

Quality Assurance Plan

For

Annual Forest Inventory in the South

May 2012

Southern Research Station
Forest Inventory and Analysis
4700 Old Kingston Pike
Knoxville, TN 37919

Quality Assurance Plan Approval

This quality assurance plan was developed to ensure that all data generated by the Forest Inventory and Analysis (FIA) program in the South are scientifically valid and of acceptable quality to achieve the objectives of the U.S. Department of Agriculture Forest Service, FIA program.

Overall authority and responsibility for implementation of the quality assurance program rests with the Southern Research Station, FIA program.

Approved:



Dale Trender
Data Acquisition Section Head
Forest Inventory and Analysis
USDA Forest Service
Southern Research Station
4700 Old Kingston Pike
Knoxville, TN 37919

Date 05-25-2012



William G. Burkman
Program Manager
Forest Inventory and Analysis
USDA Forest Service
Southern Research Station
4700 Old Kingston Pike
Knoxville, TN 37919

Date 5/25/12

CONTENTS

	<i>Page</i>
Quality Assurance Plan Approval	i
Contents	ii
Introduction	1
National Quality Assurance Direction	1
Annual Forest Inventory System in the South	1
Background.....	1
Quality Assurance, Products, and Benefits	2
Objectives of the quality assurance plan	2
Quality assurance program benefits.....	2
Quality Assurance Principals and Components	2
Prevention	3
Activities	3
Training	3
Assessment and Appraisal.....	4
Measures of data quality	4
Activities	5
Correction	5
SRS FIA Quality Assurance Procedures	6
Prevention.....	6
Standardized Definitions	6
Development of Standardized Procedures	6
Documentation of Field Methods	6
Data Tolerance Limits	6
Calibration	6
Equipment.....	6
Training	6
Field Data Collection Crews	6
Certification	7
Assessment and Appraisal	7
Inspections	7
Definitions.....	8
Hot/Exit Check Cruise	8
Cold Check Cruise	9
Blind Check Cruise.....	9
Blind Check Procedures.....	10
Reuse of Blind Checks as Cold Checks.....	10
Plot Selection Criteria for Blind and Cold Checks.....	10
Feedback and Debriefing of Field Data Collection Crew Personnel.....	11
Data Validation and Verification	11
Correction	12
Training	12
Analysis of Check Cruises	12
Procedure for Failure to Meet Standards.....	12
Quality Assurance Monitoring and Reporting	12
Monitoring.....	12
Reporting	13
For Additional Information	13

Introduction

In response to legislation and policy requirements, the U.S. Department of Agriculture (USDA) Forest Service, Southern Research Station (SRS), Forest Inventory and Analysis (FIA) program conducts an inventory of the forest resources of the South. The inventories use a systematic plot design. Data collection by Federal, State, or private contract crews will require strict adherence to quality assurance (QA) standards developed by the USDA Forest Service.

The QA plan focuses on the qualitative and quantitative specifications required to meet the objectives of the annualized inventory for the South. The plan describes the QA process and references the current field manual and QA/quality control (QC) manual for the data standards.

National Quality Assurance Direction

This QA plan builds upon the direction provided in the FIA research program national QA plan dated April 21, 1994, the FIA 2002 plot component QA implementation plan, and the revised QA plan for annual forest inventory in the South dated October 2006. The national QA policy statement and direction on data generation, data management, audit program, data analysis and interpretation, document record keeping, resources, annual planning, and training are the foundation of the Southern Region's QA plan. The national FIA program is in the process of adopting a nationally consistent approach to QA provided in the FIA 2004 plot component QA implementation plan. The QA plan for annual forest inventory in the South is consistent with the national approach.

Annual Forest Inventory System in the South

Background—FIA is a national program of the Forest Service that conducts and maintains comprehensive inventories and reports on status and trends of the Nation's forests. The FIA program collects data on forests in three phases. In phase 1, forested areas are identified using remote sensing for stratification purposes, and then in phases 2 and 3, a sample of the forested acres are visited and measured on the ground to further describe the vegetation and related resources growing on those acres. FIA continues to provide the only national source of comprehensive strategic inventory information on the extent, condition, and use of all forested lands in the Nation.

Implementation of the annual inventory in the South began with Georgia in March 1998 and is now in all 13 States in the Southern region. Puerto Rico and the U.S. Virgin Islands are still using periodic inventories.

The FIA program is the only entity that conducts comprehensive forest resource inventories on both public and private lands in the Southern United States. This information is vital for a wide array of customers drawn from public and private environmental organizations, business enterprises, researchers, consultants, and private citizens. Timely inventory information for land managers about southern forest ecosystems is a high priority. With rapid change occurring in the South, reliable forest resource information is needed on an annual basis. Large catastrophic events such as hurricanes, changes in land use such as the wildland/urban interface, and balance of growth to harvest must be monitored.

Because of the importance that the wood-using industries play in shaping the economic future of the Southern States, it is imperative that the status and trends of these forest resources be assessed in a timely manner to assure sustainability. This need led to a major collaborative partnership of the Forest Service (the SRS and Region 8 of the National Forest System), Southern State agencies, industry, universities, and others. The FIA program is focused on the development of the annual inventory system for the South; State Foresters have contributed substantial human and financial resources to developing and implementing annual inventories.

The annual forest inventory for the South systematically measures a percentage of the FIA plots each year. Implementing the annual inventory means all States will have some data collected every year. Thus, at least some inventory data will be current for each State, although completing a cycle within a State will take about 5 or 7 years, depending on available funding. Presently, west Texas and west Oklahoma are on a 10-year inventory cycle due to the large number of plots in these areas.

Quality Assurance, Products, and Benefits

High standards set early and maintained over the years by FIA have established a tradition of complete, unbiased, and factual representations of our forest resources. Information has routinely and accurately described the various collected data elements, in addition to derived components and resource analysis studies. Historically, this information was distributed through various inventory reports, research publications, data bases, and applied research such as spatial analysis studies. QA standards, definitions of terms, and highly refined processing techniques spanning several inventory cycles were constantly reevaluated and continually improved.

Derived from these efforts, the annualized inventory system is now a cooperative activity widely supported by customers who rely on the data and associated products. The objective is to provide certified information with the greatest value and the highest standards in quality. In adherence to the national QA plan, the annual forest inventory in the South will produce timely, reliable, and high quality forest resource information and products. This information and these products will be invaluable in the forest policy and management decision making process and serve the diverse and daily interests of a broadly based community requesting data.

Objectives of the Quality Assurance Plan—

- Provide high quality, accurate, timely, and consistent data while (1) reducing the need for redundant data and programs, (2) strive for compatibility between FIA units, the National Forest System, and among agencies, and (3) ensure that all attribute data is geo-referenced.
- Develop and maintain information management systems made up of ecological forest inventory data where information collected from the field (and generated data) are rigorously subjected to QA/QC standards, procedures, and studies.
- Provide policies and technologies that anticipate the direction of the Forest Service, FIA and cooperating units, private industry, and the future needs of customers within and outside the agency.
- Comply with all Forest Service and other Federal standards for data quality and data security measures at a reasonable cost to the government.

Quality Assurance Program Benefits—

- Information will be timely, accurate, readily available and accessible, and uniform from State to State.
- Events and/or trends will be evaluated and monitored annually.
- New data will be available annually to all participating States.

Quality Assurance Principles and Components

Supporting a continual QA program is vital to the success of the annual forest inventory system. The goal of this plan is to continually improve the quality of the data. The information provided by this QA plan is essential to interpreting and evaluating survey results. This information will also be used to develop realistic objectives for measuring quality, revising methodology to reduce efforts, improving the effectiveness of training sessions, and revising the remeasurement program (for QC data) to increase cost effectiveness and efficiency in subsequent field seasons. The information provided in this QA plan will be used by all personnel involved with the collection of field plot data.

QA involves activities performed to ensure that the final product will meet a desired level of quality. QA ensures that operations and procedures requiring control are identified and that appropriate control protocols are defined, documented, and implemented.

Any QA program has three basis components: (1) prevention (2) assessment and appraisal, and (3) correction.

Prevention

Activities—Prevention attempts to ensure that good data are collected before data collection begins. Specific prevention activities include:

- Developing standardized definitions,
- Developing standardized procedures,
- Documenting field methods,
- Establishing data tolerance limits, and
- Using calibration techniques.

Standardized definitions are required for all aspects of the national plot design. These definitions define a data collection detection standard, not a specific procedure. Standardized definitions provide maximum flexibility in method selection as long as the selected procedure meets the minimum detection standards and measurement quality objectives (MQOs).

Standardized procedures should include the scope and purpose of the measurement system; necessary equipment, skills, or both; calibration or maintenance procedures; the necessary steps to collect the data; reporting units, codes, or both; MQOs; data quality estimates; and references.

Documentation of field methods (current and previous) is an important aspect of QA. Documentation of current procedures provides a complete understanding of the measurement process in place and can be used by personnel as a reference document during data collection. Understanding the measurement process facilitates designing an effective and efficient QA program. Previous procedures will be kept on file so data from previous years can be interpreted with the appropriate method. This historical record will also promote consistency even when personnel changes occur.

Changes in data collection methods should be documented, and a comparison study between the old and the new information should be conducted. This comparison study should allow for trend and change interpretations in the information.

Establishing data tolerance limits, alternately called MQOs, clearly defines the precision for the measurement process. Data tolerance limits are set at the start of a program and may be modified over time. They are necessary for developing an effective calibration and training program.

The specific activities of calibration include developing field guides and conducting training sessions and workshops. Workshops that include all data collection personnel can also be used to calibrate the implementation of survey procedures through a discussion of common problems, division of duties, and other activities. Annual meeting of all SRS QA personnel to calibrate the implementation of QA procedures through discussion of common problems and taking measurement of a common plot and/or test trees for comparison and standardization.

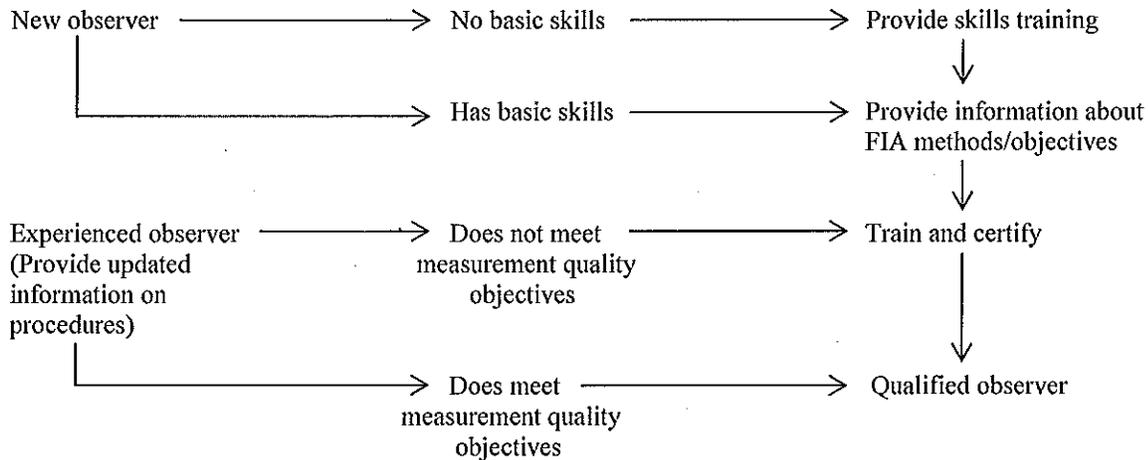
Training—Training is probably the most important aspect of calibration. The objectives of training are three-fold, all leading to the goal of collecting the best quality data possible. They are:

- Ensure that observers (crew personnel) have the required basic skills and can meet the MQOs for the data collection;
- Provide information about national plot design and data collection, which includes changes as they occur; and
- Incorporate feedback from observers (crew personnel) into the survey design, execution, and reporting of results.

Training is conducted in three steps, with group sessions used where possible, through on-the-job training (OJT) with certified individuals, and individual instruction and practice used to address specific and possibly different training needs. These steps include

- Instructing personnel on the specific methodology,
- Practicing the methodology, and
- Evaluating and documenting (certifying) field crew performance.

The structure of each training session should be based on the following flowchart:



Evaluating field crew/QA personnel should be part of the training. The session should include all aspects of the measurement process possible at the training location. In each major training area, testing should be conducted under simulated field conditions. Test results should be used to immediately evaluate the effectiveness of training and to identify needs of the individual trainees. Test results should be used to evaluate consistency between QA personnel and field crew personnel.

OJT for each trainee takes place in the field for about 6–16 weeks with certified State cruisers and Forest Service QA personnel. During the OJT period, various informal tests or checks are completed to evaluate the field crew understanding of data collection procedures and their ability to apply these procedures in a variety of field situations. These activities will be conducted and evaluated by QA personnel to determine a trainee’s level of skills and readiness for certification. The checks are supplemented with weekly evaluation reports signed and dated by trainer and trainee.

Finally, the effectiveness of the training should be evaluated by the trainees and QA personnel. Group discussion sessions and/or individual questionnaires, on the training sessions (classroom and field), the instructor’s organization of the session, and training evaluation procedures can be used to improve the effectiveness of subsequent sessions. All aspects of training is documented, including who was trained and certified, where and when training occurred, a list of trainers, a short description of the training, any problems/questions encountered (and how they were resolved), feedback from trainees/QA personnel, and certification of results.

Assessment and Appraisal

Measures of data quality—There are four measures of data quality: precision, accuracy, completeness, and comparability. Precision describes how useful a method is in reproducing the same value within a narrow range. Accuracy describes how useful a method is in obtaining the correct or true value. Completeness is the percent of valid, usable data points out of the total possible data points. Comparability describes the ability to combine data within and outside the primary dataset.

Precision is the first step in evaluating any method. It is essential that the same value be consistently reproducible within a defined range. For some variables the range will be very small, while for others the range will be very large.

The acceptable range must be determined for all data measurements. Variables that cannot be collected within the defined range must be changed or dropped from the measurements, or the defined range must be reevaluated.

Activities—Assessment and appraisal are used to evaluate and document data quality. The specific activities include:

- Hot check cruises,
- Exit check cruises,
- Cold check cruises,
- Blind check cruises,
- Debriefings and field personnel feedback, and
- Data validation and verification.

Hot and/or exit check cruises by QA personnel, which are done during field visits with crews, are used to qualitatively evaluate method implementation. Hot and/or exit checks also provide an opportunity for field crew feedback. A short report should be developed from each hot check and filed with other training documents with appropriate work zone supervisor. Exit checks are used to verify the skill level of the trainee. The resulting scores from exit check cruises determine the need for additional training and/or trainee's readiness for certification plot.

The exit check cruise score will not be included within individual cruiser's overall accuracy report. The report includes the following information: check cruiser, personnel audited, location, problems encountered and/or questions (including resolution and/or answer), and any follow-up action item(s) for additional training. This information is used to evaluate the effectiveness of the training period or session, to identify logistical problems, and to correct problems with the interpretation and application of methodology.

At a minimum, each measure in use should be remeasured so comparability can be quantified. The target remeasurement intensity is 8 percent of the total number of measurement units (or plots) in the system. The long-term distribution of that total 8 percent will be about 2-percent hot checks, 3- to 5-percent cold checks, and 2- to 3-percent blind checks. Remeasurement of blind checks is done without knowledge of original measurement values to provide an unbiased estimate of measurement error or precision.

The remeasurement values should be used as a point of comparison. Deviations or differences are calculated by subtracting the remeasurement value from the original value. The measurement precision values should be compared with target MQOs to identify problem areas in methods, training, or implementation. The precision estimates will be used to develop realistic MQOs for subsequent field seasons.

Annually, all field crew and QA personnel should complete a questionnaire or participate in a debriefing, or both. Topics should cover all areas including the training session, data collection and recording techniques, logistics, methodology problems, and coding problems. Annually, all SRS QA personnel should complete a common plot and/or station tests to check standardization within QA section.

Data validation is the process of determining whether valid codes are recorded. Data verification is the process of evaluating whether correct codes are recorded. Most data verification and validation checks are built into the portable data recorder programs and this greatly reduces errors (completeness) and subsequently produces higher quality data. Other verification checks can be developed, based on the system in place.

Correction

Correction uses all the information from assessment and appraisal to improve the measurement system procedures. The FIA data acquisition section head will have primary responsibility for assessing potential improvements. Corrections are usually made after the completion of a field season or at a set time each year, although some corrections can be made during the field season.

SRS FIA Quality Assurance Procedures

Prevention

Consistent protocols and definitions are a vital part of a QA program. The national FIA core field data collection manuals have been finalized for Phase 2 and Phase 3 measurements. These documents describe the standards, codes, methods, and definitions for FIA field data items. The objective of these manuals is to describe CORE FIA field procedures that will be consistent and uniform across all FIA units. This CORE FIA program serves as the framework for the SRS regional FIA program; other regional FIA programs may add variables, but may not change the CORE requirements. A glossary of definitions is provided in appendix 7 of the national FIA field manual, some of which will be repeated and/or expanded below to clarify the role of various procedures in the SRS FIA QA program.

Standardized Definitions

A set of definitions is contained in the field data collection procedures for Phase 2 and Phase 3 plots. Clarification of current definitions or additional definitions will be incorporated as needed into the field instructions, with appropriate adjustments in training and QA.

Development of Standardized Procedures

Standardized procedures have been developed and are contained in the field data collection procedures for Phase 2 and Phase 3 Plots. As new procedures are developed, tested, and adopted they will be incorporated into the field instructions. Each edition of the field instructions will be designated with a unique version number and date.

Documentation of Field Methods

The field methods are documented in the field data collection procedures for Phase 2 and Phase 3 plots. Any changes or additions in field methods will be documented in the field instructions, with appropriate changes in training and QA.

Data Tolerance Limits

Data tolerance limits for each of the data measurements have been established and are in the current field guide and QA/QC manual.

Calibration

Two components of the annualized inventory require calibration—equipment and training.

Equipment—The items requiring calibration or accuracy check are the compass, clinometer, Garmin units, and the Vertex Hypsometer. These items will be checked with the appropriate procedures at the beginning of each training session.

Training—All certified crews must consistently measure within specified tolerance limits. To achieve full certification, crew leaders and assistants will receive intensive training and testing. FIA QA personnel will train and test all potential crew leaders. Fully certified crew leaders may train potential crew leaders.

Field Data Collection Crews

A field data collection crew consists of a crew leader and an assistant. Crew leaders and assistants will work out their own process of collecting and recording data. Duties of assistants will vary with their experience and plot logistics. Duties will include assisting in locating the plot and locating and installing subplots, determining whether individual trees are on or off the plot, and measuring the length and diameter at breast height of trees. Crew leaders will ensure that assistants meet the MQOs before data collection starts and will check measurements to ensure data quality. The certified crew leader assumes all responsibility for the accuracy and completeness of all plot data.

Certification

The goal is to have all plots installed by certified individuals. However, it is recognized that OJT training is required for new crew members. Each production crew shall have at least one certified individual who is responsible for data quality.

New crew members (trainees) shall demonstrate their ability to collect quality data in actual field conditions during the OJT phase (during the probationary period as a new employee). Hot checks and exit checks are used to determine if the trainee is ready for a certification plot. The trainee, trainee's supervisor, and QA personnel must concur on the readiness of the individual for a certification plot. The crew member either passes certification plot or not, based on established minimum score of 80 percent. If the result is a "pass," then the crew member is "certified." If the crew member fails, a retraining period shall ensue, followed by a second certification plot. If the crew member passes on the second plot inspection, then the crew member is certified. If the second plot also fails, that person is either removed from the project or assigned work that is directly supervised and checked by a certified individual. Depending on the personnel rules of the employing organization, usually during a probationary period, an employee can be released for not being certified.

An individual that has only worked outside of the Southern FIA region shall demonstrate their ability to collect quality data in actual field conditions during an OJT phase (due to regional variables and different plot conditions). Hot checks and exit checks are used to determine if the new employee is ready for certification. The complete certification process will follow the same certification guidelines used for a new FIA cruiser.

A refresher training of employees shall be required after a period of inactivity exceeding only 1 year which mimics the training process using exit training and hot checks (must meet a minimum acceptable level of accuracy).

Certification for a crew leader can be revoked if follow-up inspections reveal plots (a continual pattern) that fail to meet MQOs and/or maintain a minimum 87-percent check plot average during the appropriate evaluation period, generally the Federal fiscal year (October 1 to September 30) or probationary period. [Note: probationary period may vary depending on the parent organization of the crew leader]. The certification process will only take place twice before permanent removal as crew leader throughout the field career of individual cruiser.

Certification can be revoked at any time if a cruiser is determined to be unethical in data collection by immediate supervisor, QA personnel, and SRS-data acquisition section head following a fact-finding visit.

Assessment and Appraisal

There are two distinct purposes for check plot activities; control of the data collection process which is accomplished with hot checks, exit checks, and cold checks, and evaluation of the quality of the data that is produced and released to the public, which is accomplished using blind check data. Each individual certified cruiser and cumulative State check plot average must meet minimum 87 percent level of competency and maintained during either the Federal fiscal year or probationary period.

Inspections

Inspections are a vital part of the mechanism for assuring quality data are continuously generated. One underlying assumption of this plan is that every plot installed has a chance to be inspected. Crews are made aware of this policy. Two distinct types of QC inspections are done: hot checks, and cold checks. Below are a series of definitions associated with these inspections that clarify the purpose and scope of the operation.

Definitions

Training plot—a plot established for training or certification purposes only. It is not part of the basic set of FIA plots measured for deriving an inventory estimate.

Production plot—a plot that is part of the basic set of FIA plots measured for deriving an inventory estimate. It may also be used for training purposes (hot or exit checks during OJT).

Certification (refresher) plot—a plot installed by a certification or refresher candidate. It is the final training plot used to certify (or refresh) the candidate trainee for field data collection. The candidate crew member works alone to install the plot.

Production (or field data collection) crew—a crew containing at least one certified individual. The crew is involved in routine installation of plots.

QA/inspection crew—a crew of at least one qualified QA forester (crew may include certified State coordinator) whose primary responsibility is the training, certification, and inspection of production crews.

Hot check—an inspection normally done as part of the ongoing training/auditing process. The QA/inspector crew is present on the plot with the trainee/crew and provides immediate feedback regarding data quality. Data errors are corrected. Hot checks can be done on training plots or production plots.

Exit check—an inspection done as part of the training process. Normally the installation crew is present at the time of inspection. The QA/inspector crew has the completed data in-hand at the time of inspection. The inspection can include the whole plot or a subset of the plot. Data errors are corrected. The score from inspection is entered into the QA check plot score database but is not used within trainee's cumulative grade. The exit check is used only for training purposes and for evaluation of trainee readiness for certification plot.

Cold check—an inspection done either as part of the training process, or as part of the ongoing QC program. The field data collection crew may or may not be present at the time of inspection. The QA/inspector crew has the completed data in-hand at the time of inspection. The inspection can include the whole plot or a subset of the plot. Data errors are corrected. Cold checks are done on production plots only. This type of QA measurement is known as a single blind measurement in that the crews do not know when or which of their plots will be remeasured by the QA/inspector crew and cannot alter their performance as a result of this knowledge.

Blind check—a reinstallation done by a QA/inspector crew only consulting available field crew data to access the plot; a subset or full reinstallation of the plot is required for the purpose of obtaining a measure of data quality. The two datasets are maintained separately, discrepancies between the two sets of data are not reconciled. Blind checks are taken on production plots only.

Hot/Exit Check Cruise

Hot checks occur on production plots with QA/inspector crew present during data collection. Hot/exit check cruises will be conducted during OJT. Hot checks will also be conducted within 2 weeks after crew leader certification. Newly certified crew leaders who experienced problems during field training or testing will receive check cruises sooner than those with no problems. Any deviation from this schedule must be documented and approved by the appropriate Forest Service official (e.g., work zone supervisor and/or data acquisition section head).

Trained SRS FIA QA personnel will use the following steps to conduct each check cruise:

1. Monitor data collection on randomly selected plots from those plots already completed to ensure that the crew is meeting MQOs.
2. Carefully review all facets of cruising with the crew, completely answer all questions, resolve all problems, and immediately correct any discovered discrepancies.

3. Document the visit on every plot, noting any problems and/or additional training needed.
4. Revisit the field data collection crew on another plot within 2 weeks if significant problems and/or additional training needs were noted.
5. Discuss course of action to take with appropriate officials (field crew supervisor, appropriate SRS FIA work zone supervisor and/or data acquisition section head) if concerns arise about the field data collection crew's ability to do the assigned job.
6. Alert all crews about data collection problems/issues to prevent or correct the same problems/issues throughout the SRS FIA region.

Cold Check Cruise

Cold check cruises will be conducted within 2 weeks after initial hot check cruises are completed. A cold check must contain a complete set of core variable measurements (plot condition and subplot) and can include a full or partial set of tree-level data); the dataset must be maintained separately from the original data. Newly certified (refreshed) field crew leaders experiencing problems during the first check cruise (hot check) will have priority for cold check cruises over crews with no problems noted during the initial check cruise.

Trained SRS FIA QA personnel will use the following steps to conduct a cold check cruise:

1. Remeasure plots appearing on the transmitted plot list within 2 weeks after field crew has completed/transmitted measurements if during the growing season. Any deviation from this schedule must be documented and approved by the appropriate Forest Service official (e.g., work zone supervisor and/or data acquisition section head).
2. Compare measurements before leaving the site; this is a cold check.
3. Document and notify checked crew leader and immediate supervisor of results within 1 week.
4. Crew leaders who fail to meet and maintain the 87 percent minimum level of competency will be identified and a determination of the appropriate action to be taken will be made by the work zone supervisor and/or data acquisition section head (in consultation with the field crew supervisor).
5. Some plots may be rejected, in which case they will be remeasured and additional training will be provided. Crew leaders with repeated problems may be removed from the program following a determination by the work zone supervisor and/or data acquisition section head (following appropriate personnel practices by immediate supervisor).
6. Crew leaders with previous problems may have a higher percentage of cold checks.

Blind Check Cruise

This type of QA measurement is a "blind" measurement by QA/inspector in that the crew does not know when or which of their plots will be remeasured by the inspection crew and therefore cannot alter their performance accordingly. This represents a direct measurement of accuracy and precision of field crew measurements using the regional QA crew measurements as the basis for comparison. Plots selected for blind check measurement will be a random subsample of all plots measured. Remeasure plots appearing on the transmitted plot list within 2 weeks after field crew has completed/transmitted measurements if during the growing season. Any deviation from this schedule must be documented and approved by the appropriate Forest Service official (e.g., work zone supervisor and/or data acquisition section head).

A blind check must contain a complete set of core variable measurements (plot condition and subplot), and can include a full or partial set of tree-level data); the dataset must be maintained separately from the original data. No corrections of original data are permitted.

This type of QA measurement is used for data quality documentation and is not generally used to provide immediate feedback to the crews. Blind checks will allow assessment of overall crew performance, as well as documenting precision and bias of the crew's data. Following are brief instructions that the QA crews should follow to collect blind check data.

Blind Check Procedures

The general procedures for the inspection crews to use are:

- The QA/inspector crew measures the blind check plot as a standard production plot. Data are recorded independently without the original crew data being available to the inspectors. For remeasured plots, the downloaded data file containing only the data from the previous inventory cycle must be available to the QA/inspector crew as a data entry template. That is, the QA/inspector crew must have access to only the data that would be available to the field data collection crew prior to measurement. The field data collection crew's locational information (drawsheet) will be provided to QA/inspector crew for access purposes only.
- Site trees present unique difficulties in that the QA/inspector crew might not choose the same site trees to measure on newly established production plots as the production crew. In addition, even if the same site tree is chosen in both cases, different results may be a result of different cores being drawn. The QA/inspector crew should still take site data per production plot protocol. This site data can be used to determine repeatability of the distribution of site tree measures. The ultimate comparison for site trees is the comparison of the site class between the field data collection crew and QA/inspector crew.
- Following entry of both the production data and the blind check QA/inspector data into the database, and prior to release of the blind check data, both sets of data are made available to a data production analyst in order to match the QA/inspector tree numbers to the field data collection crew tree numbers. The tree numbers may only be changed in the QA/inspector data, not the field data collection crew data; no other changes are made to either dataset. Otherwise, the two plot datasets cannot be used for uncertainty estimation.

Public release of the blind check data would require that the data be sanitized with respect to field data collection crew identification.

Reuse of Blind Checks as Cold Checks

It is possible to maximize the utility of check plots by strictly adhering to the rules for blind checks while performing a cold check. The national guidance for collection of blind check data is to collect plot remeasurements without access to the field data collection crews' original tally data, and to maintain both datasets unchanged as independent samples in the national database. It would be acceptable to subsequently use the blind check data for crew performance scoring as would normally be done with cold checks. This approach could optimize use of QA data by allowing an increase in the percentage of blind check plots measured relative to cold checks. It should be emphasized that both the original crew data and the cold check measurements would go into the national database as separate independent datasets. In this case no changes would be allowed to crew data based on cold check results. No changes would be allowed with crew production plot, cold check data, or blind check data.

Plot Selection Criteria for Blind and Cold Checks

The blind and cold checks will be randomly selected by the QA/inspector crew. Blind and cold checks will be purposefully chosen by the work zone supervisor and/or data acquisition section head dependent on the needs of the unit and or the employee in question. This technique achieves the following goals.

1. Designation of which plots will be checked is completely random and unknown until the time of production plot transmission.
2. Field data collection crews have no way of knowing which plots are being selected by the QA/inspector crew or when it is occurring.

3. The selection process is never known by the field data collection crew being checked prior to the check itself. This prohibits last minute changes by the field data collection crew when possibly alerted to the fact a particular plot will be checked.
4. The probability of "flagging" a plot to be a candidate for checking is dependent upon whether it is a regular forested plot, a regular nonforest plot, or an intensified study plot, and varies by State according to its ratio of forested/non-forested/intensified study plots. The current protocols try to adhere to the percentages of the forest/non-forest area in each State as a guide only. Efficiencies, needs of SRS FIA, and needs of the employee in question can vary the final distribution of the check plots within any given State.
5. The QA target percentages for check plots can be raised or lowered for each field data collection crew and/or State as needed.
6. This selection process provides a "pool" of potential plots to be checked, but does not exclude the option of selecting a particular plot to be checked by the QA/inspector crew due to special circumstances (with supervisory approval or direction).

Random selection of blind and cold checks should be the default scenario unless one of these situations above dictates otherwise.

Feedback and Debriefing of Field Data Collection Crew Personnel

Field crews are often the first to identify problems and frequently provide the best solutions. The following process will ensure that feedback is received and potentially used:

1. The SRS FIA data acquisition section head, work zone supervisors, and training coordinator will establish a system of constant feedback.
2. The SRS FIA data acquisition section head, work zone supervisors, and training coordinator will evaluate feedback and take appropriate action.
3. Field data collection crew questions, suggestions, and concerns with field or QA procedures will be addressed in a timely manner.
4. At given intervals, such as completion of one-fifth of the plots in a State or at least once per year, FIA QA/inspector crew will debrief field data collection crew.
5. The feedback from the debriefing will be evaluated and appropriate changes made by the SRS FIA data acquisition section head, work zone supervisors, and training coordinator.

Data Validation and Verification

The data must be validated to ensure the highest possible standards. The QA plan is based entirely on the weights and tolerances listed in the field data collection manual and the QA/QC manual for all variables and the scoring system developed from these variables.

The data checking edit built into portable data recorders provide a primary level of data verification. The work zone supervisors and/or QA/inspector crew reviews data for obvious errors as a second verification step. Hot checks and cold checks are control processes used to validate and verify data quality. Data are verified by computerized data checking when data are downloaded into the regional database which provides a final level of consistency checking for related variables.

Correction

Training

All field data collection crew members will be tested during training and at the completion of training. Trainees failing to meet MQOs for any variables will be retrained and retested. These failures will also be evaluated to determine whether modifications in training and/or field data collection procedures are needed.

Analysis of Check Cruises

Hot check cruises will be used to identify and correct problems in meeting the data tolerance limits. Corrections will be made onsite as problems are identified. Problems will be documented and later evaluated, to determine whether the program or the crew member is responsible. Cold check cruises will be evaluated as soon as possible to identify problems and identify errors. The appropriate work zone supervisor in consultation with the data acquisition section head will determine whether or not to reject or remeasure plots having errors.

Procedure for Failure to Meet Standards

As stated earlier (see certification section on page 8) new crew members (trainees) shall demonstrate their ability to collect quality data in actual field conditions during the OJT phase (during the probationary period as a new employee). Hot checks and exit checks are used to determine if the trainee is ready for a certification plot. The trainee, trainee's supervisor, and QA personnel must concur on the readiness of the individual for a certification plot. The crew member either passes certification plot or not, based on established minimum score of 80 percent. If the result is a "pass," then the crew member is "certified." If the crew member fails, a retraining period shall ensue, followed by a second certification plot. If the crew member passes on the second plot inspection, then the crew member is certified. If the second plot also fails, that person is either removed from the project or assigned work that is directly supervised and checked by a certified individual. Depending on the personnel rules of the employing organization, usually during a probationary period, an employee can be released for not being certified.

Check-plot-score sheets provide a basis for determining when a crew fails to meet and maintain the 87 percent minimum level of competence expected for each plot and overall employee average during either the Federal fiscal year or probationary period. Because failures can range from small to large, they will be handled on a case-by-case basis. Corrective actions including decertification will be determined by the Forest Service, which has overall responsibility for the QA program. The disposition of decertified Forest Service/non-Forest Service employees is the responsibility of the employing agency. The Forest Service will not accept data from any non-certified crew leader.

Certification will be revoked any time a field crew leader is determined to be unethical in data collection following a fact finding visit by immediate supervisor, QA crew, work zone supervisor, and data acquisition section head. A training period and recertification of field crew leader will not take place if the cause of decertification is determined to be unethical behavior and not a question of field procedure training.

Quality Assurance Monitoring and Reporting

Monitoring

All data from the training, various types of check cruises, and blind check cruises will be compiled and analyzed to determine adherence to the MQOs on a constant and cumulative basis. All check plot scores are reviewed by the immediate supervisor, QA crew, work zone supervisor, and if needed, the data acquisition section head. The field crew leader being evaluated signs the check plot score sheet and adds any pertinent comments as does the QA/inspector crew. Typically, these data will be summarized in quarterly and annualized QA reports. Other reports may be generated by the Forest Service depending on the needs of the State agencies. Each field data collection crew must maintain the 87 percent annualized level of competence to maintain certification. Quarterly reports can be used to point out the need to decertify a cruiser should a pattern of poor performance be noted. Unethical behavior during data collection can and will result in automatic decertification if the fact-finding mission supports this assertion.

Reporting

The annualized and quarterly inventory reports will reference the QA report and may contain summary tables with such pertinent information as type and number of checks per field crew leader, panel, or number of checks in any geographical area. These reports are generated to provide State, regional, and national information concerning adherence to regional and national requirements and mandates. This information is critical to assuring quality data and genuine acceptance of the data for all of our State, regional and national data users.

For Additional Information

- Pollard, J.E. 2002. Forest inventory and analysis 2002 plot component quality assurance implementation plan (in preparation). U.S. Forest Service, Forest Inventory and Analysis Program, Washington, DC 20090.
- U.S. Department of Agriculture Forest Service. 1994. Forest inventory and analysis research program national quality assurance plan. Washington, DC: U.S. Department of Agriculture Forest Service. 10 p. On file with: Southern Research Station, Forest Inventory and Analysis, P.O. Box 2680, Asheville, NC 28802.
- U.S. Department of Agriculture Forest Service. 1998. Field instructions for southern forest inventory: remeasurement of prism plots. U.S. Department of Agriculture Forest Service. 169 p. [Draft]. On file with: Southern Research Station, Forest Inventory and Analysis, P.O. Box 2680, Asheville, NC 28802.
- U.S. Department of Agriculture, Forest Service. 2001. Volume 1: field data collection procedures for phase 2 Plots. U.S. Department of Agriculture Forest Service. 311 p. On file with: Southern Research Station, Forest Inventory and Analysis, 4700 Old Kingston Pike, Knoxville, TN 37919.
- U.S. Department of Agriculture Forest Service. 2002. Volume 2: field data collection procedures for phase 3 plots. U.S. Department of Agriculture Forest Service. 130 p. On file with: Southern Research Station, Forest Inventory and Analysis, 4700 Old Kingston Pike, Knoxville, TN 37919.
- U.S. Department of Agriculture, Forest Service. 2003. Quality assurance plan for forest inventory in the south. Knoxville, TN: U.S. Department of Agriculture, Forest Service. 33 p. [Draft]. On file with: Southern Research Station, Forest Inventory and Analysis, 4700 Old Kingston Pike, Knoxville, TN 37919.
- U.S. Department of Agriculture, Forest Service. 2006. Quality assurance plan for forest inventory in the south. Knoxville, TN: U.S. Department of Agriculture, Forest Service. 33 p. On file with: Southern Research Station, Forest Inventory and Analysis, 4700 Old Kingston Pike, Knoxville, TN 37919.