



Farms and Land in Farms Methodology and Quality Measures

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Survey Methodology for Farms and Land in Farms in 2020

Scope and Purpose: In 2020, the National Agricultural Statistics Service (NASS) implemented a statistical modeling approach to generate survey indications. This approach was in response to the impacts of the COVID-19 pandemic on data collection processes and the suspension of in-person data collection. NASS has been doing everything possible to keep all parties involved safe and slow the spread of the virus while continuing to produce critical data about American agriculture.

Reliability: For 2020, the uncertainties associated with the modeled estimates are expressed as coefficients of variation (CVs), a measure of relative error calculated as ratios of standard deviations and corresponding estimates multiplied by 100. The CV for the United States number of farms was 0.3 percent and land in farms was 0.1 percent. The additional measurement error due to uncertainty associated with model selection is not reflected in the reported CV's.

Estimation: In 2020, Bayesian models relating the historical official estimates to a time-trend were developed to produce estimates of farms and land in farms. The response variables in these models were historical official estimates and the covariate was time-trend. Non-informative priors were used. Estimates and the corresponding standard deviations were calculated as posterior means and posterior standard deviations, respectively. Coefficients of variation were calculated as ratios of standard deviations and corresponding estimates multiplied by 100.

Estimates were established under secure conditions to protect reports until they were publicly released at preannounced dates and times. For both 2020 and prior years, NASS assembles a panel of statisticians to serve as the Agricultural Statistics Board (ASB), which establishes the national estimates and ensured that state estimates are in balance with the national numbers.

Survey Methodology for Farms and Land in Farms Prior to 2020

Scope and Purpose: Prior to 2020, data were collected by NASS during the June Agricultural Survey using sampling procedures to ensure every farm and ranch has a chance of being selected. NASS used a multiple sampling frame approach to count farms and measure land in farms. An Area Sampling Frame that divided all land into segments is built for every state except Alaska. A sample of segments was selected in each state except Alaska and Hawaii and enumerated in early June. Highly trained interviewers located each sampled segment and identified every farm and ranch operating land in the segment and the number of acres in each operation.

These data were used to compute summaries of farm numbers and acres of land in farms. Additionally, all farms found in the segments were checked against a list of farms and ranches maintained by NASS to determine whether the farm is on the list. Operations found in the Area Frame sample that were not on the list provided a measure of incompleteness of the list. The summarized totals for these non-overlap (or not-on-list) operations were combined with summarized totals collected from a sample selected from the list to calculate additional indications of farms and land in farms.

Survey Timeline: Some pre-survey screening is done in May to identify farm operators to be interviewed. Data collection is conducted by personal interview from the end of May through mid-June. The reference date for the June Area Survey is June 1. Regional Field Offices (RFOs) conduct the first round of editing and analysis over a three-week period, ending in late June. An additional two weeks of editing and analysis occur in July. Once editing is complete, the data are summarized. Following summarization, RFOs review the survey results and submit state-level recommendations to NASS

headquarters. A national review is completed and national estimates are established. The farms and land in farms estimates are published annually in mid-February.

Sampling: The target population for the farms and land in farms estimates is all farms and ranches with \$1,000 or more in agricultural sales (or potential sales). The June Area Survey utilizes an area sampling frame. The area frame consists of all land in all states, except Alaska, and thus represents all farms and ranches. Although Hawaii has an area frame, NASS does not conduct the June Area Survey in Hawaii. The frame in each state is stratified by the percentage of land devoted to agriculture and divided into segments of land, which are about one square mile in size. A stratified random sample is selected in each state with a national sample size of about 9,000. Sampled segments are in the survey for five consecutive years. About 20 percent of the segments are rotated out and replaced with new ones each year.

Each segment is divided into tracts, each tract representing a unique operating arrangement. Some tracts do not have agriculture and are screened out. Data are collected on the remaining agricultural tracts.

Data Collection: Each enumerator is responsible for collecting information on all agricultural tracts within each of several segments of land. The enumerator collects information on each agricultural tract through personal interviews. The completed survey questionnaires are returned to the RFOs where they are reviewed and key entered.

Questionnaire content and format are evaluated annually through a specifications process where requests for changes are evaluated and approved or disapproved. Input may vary from question wording or formatting to a program change involving the deletion or modification of current questions or addition of new ones. If there are significant changes to either the content or format proposed, a NASS survey methodologist will pre-test the changes for usability.

All federal data collections require approval by the Office of Management and Budget (OMB). NASS must document the public need for the data, show that the design applies sound statistical practice, and ensure that the data do not already exist elsewhere and that the public is not excessively burdened. The June Area questionnaire must display an active OMB number that gives NASS the authority to conduct the survey, a statement of the purpose of the survey and the use of the data being collected, a response burden statement that gives an estimate of the time required to complete the form, a confidentiality statement that the respondent's information will only be used for statistical purposes in combination with other producers, and a statement saying that response to the survey is voluntary and not required by law.

Survey Edit: As survey data are collected and captured, data are edited for consistency and reasonableness using automated systems. Reported data are edited as a batch of data when first captured. The edit logic ensures the coding of administrative data follows the methodological rules associated with the survey design. Relationships between data items (i.e. responses to individual questions) on the current survey are verified. Some data items in the current survey are compared to data items from earlier surveys to ensure certain relationships are logical. The edit will determine the status of each record to be either "dirty" or "clean" (i.e. failing or passing the edit requirements for consistency and reasonableness). Records that fail edit requirements must be updated or must be certified by an analyst to be exempt from the failed edit requirement. Only records that pass edit requirements are eligible for final summary.

Analysis Tools: Edited data are processed through an interactive analysis tool that displays data for all reports by item. The tool provides scatter plots, tables, charts, and special tabulations that allow the analyst to compare an individual record to similar records. Atypical responses and unusual data relationships become evident and Regional Field Office staff review them to determine if they are correct. The tool allows comparison to an agricultural operation's previously reported data to detect large changes in the operation. Data found to be in error are corrected.

Reliability: Prior to 2020, two types of survey errors, sampling and non-sampling, are possible in the final estimates, and both can affect the quality of the estimates. Sampling error occurs because a complete census is not taken. The sampling error measures the variation in estimates from the average of all possible samples. An estimate of 100 with a sampling error of 1 would mean that chances are 19 out of 20 that the true population value lies between 98 and 102 (the survey estimate, plus or minus 1.96 times the sampling error). In 2019, the CV for the United States number of farms was 2.0 percent and land in farms 1.6 percent. The CVs by economic sales class ranged from 2.7 percent to 5.1 percent for number of farms and 3.1 to 7.6 percent for land in farms at the United States level.

Non-response Adjustment: Response to the June Area Survey is voluntary. Some producers refuse to participate in the survey, others cannot be located during the data collection period, and some submit incomplete reports. These non-respondents must be accounted for if accurate estimates of farm numbers are to be made. The non-response data items and sampling units are manually imputed by Regional Field Office statisticians, largely by observation. The weights for data items from reporting farms and ranches are not adjusted.

Estimators: The primary estimators used to set farms and land in farms estimates are the area frame direct expansion and ratio estimators. The direct expansion generates a total for the current year. It is calculated by summing the June Area Survey data multiplied by the proportion of the farm residing inside the segment and weighted by the original segment sampling weight. The ratio estimator measures the change from year to year and is the ratio of the current year's and previous year's direct expansions for comparable segments. The sampling weights are adjusted to account for those segments that are not comparable.

A multiple frame direct expansion is also generated for farms and land in farms. It is the sum of direct expansion from the June Agricultural Survey data, a NASS list only survey, and the non-overlap (NOL) portion of the direct expansion from the June Area Survey data. The NOL portion of the June Area Survey refers to those operations identified on the area frame that are not matched to an operation eligible for sampling for the June Agricultural Survey.

Estimation: For the national estimates, NASS assembles a panel of statisticians to serve as the Agricultural Statistics Board (ASB), which reviews the national results and establishes the national estimates. Since larger sample sizes yield more precise results, NASS employs the "top-down" approach by determining the national estimates first and reconciling the state recommendations to the national number for total number of farms and land in farms, as well as each of the economic sales classes. The ASB also enjoys an advantage in being able to examine results across states, and compare the state recommendations. The same estimators used in the state summaries are produced by the national summary. The ASB follows the same approach the states do in determining the national estimate. The historical relationship of the survey estimates to the official estimate is evaluated to determine accuracy and bias using tables and graphs. Each ASB member completes an independent interpretation of the survey results which is shared with the other members and a consensus is reached. Often the state recommendations do not sum to the national estimate. ASB members must reexamine the state results and revise some states to make the sum of the state estimates agree with the national estimate.

Quality Metrics for Farms and Land in Farms

Purpose and Definitions: Under the guidance of the Statistical Policy Office of the Office of Management and Budget (OMB), the United States Department of Agriculture's National Agricultural Statistics Service (NASS) provides data users with quality metrics for its published data series. The metrics tables in this document describe the performance data for the survey contributing to the publication. The accuracy of data products may be evaluated through sampling and non-sampling error. The measurement of error due to sampling in the current period is evaluated by the coefficient of variation for each estimated item. Non-sampling error is evaluated by response rates.

Farm Tract is a portion of a sampled segment that represents a unique operating arrangement that meets the definition of a farm.

Sample Size is the total number of farm tracts found in the sample segments in the June Area Survey.

Response rates measure the proportion of total farm tracts responding to the June Area Survey.

Coefficient of Variation provides a measure of the size of the standard error relative to the point estimate and is used to measure the precision of the results of a survey estimator.

June Area Survey Farms and Land in Farms Sample Size and Response Rates: To assist in evaluating the performance of the estimates in the *Farms and Land in Farms* report, the sample size and response rates are displayed. The sample size changes from year to year as the number of farm tracts identified within the sampled segments varies.

Farms and Land in Farms Sample Size and Response Rate – States and United States: 2019-2020

State	Sample size		Response rate	
	2019 (number)	2020 (number)	2019 (percent)	2020 (percent)
Alabama	418	(NA)	83.3	(NA)
Alaska	(NA)	(NA)	(NA)	(NA)
Arizona	184	(NA)	83.7	(NA)
Arkansas	796	(NA)	78.1	(NA)
California	633	(NA)	73.0	(NA)
Colorado	637	(NA)	49.0	(NA)
Connecticut	25	(NA)	52.0	(NA)
Delaware	56	(NA)	51.8	(NA)
Florida	202	(NA)	66.8	(NA)
Georgia	493	(NA)	56.8	(NA)
Hawaii	(NA)	(NA)	(NA)	(NA)
Idaho	453	(NA)	60.3	(NA)
Illinois	1,549	(NA)	67.4	(NA)
Indiana	965	(NA)	67.7	(NA)
Iowa	1,547	(NA)	66.8	(NA)
Kansas	1,517	(NA)	41.8	(NA)
Kentucky	671	(NA)	64.1	(NA)
Louisiana	319	(NA)	81.5	(NA)
Maine	42	(NA)	69.0	(NA)
Maryland	148	(NA)	56.1	(NA)
Massachusetts	27	(NA)	74.1	(NA)
Michigan	632	(NA)	72.3	(NA)
Minnesota	1,502	(NA)	75.3	(NA)
Mississippi	611	(NA)	84.3	(NA)
Missouri	1,640	(NA)	61.5	(NA)
Montana	699	(NA)	80.3	(NA)
Nebraska	1,229	(NA)	63.4	(NA)
Nevada	20	(NA)	70.0	(NA)
New Hampshire	20	(NA)	50.0	(NA)
New Jersey	76	(NA)	75.0	(NA)
New Mexico	312	(NA)	78.2	(NA)
New York	236	(NA)	72.5	(NA)
North Carolina	611	(NA)	69.9	(NA)
North Dakota	1,298	(NA)	63.4	(NA)
Ohio	954	(NA)	85.0	(NA)
Oklahoma	1,043	(NA)	53.9	(NA)
Oregon	402	(NA)	71.1	(NA)
Pennsylvania	354	(NA)	72.0	(NA)
Rhode Island	17	(NA)	41.2	(NA)
South Carolina	197	(NA)	48.2	(NA)
South Dakota	1,048	(NA)	62.9	(NA)
Tennessee	919	(NA)	75.5	(NA)
Texas	3,069	(NA)	73.3	(NA)
Utah	261	(NA)	79.3	(NA)
Vermont	66	(NA)	84.8	(NA)
Virginia	348	(NA)	72.1	(NA)
Washington	462	(NA)	53.9	(NA)
West Virginia	169	(NA)	95.9	(NA)
Wisconsin	653	(NA)	67.7	(NA)
Wyoming	166	(NA)	50.6	(NA)
United States	29,696	(NA)	67.6	(NA)

(NA) Not available.

Quality Metrics for Farms and Land in Farms – States and United States: 2019-2020

State	Coefficient of variation			
	Number of farms		Land in farms	
	2019	2020 ¹	2019	2020 ¹
	(percent)	(percent)	(percent)	(percent)
Alabama	10.6	1.4	9.4	0.9
Alaska	(NA)	(NA)	(NA)	(NA)
Arizona	21.0	3.2	10.8	1.8
Arkansas	10.5	0.9	5.6	0.3
California	20.4	1.2	11.0	0.6
Colorado	17.6	1.2	5.2	0.4
Connecticut	28.3	3.5	63.5	4.2
Delaware	21.6	1.0	9.2	1.2
Florida	16.2	0.3	17.0	0.5
Georgia	27.6	1.7	9.7	1.2
Hawaii	(NA)	(NA)	(NA)	(NA)
Idaho	13.0	1.0	13.9	1.2
Illinois	5.1	0.8	1.3	0.2
Indiana	8.2	1.2	2.0	0.5
Iowa	3.8	0.3	0.9	-
Kansas	5.5	0.9	1.2	0.1
Kentucky	8.9	1.1	5.6	0.8
Louisiana	20.4	1.2	5.5	0.6
Maine	28.5	1.4	30.6	3.0
Maryland	15.7	0.6	10.4	0.7
Massachusetts	33.5	1.6	44.0	1.5
Michigan	7.6	0.7	4.1	0.4
Minnesota	4.9	0.7	2.2	0.4
Mississippi	11.8	1.0	5.6	0.8
Missouri	7.5	1.3	3.7	0.3
Montana	12.7	0.8	5.6	0.5
Nebraska	4.9	1.3	3.6	0.1
Nevada	42.0	6.2	57.9	0.6
New Hampshire	49.6	1.6	51.1	1.7
New Jersey	31.5	2.1	19.5	0.8
New Mexico	20.4	3.4	5.7	0.6
New York	11.3	0.7	8.9	0.8
North Carolina	17.4	1.0	8.5	1.0
North Dakota	4.9	2.3	2.5	0.2
Ohio	8.7	0.6	4.2	1.2
Oklahoma	9.1	0.8	2.8	0.4
Oregon	19.5	1.9	13.5	0.9
Pennsylvania	10.7	1.4	7.0	1.3
Rhode Island	5.1	3.2	12.2	6.0
South Carolina	42.5	1.4	14.0	1.2
South Dakota	6.2	1.1	2.7	0.1
Tennessee	7.0	2.1	3.9	0.5
Texas	7.4	0.4	5.3	0.3
Utah	15.1	1.6	35.3	0.4
Vermont	31.9	1.2	19.3	1.4
Virginia	10.7	1.0	10.1	1.2
Washington	13.4	0.7	13.3	0.5
West Virginia	19.7	2.1	19.5	1.6
Wisconsin	7.2	1.6	5.2	0.3
Wyoming	21.6	0.9	25.7	0.9
United States	2.0	0.3	1.6	0.1

- Represents zero.

(NA) Not available.

¹ 2020 Coefficients of Variation are not comparable to 2019 since the Bayesian linear regression model was used to produce the indications in 2020.

Quality Metrics for Farms and Land in Farms by Economics Sales Class – United States: 2019-2020

Economic sales class	Coefficient of variation			
	Number of farms		Land in farms	
	2019	2020	2019	2020
	(percent)	(percent)	(percent)	(percent)
\$1,000 - \$9,999	3.4	(NA)	4.7	(NA)
\$10,000 - \$99,999	2.7	(NA)	4.4	(NA)
\$100,000 - \$249,999	3.6	(NA)	5.9	(NA)
\$250,000 - \$499,999	3.1	(NA)	5.8	(NA)
\$500,000 - \$999,999	3.1	(NA)	7.6	(NA)
\$1,000,000 or more	5.1	(NA)	3.1	(NA)
Total	2.0	(NA)	1.6	(NA)

(NA) Not available.

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