



# Cattle Methodology and Quality Measures

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**Scope and Purpose:** The Cattle Inventory surveys are conducted semi-annually in January and July. The January Cattle Survey targets cattle and calf producers in the U.S., excluding Alaska, and the July Cattle Survey excludes both Alaska and Hawaii. The surveys collect data for total cattle inventory and the components of that total, including beef cows, milk cows, bulls, replacement heifers, other steers and heifers, cattle on feed, and calves. The January survey collects calf crop (calves born from the previous year), death loss from the previous year, slaughter for consumption, breeding animal values, and grazing fees data. Data are also collected for total cattle grazing on small grain pastures in Kansas, Oklahoma, and Texas. Every five years a Cattle and Calf Predator and Non-Predator Loss Survey is conducted nationally and incorporated as part of the January Cattle Survey; in other years a similar but less comprehensive survey is conducted by Wyoming. The five-year Cattle and Calf Predator and Non-Predator Loss Survey is a federal program survey, and the Wyoming-only survey is a state reimbursable survey, conducted in the other years. The July survey collects mid-year and projected-year calf crop data and mid-year death loss data.

**Survey Timeline:** The reference dates for the January and July Cattle Surveys are January 1 and July 1 with data collection periods of 15 days, respectively, surrounding the reference date. Field Offices may begin data collection one day prior to the reference date. Data collection continues until a scheduled ending date and Field Offices have about 4 or 5 business days to complete editing and analysis, execute the summary, and interpret the survey results. The Agricultural Statistics Board must perform the national review, reconcile state estimates to the national estimates for the January survey only, and prepare the official estimates for release in 5 or 6 business days. The January survey is the larger of the two surveys with estimates submitted by all states. The estimates are released to the public on the last Friday in January and the second to the last Friday in July.

**Sampling:** The Cattle Inventory surveys are conducted in January and July of each year. The January survey is the larger of the two surveys. The July survey is a subset of the January survey and includes a reduced-list sample of the larger cattle operations. For most states the target population for the January Cattle Survey is all agricultural establishments with one or more head of cattle on the land operated. A lower boundary, such as 20 head, is used in a few states to establish the population. NASS uses a dual frame approach, consisting of list frame and area frame components, to provide complete coverage of this target population. The January Cattle Survey is conducted in every state except Alaska, and the July survey additionally excludes Hawaii.

The list frame includes all known agricultural establishments. A profile, known as control data, of each establishment is 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 cattle control data are included in the list frame population. The list frame cattle population includes approximately 860,000 farms and ranches and covers approximately 90 percent of January cattle inventory in the U.S. For the July survey a reduced-list sample is used for all states to define the population. The list frame cattle population includes approximately 21,000 farms and ranches and covers approximately one third of the January cattle inventory in the U.S.

The area frame contains all land in the state and, as such, is complete. The land is stratified according to intensity of agriculture using satellite imagery. The land in each stratum is divided into segments of roughly one square mile. Segments are optimally allocated and sampled to effectively measure crops and livestock. The sampled segments are fully enumerated in June. All farms and ranches found operating tracts in these segments are checked to see if they are included in the list frame cattle population. The farms and ranches that are not included in the list frame cattle population, called nonoverlap tracts, are sampled for the Cattle Inventory survey so that the target population is completely represented. The

area frame component of the January Cattle Survey covers approximately 10 percent of the January cattle inventory in the U.S., whereas the area frame component of the July Cattle Survey covers about 67 percent of the July cattle inventory.

The January Cattle Survey list frame sample is selected using a hierarchical stratified sampling design with strata defined by total cattle and calves, milk cows, and cattle on feed. The sample is designed to achieve a U.S. standard error of 1 percent of the point estimate for total cattle and calves, 2 percent for milk cows, and 2 percent for cattle on feed. The U.S. list frame sample size for the January Cattle Survey in recent years is approximately 36,000. The January Cattle Survey nonoverlap sample is a subset of the June Area Frame Survey. The sample (or subsample) uses a stratified sample design based on the cattle data collected from the June Area Frame Survey. The area frame sample size is approximately 4,000. Each list frame and area frame sampling unit is assigned a sampling weight which is used to create the survey estimates.

The July Cattle Survey list frame sample is a subset of the January Cattle Survey. The sample is designed to achieve a U.S. standard error of 2 percent of the point estimate for total cattle and calves. The U.S. list frame sample size for the July Cattle Survey in recent years is approximately 10,000. There is not a nonoverlap sample for the July Cattle Survey, but the survey uses the cattle data collected from the June Area Frame Survey to account for the incompleteness of the reduced List sample. The area frame sample size is approximately 41,000. Each list frame and area frame sampling unit is assigned a sampling weight which is used to create the survey estimates.

**Data Collection and Editing:** For consistency across modes, the paper version is considered the master questionnaire and the web and Computer Assisted Telephone Interview (CATI) instruments are built to model the paper instrument. 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 web and CATI instruments are thoroughly tested.

All federal data collections require approval by the Office of Management and Budget (OMB). NASS must document the public need for the data, show the design applies sound statistical practice, ensure the data do not already exist elsewhere, and that the public is not excessively burdened. The cattle 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.

In addition to asking the specific cattle items, 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 presurvey letter explaining the survey and that they will be contacted for survey purposes only. The letter provides the questions to be asked to allow respondents to prepare in advance and also provides a pass code they can use to complete the survey on the internet. All modes of data collection are utilized for cattle surveys. Field Offices are given the option of conducting a mail out/mail back phase. While mail is the least costly mode of collection, the short data collection period and the uncertainty of postal delivery times limit its effectiveness. Most of the data are collected by computer-assisted telephone interviews (CATI) by individual Field Offices and Data Collection Centers. Limited personal interviewing is done, generally for large operations or those with special handling arrangements. A program is run to determine if any sampled farms are in multiple on-going surveys, so data collection can be coordinated.

**Survey Edit:** As survey data are collected and captured, they are edited for consistency and reasonableness using automated systems. Reported data are typically first 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 on the current survey are verified and in certain situations those items may be compared to data from earlier surveys to make sure certain relationships are logical. The edit will determine the status of each record to be either

“dirty” or “clean”. Dirty records must be updated and reedited or certified by an analyst to be clean. If updates are needed, they are reedited interactively. Only clean records are eligible for analysis and summary.

**Analysis Tools:** Edited cattle data are processed through an interactive analysis tool which 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 other similar records within their state. Outliers and unusual data relationships become evident and Field Office staff will review them to determine if they are correct. The tool also allows comparison to a farm’s previously reported data to detect large changes in the operation. Suspect data found to be in error are corrected, while data found to be correct are kept.

**Nonsampling Errors:** Nonsampling errors are present in any survey process. These errors include reporting, recording, editing, and imputation errors. Steps are taken to minimize the impact of these errors, such as questionnaire testing, comprehensive interviewer training, validation and verification of processing systems, detailed computer edits, and the analysis tool.

**Estimators:** Each farm and ranch in the sample has an initial sampling weight. This is the inverse of the sampling fraction. For example, if a stratum has 1,000 farms in the population and 200 are sampled for this survey, each sampled farm has a weight of 5. In other words, each sampled farm represents 5 farms. The nonoverlap tracts sampled to measure the cattle not accounted for by the list have a weight determined by adjusting their original area frame weight by any second stage sampling weight.

Response to the Cattle Inventory surveys 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 nonrespondents must be accounted for if accurate estimates of cattle are to be made. For the Cattle surveys, nonrespondents are accounted for by adjusting the weights of the respondents. The adjustment occurs by stratum as the bounded strata represent homogeneous groupings of similar sized farms. The largest stratum is unbounded and is made up of large and, often unique, farms. Nonrespondents in this stratum and the nonoverlap tracts must be manually imputed by Field Office statisticians and their weights are not adjusted. The adjustment is performed by individual item on the questionnaire (total cattle, beef cows, calf crop) so adjustments for item nonresponse (partial reports) and unit nonresponse (refusals and inaccessible) are done in a single calculation. Using the previous example, if 180 of the original 200 respond, the weights of the 180 will be adjusted to 1,000 divided by 180, or 5.56.

Two estimators are used to compute direct measures of the cattle items. The “reweighted” estimator and the “adjusted” estimator are computationally identical except in how the nonresponse adjustments are made. The reweighted estimator uses a global weight adjustment across all usable reports. The nonresponse weight adjustment for the adjusted estimator uses an additional piece of information. When a sampled farm refuses to cooperate, interviewers will probe to determine the presence of cattle even though the number is not known. This presence/absence indicator is used in the weight adjustment.

Point estimates, called direct expansions, for both estimators are calculated by multiplying the reported value by the nonresponse adjusted weight and summing to a stratum total. A variance estimate is also computed at the stratum level. The nonoverlap tracts are treated as an additional stratum. Totals and variances are additive across strata to form a state estimate and states are additive to a national estimate.

Ratio estimates are also computed for many items. For example, beef cows can be estimated as a percent of total inventory. Ratio estimates use the reweighted estimator described above for the numerator and denominator. Both the numerator and denominator must be reported in order for that record to be used in the ratio estimator.

**Estimation:** When all samples are accounted for, all responses fully edited, and the analysis material is reviewed, each Field Office executes the summary for their state. When all Field Office have run summaries, Headquarters executes the national summary. Since all states conduct identical surveys, the samples can be pooled and national survey results computed. The summary results provide multiple point estimates and their standard errors for each data series being estimated. It also provides information used to assess the performance of the current survey and evaluate the quality of the survey estimates, such as strata level expansions, response rates, and percent of the expansion from usable reports.

Field Offices are responsible for performing a detailed review of their survey results. Any irregularities revealed by the summary must be investigated and, if necessary, resolved. Using the historical relationship of the survey estimates to the official estimate, Field Offices interpret the survey results and submit a recommended estimate to Headquarters. The data are viewed in tabular and graphical form and a consensus estimate is established. Field Offices see their survey results only and do not have access to other states' results. For some data series, information from other sources is also utilized in the process of establishing estimates. For the July Cattle Survey, only US-level estimates are set, but the Field Offices are responsible for their data review and summary submission.

For the national estimates, NASS assembles a panel of statisticians to serve as the Agricultural Statistics Board 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 estimates to the national number for total cattle and the cattle classes. The "Board" also enjoys an advantage in being able to examine results across states, compare the state recommendations, and utilize administrative data available only at the U.S. level. The same estimators used in the state summaries are produced by the national summary. The Board 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 over time to determine accuracy and bias using tables and graphs. Every 5 years NASS conducts the Census of Agriculture, which is an exhaustive data collection effort for all known farm operations across the U.S. The information gathered from the Census of Agriculture is used to establish "bench mark" levels by which the survey estimators can be compared and bias determined. Survey based estimators can also be impacted by "outliers" – individual reports that have "excessive influence" on the results due to either improper classification or extremely unusual data for a given operation (i.e. operation is not representative of other operations). NASS thoroughly reviews the survey data to identify these situations and consider their impact on the survey results when establishing the official estimates.

External information (administrative data) is also utilized in the process of setting estimates. In order to be considered, these data must be deemed to be reliable and come from unbiased sources. The most common administrative data is commercial slaughter. NASS employs a balance sheet approach whenever possible to ensure that estimates are as accurate as possible. This approach typically is limited to National-level estimates. A balance sheet and its components are reviewed when the inventory numbers are established. Commercial slaughter is an important element of the balance sheet at the national level since its high degree of reliability is based on a near-actual count of animals slaughtered. Live U.S. imports and exports to other countries are also considered.

Subtracting the disposition components of the balance sheet from supply components should, theoretically, give the current inventory. However, each component of the balance sheet has varying degrees of possible estimation error. To be most useful as an indication of inventory, therefore, each component should be estimated on the basis of all available information. The supply components of the U.S. balance sheet are the beginning inventory, births, and imports (inshipments for State balance sheets). From this supply, the disposition components – commercial slaughter (marketings at State level), farm slaughter, deaths, and exports – are subtracted. The result is the indicated number on hand at the end of the period or year.

## Quality Metrics for Cattle

**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 non-sampling error. The measurement of error due to sampling in the current period is irrelevant for a fully enumerated data series. Non-sampling error is evaluated by response rates and the percent of the estimate from reported data. For the January Cattle Survey both state-level and US-level estimates are published, but for the July Cattle Survey only US-level estimates are published.

**Sample size** is the number of observations selected from the population to represent a characteristic of the population.

**Response rates** is the proportion of the sample that responded to the survey.

**Percent of estimate from reported data** is the percent of the estimate represented by the actual survey respondents.

**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 a survey estimator.

**Cattle Survey Sample Size and Response Rates:** To assist in evaluating the performance of the estimates in the cattle report, the sample size and response rates are displayed. Response rates overall for 2011 and 2012 are displayed.

### Cattle Survey Sample Size and Response Rates - United States: July 1, 2011-2012

	Sample size		Response rates	
	2011	2012	2011	2012
	(number)	(number)	(percent)	(percent)
United States .....	50,871	50,042	96.57	96.55

### Quality Metrics for July Cattle by Class - United States: July 1, 2011-2012

Class	Percent of estimate from reported data		Coefficient of variation	
	2011	2012	2011	2012
	(percent)	(percent)	(percent)	(percent)
Cattle and calves .....	95.01	94.60	1.30	1.16
Cows and heifers that have calved .....	95.09	94.44	1.53	1.36
Beef cows .....	96.82	96.17	1.87	1.62
Milk cows .....	89.08	88.79	2.06	2.23
Cattle on feed .....	97.65	97.72	1.46	1.44
Calf crop .....	95.23	94.58	1.56	1.43

## Information Contacts

Process	Unit	Telephone	Email
Estimation .....	Livestock Branch .....	(202) 720-3570	HQ_SD_LB@nass.usda.gov
Data Collection .....	Program Administration Branch .....	(202) 690-8747	HQ_CSD_PAB@nass.usda.gov
Questionnaires and Editing .....	Editing and Questionnaire Branch .....	(202) 720-6201	HQ_CSD_DCB@nass.usda.gov
Sampling .....	Survey Sampling Branch .....	(202) 720-3895	HQ_CSD_SB@nass.usda.gov
Analysis and Estimators .....	Statistical Methods Branch .....	(202) 720-4008	HQ_SD_SMB@nass.usda.gov
Dissemination and Webmaster .....	Data Dissemination Section .....	(202) 720-7017	HQ_DAPP_MISO@nass.usda.gov
Media Contact .....	Public Affairs Section .....	(202) 720-7017	HQ_DAPP_MISO@nass.usda.gov

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