



# National Hemp Report Methodology and Quality Measures

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Released May 17, 2023, by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA).

**Scope and Purpose:** The Hemp Production and Disposition Inquiry (PDI) is a survey conducted under an agreement with the Agricultural Marketing Service (AMS) and collects information on the total planted and harvested area, yield, production, and value of hemp by utilization in the United States. The survey provides critical data about the hemp industry to assist producers, regulatory agencies, state governments, processors, and other key industry entities. As defined in the Agricultural Improvement Act of 2018 (2018 Farm Bill), the term “hemp” means the plant species *Cannabis sativa* L. and any part of the plant such as the seeds, all derivatives, and extracts, whether growing or not, with a delta-9 tetrahydrocannabinol (THC) concentration of not more than 0.3% on a dry weight basis. The Domestic Hemp Production Program, established in the 2018 Farm Bill and administered by AMS, allows for the cultivation of hemp under certain conditions. In 2021, twenty-seven States (DE, FL, GA, HI, IN, IA, KS, LA, MD, MA, MI, MN, MS, MO, NE, NV, NH, NJ, OH, OK, PA, RI, SC, SD, TX, WA, and WY) and all Native American Tribes operated under the regulations of the 2018 Farm Bill. Twenty-two States (AL, AK, AZ, AR, CA, CO, CT, IL, KY, ME, MT, NM, NY, NC, ND, OR, TN, UT, VT, VA, WV, and WI) followed the regulations of the 2014 Farm Bill which was administered by the respective state governments. Idaho did not have a regulated hemp growing program in 2021, but producers could obtain a license and grow hemp in a neighboring State. In 2022, all 50 states operated under the regulations of the 2018 Farm Bill. The target population for the Hemp PDI survey is all growers in the United States who are licensed to grow hemp in 2022 under the 2018 Farm Bill. The survey is administered in all 50 States.

**Timeline:** For the 2022 crop year, data collection began with the mailing of questionnaires in January of 2023. Telephone follow up with nonrespondents began in February and concluded in March. Analysis, summarization, and the establishment of estimates were completed from mid-March to mid-April. The publication was released on April 19, 2023.

**Sampling:** For the 2021 survey, the sampling frame was comprised of two independent frames to enable a measure of coverage. The first sampling frame contained all farm operations potentially growing hemp on the NASS list frame which was constructed from lists from AMS and other USDA agencies, lists obtained by Regional Field Offices (RFO), and normal NASS list building efforts. The second sampling frame was a web-scraped list of potential licensed hemp growers. Stratification was based on the following criteria: sampling entity on one or both sampling frames, list building source, and active or potential farm operation. For 2021, a stratified sample of 20,501 growers was selected from the union of the two sampling frames. The portion of the sample from the NASS list frame was 16,557 operations while the remaining portion (3,944) was selected from the web-scraped frame.

For the 2022 survey, the sampling frame is all farm operations potentially growing hemp on the NASS list frame and was updated using lists from AMS and other USDA agencies. The resulting sample of 9,110 operations is a census of all known hemp growers. No web-scraped list was constructed for the 2022 survey.

**Data Collection:** NASS in cooperation with AMS and other USDA agencies developed the Hemp Production and Disposition Inquiry questionnaire. During questionnaire development, NASS survey methodologists conduct cognitive interviews, and updates are made based on cognitive testing results. Mail, web, and telephone interview modes of data collection are utilized for the survey. All sampled operations are mailed a questionnaire and instructions to complete the survey on the internet. A postcard reminder is mailed after the first week of data collection to those who have not responded, and then telephone follow up begins with any remaining nonrespondents. NASS promotes the survey online and emphasizes the importance of survey response.

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.

**Survey Edit:** As survey data are collected and captured, they are edited for consistency and reasonableness using automated systems. The edit logic also ensures administrative coding 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. Records that do not pass the edit logic are either updated or certified by an analyst as accurate. In some cases, respondents are re-contacted to verify unusual survey responses.

**Analysis Tools:** Edited data are analyzed through a standard 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 record level data of 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 the processing systems, application of detailed computer edits, and evaluation of the data via the analysis tool.

**Estimators:** Response to the Hemp PDI 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 nonrespondents must be accounted for if accurate estimates of acreage and production are to be made.

For the 2021 survey, a logistic regression model was used to estimate expected probabilities of response. The predictors in the model were geographic region, Farm Bill state groups previously described, list building source, and farm status indicator on the NASS list frame. The inverse of the expected probability of response for each respondent was the nonresponse weight adjustment. In this study, two independent lists were used in combination to create the final sampling frame. However, neither list was guaranteed to be a complete list of all hemp growing operations in the United States (otherwise called undercoverage). Therefore, a coverage adjustment was calculated for the NASS list to correct for undercoverage. A probability of coverage was calculated from the survey responses from the web-scraped portion of the sample. Weighting classes by the size of area planted and harvested were used to estimate the probability of list overlap in the NASS sample. The final weight was composed of the product of the sampling weight, nonresponse adjustment, and coverage adjustment.

For the 2022 survey, nonresponse weighting groups or strata are created in each state based on historical and administrative data. Nonrespondents are accounted for by adjusting the weights of the complete responses in each stratum. The adjustment is also performed for each individual item because sometimes only a partial report is obtained. The adjustment is calculated by taking the total number of operations in the stratum and dividing by the number of complete responses in the stratum. This ratio is applied to the sampling weights of the complete records. This adjustment assumes that the data of the nonrespondents are like the data of the respondents. The sampling frame is assumed to be complete, so weights are not adjusted for undercoverage.

Two kinds of estimators are used in the Hemp PDI survey: direct expansions and ratio estimators. Direct expansions are used to estimate totals such as total planted and harvested acres and production. Direct expansions are calculated by summing the reported values multiplied by the nonresponse adjusted sampling weights. Variances and coefficients of variation (CVs) are calculated for the direct expansions to measure the precision of the estimates.

The ratio estimator takes the form of a ratio of two direct expansions which are calculated using the method described above. The ratio estimator is used for all within survey ratios (e.g., Yields and Prices). If either the numerator or

denominator of the ratio is not complete, the sampling unit is excluded from the estimate and the weights of the complete records are adjusted accordingly. CVs are also calculated for any ratio estimates in the summary. 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, State and National summaries are executed in Headquarters. The summary results provide multiple point estimates and corresponding 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 results, such as strata level expansions, response rates, and percent of the expansion from complete reports.

Information obtained from the survey along with Federal and State administrative data is used to establish estimates of total planted and harvested acres, yield, production, price, and value by utilization. These National and State level estimates are reviewed by the Agricultural Statistics Board (ASB) for errors, reasonableness, and consistency. To be considered, the administrative data must be deemed reliable and come from an unbiased source.

All hemp estimates are subject to revision the following year based on a thorough review of all available data. Estimates will also be reviewed following the 5-year Census of Agriculture, which is an exhaustive data collection effort of all known farm operations across the United States. The information gathered from the Census of Agriculture provides the last chance for revision.

## Quality Metrics for National Hemp Report

**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 Hemp PDI Survey CVs measure the error due to sampling as well as some nonsampling error. Nonsampling error is also evaluated by examining survey response rates and the weighted item response rates.

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

**Response rate** is the proportion of the above sample that completed the survey, excluding those operations that did not have the item of interest or were out of business at the time of data collection. This calculation follows Guideline 3.2.2 of the OMB Standards and Guidelines for Statistical Surveys (September 2006).

**Weighted item response rate** is a ratio of reported survey data expanded by the original sampling weight compared to final nonresponse adjusted summary totals.

**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.

## Hemp Survey Sample Size and Response Rate - States and United States: 2021 and 2022

State	Sample Size		Response Rate	
	2021 (number)	2022 (number)	2021 (percent)	2022 (percent)
Alabama .....	188	124	58.9	73.5
Alaska .....	(D)	(D)	(D)	(D)
Arizona .....	213	54	74.4	76.4
Arkansas .....	211	42	68.3	44.7
California .....	645	164	57.3	57.0
Colorado .....	967	267	68.1	64.2
Connecticut .....	161	83	66.5	78.0
Delaware .....	35	(D)	67.6	(D)
Florida .....	1,264	1,062	57.1	42.8
Georgia .....	248	224	62.3	64.1
Hawaii .....	100	(D)	60.2	(D)
Idaho .....	23	20	-	90.6
Illinois .....	566	382	71.8	70.1
Indiana .....	286	(D)	68.3	(D)
Iowa .....	125	46	71.4	81.7
Kansas .....	235	125	67.4	79.0
Kentucky .....	1,124	304	78.0	64.2
Louisiana .....	(D)	108	(D)	60.2
Maine .....	168	23	73.5	83.5
Maryland .....	153	60	84.9	81.2
Massachusetts .....	160	69	77.2	82.9
Michigan .....	307	164	64.1	67.1
Minnesota .....	579	477	69.0	65.5
Mississippi .....	302	427	82.6	52.3
Missouri .....	283	157	71.4	75.6
Montana .....	532	97	76.1	71.7
Nebraska .....	135	64	73.3	65.6
Nevada .....	242	(D)	44.2	(D)
New Hampshire .....	(D)	(D)	(D)	(D)
New Jersey .....	134	79	68.7	87.7
New Mexico .....	211	48	62.4	76.4
New York .....	597	266	57.9	76.4
North Carolina .....	1,174	541	69.1	76.2
North Dakota .....	134	73	81.5	85.0
Ohio .....	397	162	43.9	63.3
Oklahoma .....	773	(D)	63.5	(D)
Oregon .....	991	294	60.3	79.7
Pennsylvania .....	732	331	64.2	76.6
Rhode Island .....	(D)	(D)	(D)	(D)
South Carolina .....	410	216	55.4	67.9
South Dakota .....	31	47	83.3	93.3
Tennessee .....	1,787	307	54.3	71.1
Texas .....	1,330	713	55.1	62.3
Utah .....	246	60	91.4	81.6
Vermont .....	200	94	67.0	81.3
Virginia .....	662	355	53.0	76.0
Washington .....	403	106	58.5	67.2
West Virginia .....	273	121	77.1	82.3
Wisconsin .....	422	352	64.8	84.3
Wyoming .....	42	(D)	78.6	(D)
Other States <sup>1</sup> .....	300	402	71.6	69.7
United States .....	20,501	9,110	64.0	69.1

- Represents zero.

(D) Withheld to avoid disclosing data for individual operations.

<sup>1</sup> Includes data withheld above.

## Quality Metrics for Hemp Grown in the Open Area Planted - States and United States: 2021 and 2022

State	Weighted Item Response Rate		Coefficient of Variation	
	2021 (percent)	2022 (percent)	2021 (percent)	2022 (percent)
Alabama .....	54.8	68.0	49.0	41.5
Alaska .....	(D)	(D)	(D)	(D)
Arizona .....	67.7	(D)	55.6	(D)
Arkansas .....	72.2	52.4	73.4	66.2
California .....	55.3	56.1	42.7	69.0
Colorado .....	71.8	68.7	26.1	51.2
Connecticut .....	66.8	72.9	25.0	27.5
Delaware .....	71.2	(D)	65.5	(D)
Florida .....	58.6	55.7	16.9	31.0
Georgia .....	58.1	67.3	26.8	36.4
Hawaii .....	68.3	(D)	57.3	(D)
Idaho .....	-	80.0	-	64.9
Illinois .....	69.0	71.7	36.3	30.7
Indiana .....	57.6	(D)	55.3	(D)
Iowa .....	70.2	68.6	36.7	61.9
Kansas .....	75.7	79.0	44.4	35.8
Kentucky .....	68.8	73.5	28.7	32.1
Louisiana .....	(D)	(D)	(D)	(D)
Maine .....	68.1	69.6	42.7	62.2
Maryland .....	72.1	63.5	33.2	27.1
Massachusetts .....	67.8	76.8	51.3	42.0
Michigan .....	55.5	72.9	39.5	41.9
Minnesota .....	69.2	73.7	36.8	39.6
Mississippi .....	77.3	73.2	25.9	59.9
Missouri .....	73.4	84.1	56.6	36.2
Montana .....	67.5	77.9	40.9	33.1
Nebraska .....	75.3	65.3	66.5	80.2
Nevada .....	41.9	(D)	58.3	(D)
New Hampshire .....	(D)	(D)	(D)	(D)
New Jersey .....	67.6	85.7	30.9	61.7
New Mexico .....	67.5	72.9	41.5	60.4
New York .....	58.9	73.0	51.0	55.0
North Carolina .....	66.4	82.7	47.6	34.7
North Dakota .....	79.2	92.7	48.8	54.5
Ohio .....	57.0	63.6	15.9	30.4
Oklahoma .....	59.2	(D)	75.5	(D)
Oregon .....	58.4	73.8	28.2	45.3
Pennsylvania .....	67.2	73.1	70.5	25.0
Rhode Island .....	(D)	(D)	(D)	(D)
South Carolina .....	56.9	62.7	35.9	52.4
South Dakota .....	77.9	87.2	51.2	51.5
Tennessee .....	54.7	73.4	25.8	60.8
Texas .....	57.0	(D)	41.3	(D)
Utah .....	69.2	73.3	91.4	54.3
Vermont .....	56.5	78.7	58.2	54.8
Virginia .....	65.8	59.9	47.1	37.8
Washington .....	62.1	71.7	62.6	51.7
West Virginia .....	64.6	81.0	25.1	33.6
Wisconsin .....	67.6	77.7	42.1	23.9
Wyoming .....	62.3	(D)	95.5	(D)
Other States <sup>1</sup> .....	72.5	58.7	47.9	34.9
United States .....	62.6	72.9	11.9	11.7

- Represents zero.

(D) Withheld to avoid disclosing data for individual operations.

<sup>1</sup> Includes data withheld above.

## Quality Metrics for Industrial Hemp Grown Under Protection Area in Production - States and United States: 2021 and 2022

State	Weighted Item Response Rate		Coefficient of Variation	
	2021 (percent)	2022 (percent)	2021 (percent)	2022 (percent)
Alabama .....	54.0	63.7	43.3	33.2
Alaska .....	(D)	(D)	(D)	(D)
Arizona .....	68.4	70.4	74.2	58.8
Arkansas .....	69.5	(D)	59.9	(D)
California .....	57.6	56.0	54.1	38.5
Colorado .....	71.4	59.8	80.7	61.4
Connecticut .....	67.2	71.5	71.9	76.2
Delaware .....	(D)	(D)	(D)	(D)
Florida .....	58.0	55.5	40.6	51.5
Georgia .....	58.1	66.6	43.6	36.8
Hawaii .....	68.3	(D)	56.4	(D)
Idaho .....	-	(D)	-	(D)
Illinois .....	70.3	66.4	49.5	39.7
Indiana .....	56.0	(D)	81.2	(D)
Iowa .....	(D)	(D)	(D)	(D)
Kansas .....	73.5	67.1	29.6	35.5
Kentucky .....	67.8	73.1	29.9	38.3
Louisiana .....	77.2	70.4	31.7	48.8
Maine .....	-	(D)	-	(D)
Maryland .....	72.9	69.7	64.6	77.1
Massachusetts .....	66.3	76.8	68.4	72.9
Michigan .....	55.3	66.0	34.9	65.9
Minnesota .....	68.6	63.6	24.8	44.5
Mississippi .....	76.7	74.2	56.4	45.5
Missouri .....	73.4	74.0	29.4	42.0
Montana .....	69.2	(D)	71.1	(D)
Nebraska .....	74.4	(D)	52.6	(D)
Nevada .....	41.9	(D)	47.7	(D)
New Hampshire .....	(D)	(D)	(D)	(D)
New Jersey .....	(D)	85.9	(D)	58.3
New Mexico .....	67.5	72.9	47.5	82.5
New York .....	61.9	75.6	92.0	34.2
North Carolina .....	63.7	80.1	23.7	30.6
North Dakota .....	(D)	81.5	(D)	59.0
Ohio .....	54.5	63.4	21.1	39.9
Oklahoma .....	56.5	(D)	56.9	(D)
Oregon .....	56.8	73.6	26.1	61.0
Pennsylvania .....	65.8	72.9	23.6	51.5
Rhode Island .....	(D)	(D)	(D)	(D)
South Carolina .....	56.4	62.8	31.8	30.5
South Dakota .....	-	(D)	-	(D)
Tennessee .....	53.1	74.3	32.9	39.3
Texas .....	56.1	64.5	59.7	49.3
Utah .....	69.0	73.3	34.1	57.1
Vermont .....	56.4	(D)	90.2	(D)
Virginia .....	62.6	71.8	38.2	33.1
Washington .....	61.9	71.7	49.8	46.0
West Virginia .....	63.9	80.1	34.4	47.4
Wisconsin .....	(D)	78.4	(D)	34.8
Wyoming .....	(D)	(D)	(D)	(D)
Other States <sup>1</sup> .....	66.9	68.4	57.6	78.5
United States .....	61.0	66.1	19.7	18.8

- Represents zero.

(D) Withheld to avoid disclosing data for individual operations.

<sup>1</sup> Includes data withheld above.

## Information Contacts

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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](mailto:notifications@usda-esmis.library.cornell.edu) in your email client to avoid the emails going into spam/junk folders.

For more information on NASS surveys and reports, call the NASS Agricultural Statistics Hotline at (800) 727-9540, 7:30 a.m. to 4:00 p.m. ET, or e-mail: [nass@usda.gov](mailto:nass@usda.gov).

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