



Farms and Land in Farms Methodology and Quality Measures

ISSN: 2167-132X

Released February 18, 2022, by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA).

Survey Methodology for Farms and Land in Farms In 2021

Scope and Purpose: Farms and land in farms are estimated annually in February. Estimates made for this program include the number of farms, land in farms, and average farm size. Estimates are published for the United States and by state and economic sales class.

In 2021, 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. The Area Frame portion is collected on the June Area Survey 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 late March to identify farm operators to be contacted. Data collection is conducted from the end of May through mid-June. The reference date for the June Area Survey is June 1. Regional Field Offices (RFOs) conduct editing and analysis from June to mid-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.

Non-sampling Errors: Non-sampling errors are present in any survey process. These errors include reporting, recording, and editing errors. Steps are taken to minimize these errors, such as comprehensive interviewer training, validation, and verification of processing systems, application of detailed computer edits, and evaluation of the data via the analysis tools.

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 machine imputed from previously reported data or 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.

Reliability: In 2021, 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 2021, the coefficient of variation for the United States number of farms was 2.0 percent and land in farms 1.6 percent. The coefficients of variation by economic sales class ranged from 2.9 percent to 3.5 percent for number of farms and 2.3 to 6.5 percent for land in farms at the National level.

Survey Methodology for Farms and Land in Farms in 2020

Estimation: 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.

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 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.

Reliability: For 2020, the uncertainties associated with the modeled estimates are expressed as coefficients of variation, a measure of relative error calculated as ratios of standard deviations and corresponding estimates multiplied by 100. The coefficient of variation 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 coefficients of variation.

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: 2020-2021

State	Sample size		Response rate	
	2020 (number)	2021 (number)	2020 (percent)	2021 (percent)
Alabama	(NA)	380	(NA)	73.4
Alaska	(NA)	(NA)	(NA)	(NA)
Arizona	(NA)	157	(NA)	60.5
Arkansas	(NA)	767	(NA)	50.3
California	(NA)	664	(NA)	64.5
Colorado	(NA)	638	(NA)	51.3
Connecticut	(NA)	23	(NA)	39.1
Delaware	(NA)	56	(NA)	14.3
Florida	(NA)	226	(NA)	50.0
Georgia	(NA)	502	(NA)	35.5
Hawaii	(NA)	(NA)	(NA)	(NA)
Idaho	(NA)	491	(NA)	53.0
Illinois	(NA)	1,587	(NA)	57.8
Indiana	(NA)	937	(NA)	59.1
Iowa	(NA)	1,527	(NA)	55.1
Kansas	(NA)	1,559	(NA)	27.2
Kentucky	(NA)	670	(NA)	50.9
Louisiana	(NA)	321	(NA)	75.1
Maine	(NA)	42	(NA)	45.2
Maryland	(NA)	137	(NA)	45.3
Massachusetts	(NA)	30	(NA)	60.0
Michigan	(NA)	633	(NA)	58.5
Minnesota	(NA)	1,476	(NA)	56.6
Mississippi	(NA)	569	(NA)	64.9
Missouri	(NA)	1,618	(NA)	38.4
Montana	(NA)	743	(NA)	60.2
Nebraska	(NA)	1,202	(NA)	47.8
Nevada	(NA)	23	(NA)	82.6
New Hampshire	(NA)	21	(NA)	28.6
New Jersey	(NA)	65	(NA)	38.5
New Mexico	(NA)	318	(NA)	47.5
New York	(NA)	218	(NA)	61.0
North Carolina	(NA)	597	(NA)	55.4
North Dakota	(NA)	1,264	(NA)	46.5
Ohio	(NA)	1,033	(NA)	62.3
Oklahoma	(NA)	1,038	(NA)	42.4
Oregon	(NA)	430	(NA)	49.5
Pennsylvania	(NA)	347	(NA)	53.9
Rhode Island	(NA)	15	(NA)	33.3
South Carolina	(NA)	190	(NA)	52.6
South Dakota	(NA)	1,051	(NA)	39.3
Tennessee	(NA)	868	(NA)	63.9
Texas	(NA)	3,036	(NA)	54.8
Utah	(NA)	252	(NA)	80.2
Vermont	(NA)	68	(NA)	44.1
Virginia	(NA)	323	(NA)	58.2
Washington	(NA)	453	(NA)	39.3
West Virginia	(NA)	167	(NA)	84.4
Wisconsin	(NA)	628	(NA)	59.6
Wyoming	(NA)	170	(NA)	52.9
United States	(NA)	29,530	(NA)	52.1

(NA) Not available.

Quality Metrics for Farms and Land in Farms – States and United States: 2020-2021

State	Coefficient of variation			
	Number of farms		Land in farms	
	2020 ¹	2021	2020 ¹	2021
	(percent)	(percent)	(percent)	(percent)
Alabama	1.4	10.1	0.9	9.8
Alaska	(NA)	(NA)	(NA)	(NA)
Arizona	3.2	25.4	1.8	10.0
Arkansas	0.9	12.9	0.3	6.0
California	1.2	18.9	0.6	11.5
Colorado	1.2	17.8	0.4	5.7
Connecticut	3.5	43.5	4.2	64.4
Delaware	1.0	22.0	1.2	9.0
Florida	0.3	16.9	0.5	14.4
Georgia	1.7	26.2	1.2	7.4
Hawaii	(NA)	(NA)	(NA)	(NA)
Idaho	1.0	12.8	1.2	15.9
Illinois	0.8	4.2	0.2	1.4
Indiana	1.2	7.4	0.5	2.1
Iowa	0.3	3.9	-	1.0
Kansas	0.9	5.9	0.1	1.0
Kentucky	1.1	8.8	0.8	5.4
Louisiana	1.2	17.4	0.6	5.7
Maine	1.4	37.0	3.0	30.6
Maryland	0.6	16.0	0.7	9.9
Massachusetts	1.6	55.2	1.5	46.6
Michigan	0.7	8.4	0.4	4.7
Minnesota	0.7	4.6	0.4	2.1
Mississippi	1.0	12.0	0.8	6.1
Missouri	1.3	6.0	0.3	3.2
Montana	0.8	10.9	0.5	5.9
Nebraska	1.3	4.7	0.1	3.6
Nevada	6.2	35.7	0.6	63.1
New Hampshire	1.6	52.7	1.7	57.1
New Jersey	2.1	29.1	0.8	23.1
New Mexico	3.4	19.4	0.6	5.7
New York	0.7	11.3	0.8	8.2
North Carolina	1.0	16.3	1.0	8.7
North Dakota	2.3	4.8	0.2	2.4
Ohio	0.6	7.6	1.2	3.6
Oklahoma	0.8	8.3	0.4	3.0
Oregon	1.9	13.6	0.9	13.5
Pennsylvania	1.4	11.7	1.3	7.4
Rhode Island	3.2	16.5	6.0	0.2
South Carolina	1.4	42.7	1.2	17.4
South Dakota	1.1	5.2	0.1	2.8
Tennessee	2.1	7.5	0.5	4.8
Texas	0.4	8.1	0.3	4.6
Utah	1.6	16.1	0.4	29.4
Vermont	1.2	24.9	1.4	20.4
Virginia	1.0	11.6	1.2	10.4
Washington	0.7	14.7	0.5	13.6
West Virginia	2.1	19.3	1.6	18.7
Wisconsin	1.6	7.0	0.3	3.8
Wyoming	0.9	18.4	0.9	24.7
United States	0.3	2.0	0.1	1.6

- Represents zero.

(NA) Not available.

¹ 2020 Coefficients of Variation are not comparable to 2021 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: 2020-2021

Economic sales class	Coefficient of variation			
	Number of farms		Land in farms	
	2020	2021	2020	2021
	(percent)	(percent)	(percent)	(percent)
\$1,000 - \$9,999	(NA)	3.5	(NA)	4.4
\$10,000 - \$99,999	(NA)	2.9	(NA)	6.5
\$100,000 - \$249,999	(NA)	3.4	(NA)	4.4
\$250,000 - \$499,999	(NA)	3.2	(NA)	4.9
\$500,000 - \$999,999	(NA)	3.3	(NA)	4.8
\$1,000,000 or more	(NA)	3.3	(NA)	2.3
Total	(NA)	2.0	(NA)	1.6

(NA) Not available.

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- Cornell’s Mann Library has launched a new website housing NASS’s and other agency’s archived reports. The new website, <https://usda.library.cornell.edu>. All email subscriptions containing reports will be sent from the new website, <https://usda.library.cornell.edu>. To continue receiving the reports via e-mail, you will have to go to the new website, create a new account and re-subscribe to the reports. If you need instructions to set up an account or subscribe, they are located at: <https://usda.library.cornell.edu/help>. You should whitelist notifications@usda-esmis.library.cornell.edu in your email client to avoid the emails going into spam/junk folders.

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