

CHAPTER 5. Evaluation and Research

The Coverage Evaluation Program

Purpose

The Bureau evaluates various phases of each of its major censuses and informs data users of the limitations of the statistics. The coverage evaluation program for the 1974 Census of Agriculture was designed to—

1. Measure the completeness of the census farm count, including the completeness of the mailing list and the effectiveness of the census processing procedures in identifying farms on the list.
2. Provide estimates of the completeness of the data for selected items, and to indicate the characteristics of farms not included in the census.
3. Evaluate the accuracy of the reporting of acres of land in farms by operators.
4. Evaluate the quality of the various administrative lists used to construct the census mailing list, and provide information for improved coverage in future censuses. Special emphasis was placed on evaluating the contributions of the different list sources to the number of farms counted in the census and the accuracy of the size indicators from these sources, and on measuring the duplication among sources.

A coverage evaluation has been conducted for each census of agriculture since 1945, and the results have been published for every census since 1949. The methodology has remained essentially the same, but techniques have been refined and sample design has been improved.

Procedures

The basic procedures for 1974, described in greater detail below, were as follows:

1. An area segment sample of farmers was obtained from the 1974 June Enumerative Survey conducted by the Statistical Reporting Service (SRS) of the U.S. Department of Agriculture. This segment sample served as the base sample for measurement of census coverage.
2. The farms in the base sample were matched to the census mailing list and reports to establish the relationship between the base sample farms and those in the census.

3. Followup operations were conducted to check and clarify differences between base sample farms and census responses and to establish "true" values.
4. After processing and tabulation of the sample and census responses, the data were analyzed and the results were published.

The SRS area segment sample was used as a measurement base for the census because (1) the sample was substantially larger than those used for coverage checks prior to 1969 and it provided the capability for greater reliability and geographic detail than was previously possible; (2) it provided an independent source for a sample of farms that was designed to represent all farms in the universe, and (3) it allowed the use of more intense enumeration and followup procedures in an attempt to provide information more accurate than the census (on a limited number of items). These procedures could not be used for the census as a whole because the cost and time necessary would have been prohibitive.

There were certain problems involved in the use of the SRS sample, including the following:

1. The difference in date of enumeration: The SRS determination of qualifying farm operators was based entirely on reported 1973 sales, if these sales were above a specified level, while the census determination was based entirely on 1974 sales.
2. The classification of operating units as farms was not always comparable with census classification.
3. Contact with the SRS June survey respondents was kept at a minimum level and was restricted primarily to those not positively matched to the census.

The SRS June Enumerative Survey Sample

The area sample used by the SRS for the June Enumerative Survey was a single-stage, general-purpose sample of farms in the 48 conterminous States, geographically stratified, based on the intensity of agricultural operations. It consisted of about 16,200 area segments with approximately 60,000 associated farm operators. The average size of a segment ranged from 300 acres in heavily cultivated areas to about 4,000 acres in range or grazing areas. Information was collected in SRS field interviews.

The sample survey data (June 1974) were made available to the Bureau of the Census through an agreement with the USDA that specified the type of information to be provided and described how it was to be used.

The measurement base used for the 1974 coverage evaluation included only the 23,000 farm operators residing in the segments. (The June survey also obtained information on farms in the segments whose operators lived outside the segment, and on nonfarm tracts.) The information obtained from the SRS sample included district, segment, tract, name and address of the operator, name of the farm or ranch, county, telephone number, total acres in the place, acres in the segment, acres by tenure, and a sales class-interval code indicating total value of 1973 sales. Information concerning specific products was obtained from SRS for the smaller farms (those with total value of sales of \$2,500 or less) in the sample. These places were most likely to be missed and their qualifications as farms might have changed after the survey was made. During the processing of the coverage evaluation, operations that did not meet the Bureau's definition of a farm were deleted from the sample.

Matching and Processing Operations

The principal processing operations for the coverage evaluation were as follows:

1. Receipt and keying of SRS June Enumerative Survey data.
2. Computer matching (stage 1) of sample cases on a last-name basis to the entire 1974 census mail list and classification of sample cases as matches, possible matches, and nonmatches.
3. Clerical review of computer matching operations.
4. Mailout of report form A90 to all possible match and nonmatch cases, with followup of nonrespondents.
5. Matching (stage 2) of returned A90 forms to the census mailing list.
6. Matching coverage sample to data from census report forms and assignment of coverage classification codes to identify relationship to census.
7. Telephone followup to resolve acreage differences.
8. Preparation of data for keying.
9. Computer consistency edit and edit review.
10. Tabulation of the data.

The sample data were received in late 1974 and the match to names and addresses on the census mailing list was begun in February 1975. In general, when a positive match was found on the mailing list no further search was made; possible match and nonmatch cases were further researched.

The SRS sample cases were also matched to approximately 1.2 million names from the Agricultural Stabilization and Conservation Service list which were not included in the census mailing

list due to sampling for specified States, but were represented in the census by weighting.

The stage 1 matching operation was completed in July 1975, and A90 questionnaires were mailed to 7,300 possible matches and nonmatches on August 5. Form A90 contained questions on land, land ownership, the operational characteristics of the farm, county location, changes in acres operated in 1974, alternate mailing addresses, social security and employer identification (EI) numbers, types of business organizations, and the names and addresses of other persons associated with the operation. Three followup mailings to nonrespondents were made at 4-week intervals, beginning in the first week of September. By early November, approximately 5,700 report forms had been received, a response rate of about 78 percent. A telephone followup operation was begun in November 1975 to obtain reports from nonrespondents and to complete report forms returned incomplete.

The stage 2 match was a second attempt to locate SRS sample farms in the census mailing list, using additional information as it became available from the returned A90 questionnaires. Census report forms were pulled from the files for all matched cases and copies were prepared. The census data and the SRS sample data were then checked for acreage comparability and classification. Individual farms were classified into one of 25 coverage classification codes that identified the farm as included, overcounted, or undercounted in the census. Each of these categories had subclasses within them relating to acreage, part of the sample, or part of the census involved.

A subsample of one-tenth of the coverage units was selected to provide estimates of census coverage of land in farms. Differences in acreage or reporting units were resolved by telephone for the subsample of cases. Approximately 1,200 such acreage-resolution cases were resolved between the last week of October 1976 and the end of January 1977. A review of very small agricultural operations to determine whether they met the Bureau's definition of a farm, and a further search for large farms classified as "missed" were also carried out during the stage 2 matching operation.

Preparation of most of the coverage check data in format for keying was completed in December 1976. The computer program for the consistency edit (to identify errors made during keying and review and to identify extreme values) was completed in early 1977. The results of the coverage check are published in **1974 Census of Agriculture, Volume IV, Special Reports, Part 3, Coverage Evaluation.**

The Processing Evaluation Sample

The purpose of the processing evaluation sample of the 1974 Census of Agriculture was to investigate the effect of each stage of data processing on census data. The sample consisted of approximately 8,000 names and addresses taken from the final census mailing list prior to the initial mailout of the report forms. The complete census mailing list was stratified by the estimated value of products sold by each potential agricultural operation, and a probability sample of names was selected from

each mailing list stratum. The sample strata, economic size classes, and sampling fraction were as follows:

| Evaluation sample stratum | Estimated size class | Sampling fraction |
|---------------------------|----------------------|-------------------|
| I | \$200,000-\$499,999 | 1 in 30 |
| II | \$100,000-\$199,999 | 1 in 100 |
| III | \$40,000-\$99,999 | 1 in 200 |
| IV | \$5,000-\$39,999 | 1 in 400 |
| V | \$2,000-\$4,999 | 1 in 500 |
| VI | \$0-\$1,999 | 1 in 1,000 |
| VI | No size | 1 in 1,000 |
| VI | Multiunit | 1 in 1,000 |

A folder was prepared for each case selected for the sample. This folder initially contained only an evaluation sample worksheet, form 74-A217, listing the census file number, State code, estimated size code, codes indicating the source of each case on the census mailing list, and space for the specification of changes made to data items during processing. The selected cases were mailed questionnaires and followed up in the same manner as cases that were not selected.

Upon receipt of a census return that was part of the evaluation sample, a photocopy of the completed questionnaire was made and added to the evaluation folder for that sample case, and the report was returned to the processing cycle. Selected entries on the questionnaire were posted manually to the form A217 worksheet and identified by a code as an original response. Computer printouts of the data after keying and after each computer edit were added to each case's evaluation folder. The keyed data were compared to the original response, and omissions and/or other changes were posted to the worksheet with a code identifying the changes in the items concerned as originating with the clerk or analyst or keyer. The printout of the data from the first computer edit was compared to the data-keying printout and changes in the data were posted to the worksheet. Any further printouts from the computer edits were compared to the previous printout, and changes were posted.

Six types of data-processing changes were identified as follows:

1. Clerk or analyst change. Changes made by clerks or analysts prior to data keying.
2. Measurement unit change. A special type of clerk or analyst change identified when the difference in item value was determined to be due to a clerk's or analyst's correction of a respondent's unit of measure (e.g., changing hundredweight to bushels).
3. Keyer omissions. An item was omitted by the data keyer.
4. Keyer entry error. An error was made in keying an item value (e.g., keyer might key 110 acres on a place, instead of 10 acres).
5. Initial computer edit imputation change. Item values altered by the computer edit program during the first computer edit.

6. Edit review and subsequent computer changes. Item values altered during analyst review of initial edit failure and subsequent changes made by computer edit as a result of the analysts' changes.

After tabulation and processing, the evaluation data were used primarily as in-house resource material for Bureau planning and program design.

The Independent Verification Study

This study involved three principal areas of investigation:

1. Evaluation of the quality control plan and the protection it provided against keying errors (classified as errors of omission, keystroke, or procedure).
2. Measurement of the impact of keying errors and processing changes on publishable data items.
3. Comparison of different bases for estimating error rates and frequency distribution of respondents' responses to questionnaire items.

Sample Selection

A 4-percent simple random sample of the A1 and A2 report forms was selected from the States of Georgia and Virginia. Approximately 3,100 questionnaires were in the sample.

Procedures

Once selected, the report forms were sent to a staff of preproduction keyers. Each questionnaire was keyed twice, each time by a different keyer, and then sent for regular production keying. The data tapes of all three independent keying cycles were processed, using a computer program that allowed comparison of the data keyed for each item in each of the three data sets. The results were tabulated in terms of omission errors, keystroke errors, added items, and the overall impact of keying error on the data prior to format editing. The program also tabulated response rates for each item. To determine the accuracy of items and entries, the majority rule was used. (E.g., if two of the three keyers agreed on an item and its value, that item and value were considered to be correct. In cases involving a three-way disagreement among keyers, no decision to determine the correct data was made. The impact of such three-way disagreements was negligible, involving only 24 of the 146,000 items keyed.)

Quality Control Evaluation

The quality control evaluation plan implemented detected an error rate (on an item basis) of 0.80 percent. The omission,

keystroke, and added-item error rates (in percentages)¹ for the production and preproduction keyers were as follows:

| Type of keyer | Total | Omission | Keystroke | Added-item |
|-------------------|-------|----------|-----------|------------|
| Production keyers | 0.80 | 0.24 | 0.43 | 0.13 |
| Prekeyers 1 | .81 | .32 | .37 | .12 |
| Prekeyers 2 | .78 | .29 | .39 | .10 |

Of the total production-keying error, 30 percent was classified as omission error, 54 percent as finger (keystroke) error, and the remaining 16 percent as added-item error.

In general, the overall quality of the data-conversion operation met the standards set by the quality control plan. However, there was a considerable fluctuation of quality among the keyers. Omission error is a natural candidate for causing trouble on large reports where data are scattered and, as such, is a fair indicator of the quality of work done by keyers. The following table gives an idea of the variation in the work produced by the production-keying staff.

| Omission rate range | Keyers in the range | |
|---------------------|---------------------|---------|
| | Number | Percent |
| Total | 171 | 100.0 |
| 0.00 | 64 | 37.4 |
| 0.01-0.36 | 67 | 39.2 |
| 0.36 and over | 40 | 23.4 |

The production quality control plan required that the maximum error rate not exceed 0.36 per item. By this measure it can be seen that 40 of the keyers (23.4 percent) had difficulty maintaining the acceptable omission level.

Error Impact

The tabulations carried out as part of the evaluation program yielded several facts about the impact of processing errors on the census data. Among these were the following:

1. Approximately 65.6 percent of the items for the State of Georgia and 62.9 percent of the items for Virginia had no

processing errors, regardless of the number of entries for those items.

2. An estimated 3.7 percent of the items for Georgia had errors that caused a 25-percent impact rate (i.e., changed the data on the questionnaires by 25 percent), while for Virginia, an estimated 4.9 percent of the items had errors with an impact of at least 25 percent.
3. In general, the items having keying errors tended more often to have a negative impact (keyed value being less than true reported value), but the largest individual errors tended to result in a positive impact (keyed value greater than true reported value).

Coverage and Response

Response rates for selected items were tabulated during the study. Some of the response characteristics to the census questionnaires were as follows:

1. Only one item, the request for the respondent's telephone number, had an entry on all the questionnaires in the sample.
2. An estimated 87 percent of the respondents had entries for the number of acres of all land owned, but only 67 percent entered an estimate of the current market value of acres owned and buildings on those acres.
3. Approximately 85 percent of the questionnaires provided data on the total number of acres in each place, but only 54 percent carried those data to the later item that asked only for the information to be carried over from the earlier item.
4. The question "In what county was the largest value of your agriculture products raised or produced?" received an estimated 70-percent response.

The analysis of the results is being used as a basis for making recommendations for the improvement of the processing operations planned for future agriculture censuses.

¹ The base of the error rate computation was total items keyed.