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Forest Service Handbook 2409.13 – Timber Resource Planning Handbook

Chapter 10 - Timber Inventory Data and Information Collection

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Approved by: F. Dale Robertson, Chief

Date approved:

Responsible Staff:

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Digest: Following is an explanation of the changes throughout the directive by section.

This amendment is a reissuance of FSH 2409.13 to conform the format and structure of the Handbook to the requirements of electronic directive issuance.

This amendment makes no substantive changes to the text. The only changes made are those necessary to meet new format requirements or to correct spelling, punctuation, or unit names.

This Handbook is now available electronically in the National Information Center in the same format as the paper copy. Henceforth, amendments to this Handbook will be issued to Forest Service units electronically on a document basis.

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Timber inventories provide efficient, compatible, and statistically valid data bases that describe the timber resource, its condition, and trends for use in developing the forest plan. Through the forest planning process, data from the inventories provide input to the Resources Planning Act (RPA) National Assessment and may be used for project planning where such data are appropriate. The methods, procedures, and reporting used promote data and information sharing for other resources and users. Common timber inventory definitions are as established in FSH 4809.11 and other appropriate handbooks. Regional Foresters shall issue supplements to this section to ensure inventory quality control. These supplements shall specify inspection standards, limits of acceptable measurement error, and procedures for correcting unacceptable errors.

11 - Kinds of Inventories and Data Bases

The collection of timber data may be accomplished through stage I (extensive), stage II (stand examinations), and/or multiple-resource inventories. Store and maintain the collected timber data through the Timber Management Information System (TMIS) extensive inventory (EXT) or the stand (STAND) databases for ready retrieval (FSH 2409.14). The EXT file may be created by periodic extensive inventories (or stage I inventories) covering the entire National Forest land base. The EXT database is static and reflects the inventory at the time of planning. The STAND file arises from stage II or stand examinations, often maintained on a continuous basis. Information from stage II inventories may be used as input to the EXT file where data are available.

Evaluate the data base on a 10- to 15-year cycle, or more frequently, if necessary for accuracy, currency, and effectiveness. Schedule reinventories when and where necessary.

11.1 - Relationships to Other Functional Inventories

Conduct timber inventories primarily to collect data describing the tree components on forested lands. Information about other components and other lands is necessary for land and resource management planning.

Coordinate timber inventories with other data collection efforts to minimize duplication and to maximize the utility of the resulting information. Multiple resource inventories or integrated individual resource inventories may be used (FSM 2060).

12 - Inventory Designs

Design timber inventories to ensure that they are capable of producing outputs as out-lined in FSH 2409.13-13 and FSH 4809.11. Any design is permissible, providing it is statistically valid and cost effective and as long as it provides the required and compatible data for Forest, Region, and national timber summaries. Consider prior information and inventory data when designing new inventories (FSH 2409.13-13.1).

12.1 - Precision Requirements

Maximum acceptable allowable area and volume sampling errors for timber inventories are in exhibit 01. In some instances, area estimates may be derived from the stand files or maps to eliminate area sample errors. There are no other national requirements for sampling accuracy (or precision), as long as the method of collecting the data is objective so that it is possible to calculate sampling errors should the need arise. Regional Foresters shall supplement these standards relevant to the local decisions.

12.1 - Exhibit 01

Maximum Allowable Sampling Error Percentage in Terms of One Standard Deviation (67% Confidence Limits)				
	Area [1]		Growing Stock Volume [2]	
Regions	Withdrawn [3] Forest Land	Not Withdrawn Forest Land	Not Withdrawn Forest Land	
			Total	Net Annual Growth
1, 2, 3, 4, 5, 6, 10	10	3	10	10
8, 9	10	3	5	5

[1] Per 1 million acres. This is the maximum allowable error.
[2] Per 1 billion gross cubic feet. Error not to be exceeded if economically practical.
[3] See FSH 2409.13-21.2.

12.2 - Sample Units

Sampling units may be points, fixed-area plots, stands, or groups of stands, but they must have clearly defined boundaries that are identifiable on the ground. Use permanently located sample units to estimate growth and mortality where they provide an unbiased estimate of the attributes and where the information is appropriate.

12.3 - Units of Measure

As a minimum, determine gross and net volumes as follows:

1. Total Volume. Volume of sound wood in cubic feet of trees 1-inch diameter breast height (d.b.h.) and larger, measured from ground to top of the central stem. Deduct for missing wood, voids or holes, and for unsound portions of the stem.

2. Growing Stock Volume. Net volume in cubic feet of growing stock trees 5.0 inches d.b.h.and larger, from a 1-foot stump to a minimum top diameter of 4.0 inches outside bark of the central stem, or measured to the point where the central stem breaks into limbs.

3. Sawtimber Volume. Net volume of the sawlog portion of live sawtimber trees meeting utilization standards established in the Regional guide measured in board feet using International 1/4-inch log rule.

4. Gross Growth. The increase in volume (total, growing stock, or sawtimber volume) in the absence of cutting and mortality for a specified time period.

5. Net Growth. The increase in volume of a specified size or age class for a specified time interval. (Annual net growth includes the increment of trees in the size class at the beginning of the period that survive to its plus end, the volume of trees growing into the size class minus the volume of trees that died or were reclassified because of cull.)

6. Mortality. The volume of trees (total, growing stock, or sawtimber volume) that die from natural causes during a specified period.

Regional Foresters shall supplement these instructions by establishing merchantability and utilization standards in the Regional guide (FSM 1920).

13 - Inventory Planning

Use new inventories or reinventories periodically to maintain objectivity and to validate the database. Schedule inventories so that current information is available for the next anticipated revision of the forest plan. In some cases, updates of the extensive inventory (EXT) database may be adequate for forest plan revision.

Coordinate timber inventories that provide input to the Resources Planning Act (RPA) Assessment with the appropriate Experiment Station Forest Inventory and Analysis (FIA) units to ensure that it is possible to meet RPA information requirements.

13.1 - Use of Prior Inventories

Integrate previously established permanent plot or point locations into subsequent resurveys for growth and mortality estimation, where an adequate sample is available and where information is necessary. Remeasure a sufficient number of permanent locations to support trend level estimates and projections required for preparing and/or checking current growth and mortality estimates. Changes in area statistics between inventories that are identified, described, and explained for each of the land classifications are listed on exhibit 01 in FSM 2409.13-42.1. Changes may include shifts in land base, administrative boundaries, and definitions of species and volume classes. Document any changes when there are revisions to the forest plans.

13.2 - Inventory Scheduling

Schedule the interval for timber inventories to coincide with the development of forest plans. This may be 10 years, but up to 15 years may be acceptable in some instances. Consider more frequent intervals where rapidly changing legal, social, or forest conditions dictate revision of forest plans. Make every effort to coordinate the scheduling of the timber inventories with the data collection conducted for other resources and uses.

Stands undisturbed since the last examination may be brought forward to the present, using an appropriate growth and yield model. Data on other stands may be updated through reexaminations.

The monitoring process described in FSH 2409.13, chapter 50, and the reporting requirements of FSM 2490 provide for periodic updating of timber resource information. FSH 2409.14 contains the necessary operating instructions.

In the event that it is necessary to revise a plan before the completion of the next scheduled Forest-wide inventory, update the inventory records described in FSH 2409.13-14 to reflect trends and conditions. Base the inventory adjustment on the following:

1. Availability of stand examinations with unbiased allocation of plots, statistically valid designs, and so forth.

2. Changes resulting from treatments reported to the Timber Management Information System.

3. Mapped, natural catastrophes of sufficient severity to change the inventory classification of the affected stands.

4. Growth and mortality since inventory. Use projections only for per-acre volume changes.

13.3 - Inventory Quality Control

The Regional Forester is responsible for the controls for technical aspects of the work. As a minimum, Regional personnel inspect inventories within the first month of fieldwork and at the approximate midpoint. Inventory plans provide inspection procedures to minimize field technique errors. Emphasize accuracy, objectivity, and efficiency. As appropriate, joint or independent inspections may be arranged with Experiment Station Forest Inventory and Analysis (FIA) units. Maintain records of inventory quality checks in the planning records.

13.4 - Inventory Documentation

Documentation of data collection, methodology, and standards is essential for verification and monitoring changes in the inventory. Minimum documentation of timber inventories consists of:

1. The inventory plan, including the objectives of the inventory, maps, sample design, sample size calculation, and analysis procedures. If the inventory is to provide input to the Resource Planning Act (RPA) assessments, the appropriate Experiment Station FIA unit shall review the plan for consistency of data.

2. Aerial photo stereo pairs of each field location sampled. These are essential for relocation and remeasurement in subsequent inventories.

3. A summary of the inventory, including degree of accomplishment, noting such items as field samples not measured or established, substitute samples, production rates, and unusual situations that affected inventory results or costs. Include a summary of inspection reports evaluating technique errors.

4. Tabular results of the inventory, including statement of sampling errors.

5. A permanent record of the inventory data referenced or reflected in the forest plan.

6. Adequate maintenance and protection of the data file. The file shall be available on request to the appropriate Forest Experiment Station FIA units.

13.5 - Upgrading of Inventories

When possible, include procedures for upgrading prior estimates of stand and forest attributes in new inventory procedures. Correlating successive inventory estimates should reduce unreasonable differences arising from sampling variation and should increase efficiency. It is often appropriate to collect additional data for special studies or information needed for forest land and resource management planning.

14 - Standard Inventory Outputs

The following map, tabular, and data file information are necessary for developing forest plans. Regional Foresters, in consultation with appropriate Experiment Station Directors, may

supplement these requirements as necessary for Resources Planning Act (RPA) assessments and to meet local needs.

14.1 - Stand or Area Maps

Maps of all forest land shall be at a scale of 1:24000 or larger and show the following information:

1. Land status (forest land withdrawn or not withdrawn).

2. Forest cover type based upon the tree species that presently form a plurality of stocking in live trees.

3. Stand size classes as follows:

   a. Sawtimber Stands - stands at least 10-percent stocked with growing stock trees 5 inches diameter breast height (d.b.h.) and larger, in which the stocking of trees 9 inches d.b.h. and larger is at least equal to the stocking of trees 5 to 8.9 inches d.b.h.

   b. Poletimber Stands - stands at least 10-percent stocked with growing stock trees 5 inches d.b.h. and larger, in which the stocking of trees 5 to 8.9 inches d.b.h. exceeds the stocking of trees 9 inches d.b.h. and larger.

   c. Seedling-Sapling Stands - stands at least 10-percent stocked with growing stock trees of all sizes, in which the stand-size class is not poletimber or sawtimber.

   d. Nonstocked - forest land stands less than 10-percent stocked with growing stock trees.

4. Management area and/or compartment boundaries.

5. Habitat type or ecological site when available.

14.2 - Tables

14.21 - Area Tables

1. List area of forested lands by the following biological growth potential productivity classes (does not include growth from intensive management practices - like thinning, fertilization, genetically improved stock, and so forth:

   a. Less than 20 cubic feet/acre/year.

   b. 20 to 49 cubic feet/acre/year.

   c. 50 to 84 cubic feet/acre/year.

d. 85 to 119 cubic feet/acre/year.

e. 120 to 164 cubic feet/acre/year.

f. 165 to 224 cubic feet/acre/year.

g. 225 or greater cubic feet/acre/year.

2. Area of forest land by forest cover type.

3. Area of forest land by the forest cover type and stand size classes.

4. Where criteria are available, area of forest land not withdrawn, by treatment opportunity classes:

a. No treatment.

b. Stand establishment.

c. Intermediate stand management.

d. Final harvest.

14.22 - Volume Tables

1. List net cubic foot volume (and local board foot volume) on forest land, by species, and the following tree classes:

a. Growing stock.

b. Sawtimber.

c. Poletimber.

d. Salvageable dead.

e. Rough trees.

f. Rotten trees.

2. List net cubic foot volume (and local board foot volume) of growing stock trees on forest land, by species, and the following diameter breast height classes:

a. 0.1"-4.9".

b. 5.0"-6.9".

c. 7.0"-8.9".

d. 9.0"-10.9".

e. 11.0"-12.9".

f. 13.0"-14.9".

g. 15.0"-16.9".

h. 17.0"-18.9".

i. 19.0"-20.9".

j. 21.0"-28.9".

k. 29.0"+.

14.23 - Other Tables

1. Average annual mortality of growing stock (cubic foot volume) on forest land not withdrawn, by forest cover type.

2. Average net annual and potential growth per acre (cubic feet) on forest land not withdrawn, by forest cover type.

3. Average number of trees per acre on forest land not withdrawn, by species and diameter class.

14.24 - Data Files

Inventory data tapes and plot stand or compartment examination records provide the basic data for Forest, Regional, and national summary records. Use the Timber Management Information System (TMIS) extensive inventory (EXT) or stand (STAND) files to summarize data from these sources (FSH 2409.14). To the extent possible, make data accessible and available to other resources and users. Seek data compatibility between resources and users.

Maintain data for each location inventoried or mapped and contain the following kinds of information:

1. Area, Stand, or Plot Data.

a. State, County, Congressional District, Forest, District.

b. Land suitability classification. (FSH 2409.13 Ch. 20).

(1) Unsuitable (with reason for classification).

(2) Tentatively suitable.

c. Management area or other designated stand or plot identifier.

d. Date of survey.

e. Site class and productivity class.

f. Stand origin.

g. Stand age for even-aged or two-aged stands.

h. Seed source or seed lot identification, as listed by supplying nursery.

i. Forest cover type and local type as needed.

j. Stand-size class, including nonstocked area.

k. Past treatments or disturbances.

l. Treatment opportunities (where criteria are available).

m. Stocking in trees per acre or square feet of basal area.

n. Ecological site or habitat type (where available).

o. Plot expansion factor or stand area.

p. Percentage of area not restockable within 5 years after final harvest, where applicable.

q. Net volume per acre in cubic feet and International 1/4-inch or local board foot volume.

2. Tree Data, Where Appropriate.

a. Tree identifier.

b. Species.

c. Diameter breast height.

d. Tree class.

e. Crown ratio.

f. Crown class.

g. Height.

h. Age.

i. Cubic foot volume.

j. Cubic foot cull.

k. Local board foot volume.

l. Radial growth.

m. Tree expansion factor.

Regional Foresters may expand these data through Regional guides or other appropriate documents.