uncertainty (QC/QA), including a statistical accuracy assessment.
- 3. Remote sensing implementation
  - a. Staff contracting
  - b. Training
  - c. Pre-processing implementation
  - d. Remote sensing processing and analysis (un-supervised/supervised classification in connection with step 4)
  - e. Land use change analysis (historic data and further REDD+ monitoring)
- 4. Ground data collection (in connection with other field work)
  - a. Planning
  - b. Data collection guide
  - c. Equipment and materials
  - d. Training
  - e. Data collection
  - f. Data processing
- 5. Uncertainty analysis and reporting

### **C. Inventory Design and Data Collection Component**

This component applies to forest inventory, development of allometric models of volume, biomass and carbon, and development of forest dynamics modeling, such as for prediction of carbon stocks and trends.

- 1. Sampling methodology
  - a. Identify alternative methodological approaches
  - b. Identify sampling frame
  - c. Plot design
  - d. Sampling design
  - e. Estimation methods
  - f. Use existing data or pilot survey data to evaluate variability
  - g. Sample size requirement
  - h. Sample location
- 2. Quality Assurance/Quality Control plan
  - a. Develop QA/QC plan for data collection and QC materials for supervisors
  - b. Information management system plan and guide
- 3. Preparing for field work and data collection
  - a. Logistics
  - b. Contact local communities for acceptance and local support
  - c. Contracts
  - d. Equipment and materials
  - e. Data collection guide
  - f. Training materials

- g. Conduct training
- h. Certify data collectors
- 4. Conduct pilot test of the methodology (and as required for variability – see 1f)
- 5. Data collection
  - a. Collect data
  - b. Supervise and provide continued training and QC

#### **D. Processing, Reporting and Dissemination Component**

1. Design and develop data information systems by component
  - a. Data base
  - b. Data entry system
  - c. Data checking and editing
  - d. Compilation system
  - e. Analysis system
2. Enter and store data
  - a. Enter the data either at the point of measurement or from forms
  - b. Run edit checks and edit as needed
3. Process (compile) the data
  - a. Add and integrate auxiliary information, such as adding map attributes to plots
  - b. Apply allometric and other models
  - c. Prepare the data for analysis (e.g., add sampling design information) and link with the remote sensing data for estimation, such as stratification.
4. Analyze the data
  - a. Perform analyses to answer the monitoring questions (1c)
  - b. Disseminate the data via the web
  - c. Create and disseminate reports
5. Re-evaluate information needs and monitoring methodologies
6. Evaluate results for strategic planning