Small Grains County Estimates Methodology and Quality Measures

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Scope and Purpose: The National Agricultural Statistics Service (NASS) publishes county-level estimates of planted acres, harvested acres, production, and yield for small grain crops on an annual basis in select states. Currently, small grains county estimates are published for barley in 10 states, oats in 18 states, Durum wheat in 4 states, other spring wheat in 6 states, and winter wheat in 25 states. Information collected from two NASS surveys provide the data used to establish small grains county estimates: the September Agricultural Survey and the Small Grains County Agricultural Production Survey (CAPS).

Data from the September Agricultural Survey are first used to set final (end of season) crop estimates for planted and harvested acres, production, and yield at the State and National level for the small grain commodities listed above. The methodology for this survey is described in the Small Grains Summary Methodology and Quality Measures report. The September Agricultural Survey does not provide enough data to set county-level estimates on its own.

A supplemental survey, the Small Grains CAPS, is conducted in 32 states to collect small grains crop data from a mutually exclusive set of producers from the September Agricultural Survey. The responses from the Small Grains CAPS are combined with the September Agricultural Survey data. The resulting dataset is summarized and then used along with administrative data to estimate acreage, yield, and production at the county level.

The uses for county estimates of crop acreage, production, and yield are extensive and varied. County estimates help producers find the best market opportunities for their commodities. Often, recommendations and forecasts presented in agricultural magazines, news releases, etc. are based on data found in NASS reports. Uses of data by farm organizations, financial institutions, insurance companies, agribusinesses, State and National farm policy makers, and foreign buyers of agricultural products may range from maintaining a basic data series to preparing marketing campaigns and determining needs and rates on farm loans and insurance. Government agencies at various levels are important users of county estimates statistics. County yield data resulting from this survey are used by USDA for various programs, including those administered by USDA's Farm Service Agency (FSA) and Risk Management Agency (RMA). For example, when a natural disaster such as drought or flooding impacts crop production, these data are crucial to the agricultural industry. Other government agencies, universities, and research organizations use county estimate data to determine many production and economic values on a small area basis. County estimates are the only source of yearly localized estimates.

Timeline: The reference date for the September Agricultural Survey is the first of the month with a data collection period of approximately 15 days. State and National estimates are published in the Small Grains Annual Summary at the end of September.

Small Grains CAPS data collection in each state begins between late July to August based on approximate harvesting date. Data collection for Small Grains CAPS for all states is completed by mid-October. Regional Field Office (RFO) statisticians have an additional two weeks to review and analyze data with any corrections complete and final summary run by the end of October. Creation and review of the modeled estimates occurs in November and early December so that all final county estimates for small grains can be published by mid-December.

Sampling: The target population for the September Agricultural Survey and the Small Grains CAPS is all farms with cropland and/or storage capacity. The NASS list frame includes all known farms. Crop acreages, storage capacity, and other agricultural data of each farm are maintained on the list frame to allow NASS to define list frame sampling populations for specific surveys and to employ efficient sampling designs. Only list frame records with positive cropland acres, planted acreage of the desired commodities, or storage capacity are included in the list frame population.

The Small Grains CAPS sample is designed to be a supplemental sample to the September Agricultural survey list frame sample. For that reason, the two samples are mutually exclusive, and the data from both surveys can be combined after data collection is complete for both surveys.

The September Agricultural Survey and Small Grains CAPS list frame samples are selected using a Multivariate Probability Proportional to Size (MPPS) sampling scheme. Each list frame record is assigned a measure of size based on the frame data for multiple specified commodities. The MPPS design allows target sample sizes for the commodities of interest to be set at the county level. The desired number of samples for each commodity can be controlled with a minimum overall sample size. The MPPS design makes it easier to change samples to meet the needs of the crops program changes. The MPPS design is a more efficient design because operations will have a more optimal probability of selection based upon their individual commodities and size.

After the list frame samples for the September Agricultural Survey and Small Grains CAPS are drawn, the sample weights are calibrated so the sum of the weighted, targeted commodities in the sample of interest equals the sum of the list frame data for the targeted commodities. For example, the sum of the weighted winter wheat list frame data equals the sum of the population list frame data for winter wheat.

Data Collection: All Regional Field Offices (RFO) use the same standardized questionnaire for data collection for each survey. For consistency across modes, the paper version is considered the master questionnaire and the Computer Assisted Self Interview (CASI), mobile Computer Assisted Telephone Interview (mCATI), and Computer Assisted Telephone Interview (CATI) instruments are built to model the paper questionnaire. 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. Prior to the start of data collection, all modes of instruments are reviewed, and CASI, mCATI, and CATI instruments are thoroughly tested. For consistency across the Agricultural Survey and corresponding CAPS, a basic rule requires that the acreage and yield questions be asked identically on both sets of questionnaires.

All federal data collections require approval by the Office of Management and Budget (OMB). NASS must document the public need for the data, apply sound statistical practice, prove the data does not already exist elsewhere, and ensure the public is not excessively burdened. The questionnaires 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 be protected from disclosure, and a statement saying that response to the survey is voluntary and not required by law.

In addition to asking the specific acreage and production questions, all instruments collect information to verify the sampled unit, determine any changes in the name or address, identify any partners to detect possible duplication, verify the farm still qualifies for the target population, and identify any additional operations operated by the sampled operator.

Sampled farms and ranches receive a cover letter with the questionnaire mailing explaining the survey and providing instructions for completing the survey on the internet. The letter also notifies them that they will be contacted for survey purposes only if they do not return the questionnaire or complete the survey on the web. All modes of data collection are utilized for each survey. Most of the data are collected by CATI in one of the five Data Collection Centers. Limited personal interviewing may be done, generally for large operations or those with special handling arrangements. A coordination tool is available to determine if any sampled farms are in multiple on-going surveys, so data collection can be coordinated.

After data collection is completed for the September Agricultural Survey but before Small Grains CAPS data collection is complete, an adaptive survey design program is executed on the combined data collected to date. The purpose is to prioritize counties to increase commodity coverage and meet publication standards. It is based on individual county crop profiles and is used to refocus nonresponse follow-up calling in an unbiased and efficient manner. When a county meets the standards for the number of reports or coverage for all targeted commodities, the adaptive survey design program will

assign the county to the lowest priority group for phoning. This will leave the county still available for calling but put the remaining records for the county at the bottom of the call scheduler list. The program is executed several times throughout the course of nonresponse follow-up calling and reports are generated to gauge the status of data collection.

Survey Edit: As survey data are collected and captured, data are edited for consistency and reasonableness using automated systems. 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 assigns a status to each record, indicating whether the record passes or fails 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. All records must pass edit requirements, or be certified exempt, before further analysis and summary.

Since the Small Grains CAPS data are merged with September Agricultural Survey data to establish county estimates, a consistent edit logic must be applied to the data of both surveys. That is, September Agricultural Survey and Small Grains CAPS use the same edit limits and logic.

Analysis Tools: Edited data from both surveys are processed and analyzed separately through standard interactive analysis tools which display data for all reports by item. The tools provide scatter plots, tables, charts, and special tabulations that allow the analyst to compare record-level data with previously reported data for the same record and reported data from similar records. Atypical responses, unusual data relationships, and statistical outliers for all items are revealed by the analysis tool. RFO and Headquarters staff review such relationships to determine if they are correct. Data found to be in error are corrected, while accepted data are retained.

Nonsampling Errors: Nonsampling error is present in any survey process. This error includes reporting, recording, and editing errors, as well as nonresponse error. Steps are taken to minimize the impact of these errors, such as questionnaire testing, comprehensive interviewer training, validation and verification of processing systems, application of detailed computer edits, and evaluation of the data via the analysis tool. The respondent pool is monitored and reviewed during and after data collection, and data collection strategies modified where necessary, to continually minimize nonresponse error.

Estimators: Response to the September Agricultural Survey and Small Grains CAPS is voluntary. Some producers refuse to participate in the surveys. Others cannot be located during the data collection period, and some submit incomplete reports. These nonrespondents must be accounted for if accurate estimates of crop acreage, production, and yield are to be made. For these surveys, nonrespondents are accounted for by reallocating the sample weights of the nonrespondents to the respondents. No item-level imputation is performed.

Nonresponse weighting groups are based on operation size and type as well as Agricultural Statistics Districts (ASD). The nonresponse weighting groups for both samples are based on the frame data items for total cropland and on-farm grain storage capacity. ASDs are geographically defined groupings of counties in each state. These nonresponse weighting groups ensure that operation size and location are taken into consideration when reweighting.

When the two surveys are combined for summarization, two kinds of estimators are used for county-level indications: direct expansions and ratio estimators. Direct expansions are used to estimate totals such as planted and harvested acres and production. Reweighted direct expansions are calculated by summing the reported commodity values multiplied by the nonresponse-adjusted sample weights in each nonresponse weighting group. In each weighting group, the adjustment is calculated by summing the weights for all sampled records and dividing by the sum of the weights from the completed records. This ratio is applied to the weights of the completed records and assumes that the data of the nonrespondents are like the data of the respondents.

The ratio estimator takes the form of a ratio of two direct expansions which are calculated by summing the reported commodity values multiplied by the original sample weights adjusted for nonresponse as described above. Ratio estimators are used for all within-survey ratios (e.g., yield and harvested to planted acres) and across-survey ratios (e.g., current year to previous year planted acreages). Both the numerator and denominator must be complete to be included in

the ratio. If either of these components is not reported, the sampling unit is excluded from the estimate and the weights of the completed records are adjusted accordingly. Variances and coefficients of variation (CVs) are calculated for all direct expansions and ratio estimates to measure the precision of the acreage and production estimates. One advantage of the ratio estimator is that the CVs tend to be smaller than those for the direct expansions.

Estimation: When all samples are accounted for, all responses fully edited, and the analysis material is reviewed, each RFO executes the combined summary for their region. The summary results provide multiple point estimates and corresponding standard errors for each crop being estimated at the county level. It also provides information used to assess the performance of the current survey and evaluate the quality of the survey results, such as counts of positive reports for each indication, response rates, and percent of the expansion from completed reports.

Beginning with the 2020 crop year, model-based county-level estimates were incorporated into the NASS estimation process for small grains county estimates. Bayesian small area estimation models for county-level planted acreage, harvested acreage, and yield are fit separately for each crop and are processed in batches; common methodologies are applied nationwide. The planted and harvested acreage models input current year survey expansions, survey standard errors, and administrative data from FSA and RMA. Yield models input current survey ratios, survey standard errors, and the National Commodity Crop Productivity Index (NCCPI). County-level production estimates are derived from model-based yield and harvested acreage estimates. Model based estimates and corresponding standard deviations are calculated as posterior means and posterior standard deviations, respectively. These county-level estimates are benchmarked against previously released state-level official estimates established by the Agricultural Statistics Board (ASB). Coefficients of variation are calculated as ratios of standard deviations and corresponding estimates expressed as a percentage.

Once the model-based county estimates are reviewed by the RFO staff, they are submitted to the ASB. The ASB consists of both HQ and RFO staff and reviews the estimates for accuracy and consistency across state boundaries and verifies that proper procedures are followed throughout the entire process.

Estimates are open to revision on a preannounced schedule only if updated information becomes available. If changes are made to the State-level estimates during the normal annual revision period, then the model-based county estimates are recreated to ensure that county-level estimates continue to add up to state-level estimates. These previous year revisions are released at the same time as the estimates for the current year are published. Estimates will also be reviewed following the 5-year Census of Agriculture, which is an extensive data collection effort of all known farm operations across the U.S. The information gathered from the Census of Agriculture provides the last chance for revision.

To be published, county estimates for a given crop must meet certain publication standards. These standards include obtaining a certain number of reports in each county where the respondent reported both harvested acreage and yield or having the harvested acres from reports with respondent-reported yields account for a certain minimum percent of the current year's harvested acreage estimate for that county. Estimates that do not meet these standards are combined with other counties and published as “Other Counties” totals. The county-level estimates are then published to Quick Stats, the NASS online database of published estimates. The total number of counties published for each crop are displayed in the table below.

Quality Metrics for Small Grains County Estimates

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 below describe the performance data for all surveys contributing to the publication. The accuracy of data products may be evaluated through sampling and nonsampling error. The CVs measure the error due to sampling as well as some nonsampling error. Nonsampling error is also evaluated by examining survey response rates.

Sample size is the number of observations selected from the population to represent a characteristic of the population. Operations that did not have the item of interest or were out of business at the time of data collection have been excluded.

Response rate is the proportion of the above sample that completed the survey. This calculation follows Guideline 3.2.2 of the OMB Standards and Guidelines for Statistical Surveys (September 2006).

Coefficient of variation provides a measure of the size for the standard error relative to the point estimate and is used to measure the precision of the results of the model-based estimator. Percentiles of the published model-based CVs for each crop and estimate type are displayed in the table below. All model-based CVs for published county estimates can be found using the NASS Quick Stats system.

September Agricultural Survey Sample Size and Response Rate - States and United States: 2022 and 2023

State	Sample Size		Response Rate	
	2022	2023	2022	2023
	(number)	(number)	(percent)	(percent)
Alabama	782	717	61.3	60.7
Alaska	147	148	43.5	61.5
Arizona	317	298	63.1	72.1
Arkansas	1,206	1,274	53.8	54.4
California	1,440	1,394	41.0	45.1
Colorado	1,142	1,084	43.8	41.7
Delaware	239	231	33.1	42.9
Florida	409	407	48.2	47.7
Georgia	1,130	1,123	50.4	46.8
Idaho	1,325	1,399	40.2	50.2
Illinois	2,330	2,332	51.4	46.0
Indiana	2,028	1,960	47.9	46.2
Iowa	2,631	2,642	45.3	41.5
Kansas	2,612	2,531	37.9	39.1
Kentucky	1,142	1,127	61.7	58.4
Louisiana	867	921	67.1	61.9
Maine	230	216	59.1	57.9
Maryland	699	687	42.6	53.4
Michigan	1,395	1,390	53.2	48.9
Minnesota	2,138	2,105	40.5	40.3
Mississippi	1,181	1,159	63.7	61.3
Missouri	2,470	2,426	44.0	40.7
Montana	1,873	1,847	47.9	46.0
Nebraska	2,246	2,311	45.5	41.4
New Jersey	332	330	52.4	53.0
New Mexico	517	530	46.2	52.1
New York	927	962	53.8	49.4
North Carolina	1,110	1,152	64.8	56.9
North Dakota	2,457	2,513	42.3	40.0
Ohio	1,420	1,374	50.2	47.1
Oklahoma	2,167	2,258	59.1	56.2
Oregon	741	758	41.2	50.0
Pennsylvania	1,189	1,165	52.1	57.1
South Carolina	870	855	61.5	60.8
South Dakota	2,348	2,294	44.8	38.9
Tennessee	994	1,009	60.7	58.5
Texas	3,192	3,291	52.8	49.7
Utah	632	594	72.2	73.6
Virginia	900	899	59.6	55.6
Washington	1,307	1,292	31.3	42.5
West Virginia	361	311	75.9	78.8
Wisconsin	2,076	2,063	50.1	43.0
Wyoming	483	508	52.6	49.8
United States	56,002	55,887	49.5	48.2

Small Grains County Agricultural Production Survey Sample Size and Response Rate - States and United States: 2022 and 2023

State	Sample Size		Response Rate	
	2022	2023	2022	2023
	(number)	(number)	(percent)	(percent)
Alabama	(NA)	(NA)	(NA)	(NA)
Alaska	(NA)	(NA)	(NA)	(NA)
Arizona	55	51	69.1	76.5
Arkansas	395	346	67.3	58.1
California	548	453	67.3	60.7
Colorado	394	385	48.5	56.4
Delaware	(NA)	(NA)	(NA)	(NA)
Florida	(NA)	(NA)	(NA)	(NA)
Georgia	(NA)	(NA)	(NA)	(NA)
Idaho	743	707	59.5	65.6
Illinois	1,690	1,475	58.9	58.1
Indiana	1,161	1,120	58.1	59.5
Iowa	1,627	1,395	62.3	51.5
Kansas	2,848	2,699	56.4	49.3
Kentucky	1,320	1,165	66.4	78.5
Louisiana	(NA)	(NA)	(NA)	(NA)
Maine	33	27	90.9	59.3
Maryland	274	275	53.6	67.6
Michigan	1,683	1,636	60.0	60.3
Minnesota	3,059	2,867	58.2	54.7
Mississippi	205	205	74.1	66.3
Missouri	1,411	1,329	54.4	48.7
Montana	1,176	1,042	54.3	56.3
Nebraska	1,500	1,378	54.3	51.5
New Jersey	(NA)	(NA)	(NA)	(NA)
New Mexico	(NA)	(NA)	(NA)	(NA)
New York	832	766	63.3	64.0
North Carolina	1,270	1,141	64.1	69.9
North Dakota	1,616	1,526	48.8	51.8
Ohio	2,556	2,500	56.2	58.3
Oklahoma	1,471	1,356	66.7	62.1
Oregon	214	229	62.6	57.2
Pennsylvania	1,575	1,522	59.8	64.8
South Carolina	(NA)	(NA)	(NA)	(NA)
South Dakota	1,405	1,349	58.9	54.9
Tennessee	844	813	68.1	73.9
Texas	3,469	3,152	64.3	59.2
Utah	(NA)	(NA)	(NA)	(NA)
Virginia	661	617	55.5	69.4
Washington	246	264	50.0	56.1
West Virginia	(NA)	(NA)	(NA)	(NA)
Wisconsin	2,143	2,088	60.8	63.2
Wyoming	162	178	64.2	70.8
United States [1]	38,586	36,056	59.5	58.9

(NA) Not available.

[1] Small Grains County Agricultural Production Survey conducted in 32 states.

Number of States in the County Estimates Program and Counties Published by Crop - United States: 2022 and 2023

Crop	Number of States in the County Estimates Program	Number of Counties Published [1]	
		2022	2023
	(number)	(number)	(number)
Barley	10	113	100
Oats	18	318	238
Wheat, Durum	4	33	30
Wheat, Other Spring	6	169	150
Wheat, Winter	25	875	826

[1] Number of counties with published estimates includes estimates published for "Other Counties".

Small Grains County Estimates Quality Metrics - United States: 2022 and 2023

Crop and Estimate Type	Coefficient of Variation					
	2022			2023		
	25th percentile	50th percentile	75th percentile	25th percentile	50th percentile	75th percentile
	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)
Barley						
Planted	0.4	0.6	1.5	0.2	0.3	1.4
Harvested	9.5	14.8	19.8	9.7	13.9	19.1
Yield	4.5	6.8	10.6	4.5	6.4	10.0
Oats						
Planted	0.4	0.9	3.0	0.2	0.6	4.3
Harvested	17.3	24.2	36.9	18.7	25.0	39.2
Yield	6.3	9.2	11.8	6.3	9.3	13.1
Wheat, Durum						
Planted	0.3	0.6	2.3	0.2	0.7	3.2
Harvested	1.5	3.1	10.7	1.4	3.3	6.9
Yield	4.1	6.7	12.9	4.1	8.3	12.7
Wheat, Other Spring						
Planted	0.3	0.6	1.0	0.1	0.2	0.3
Harvested	1.4	2.2	3.3	0.6	1.2	1.8
Yield	4.5	6.3	9.6	5.0	6.9	10.1
Wheat, Winter						
Planted	0.1	0.2	0.6	0.1	0.2	0.7
Harvested	2.5	5.9	18.8	3.1	9.1	18.0
Yield	4.3	6.3	9.4	4.2	6.2	9.3

Information Contacts

Process	Unit	Telephone	Email
Estimation	Crops Branch	(202) 720-2127	HQ_SD_CB@usda.gov
Data Collection	Survey Administration Branch	(202) 690-4847	HQ_CSD_SAB@usda.gov
Questionnaires	Data Collection Branch	(202) 720-6201	HQ_CSD_DCB@usda.gov
Sampling and Editing	Sampling, Editing, and Imputation Methodology Branch	(202) 690-8141	HQ_CSD_SB@usda.gov
Analysis and Estimators	Summary, Estimation, and Disclosure Methodology Branch	(202) 690-8141	HQ_SD_SMB@usda.gov
Dissemination	Data Dissemination Office	(202) 720-3869	HQSDOD@usda.gov
Media Contact and Webmaster	Public Affairs Office	(202) 720-2639	HQOAPAO@usda.gov

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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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