To: USDA National Agricultural Statistics Service (NASS), Office of the Chief Economist's World Agricultural Outlook Board (OCE-WAOB), and the Economic Research Service (ERS)

Response to questions: *We organized our comments thematically to preserve narrative flow while responding to Questions:*
2 (what gaps exist in agricultural data produced)
3 (what new topic areas USDA should prioritize)
6 (underutilized data sets and other relevant information)
7 (how non-USDA data are used to fill gaps)
8 (how transparency on data sources, assumptions, or models could be improved)
10 (what emerging issues should be addressed in ERS or OCE outlooks and forecasts)
13 (how forecast transparency could be improved)
19 (what other USDA data or products are valuable or duplicative), and
20 (ways to receive ongoing feedback on data and analysis; groups or fora to engage with more regularly).

RE: Docket ID No. ERS-2026-0001 **April 8, 2026**

We write in response to the USDA Request for Information on emerging opportunities and challenges in agricultural statistical data, analysis, and research. Our response is primarily relevant to NASS statistical programs and OCE-WAOB forecasting, as our applications are most directly connected to crop area estimation, within-season monitoring, and early warning, but it also has implications for ERS research that may benefit from timely, transparent, and spatially explicit data on agricultural production. We organized our comments thematically to preserve narrative flow while responding to multiple questions.

Why EO is relevant to USDA's statistical mission

Addresses Q2 (gaps in the agricultural data produced), Q3 (new topic areas to prioritize for data products), Q7 (how non-USDA data are used to supplement USDA products), Q10 (emerging policy or economic issues to be addressed in analysis, outlook, and forecasts), & Q19 (other valuable USDA data or products).

We are researchers who develop techniques for applying satellite Earth Observation (EO) data to agricultural monitoring efforts in the United States and around the world, including through NASA's Agricultural Consortia (NASA Harvest, NASA Acres) and the Group on Earth Observations Global Agricultural Monitoring (GEOGLAM), and long-standing relationships and collaborations with people across USDA programs.

A substantial body of work, including by the National Academies, has highlighted how satellite EO can strengthen statistics on agricultural production.[1] Indeed, operational integration of EO can enhance the timeliness, frequency, spatial coverage, and cost-effectiveness of area and production estimates, especially where survey information is sparse, delayed, or of uncertain quality. In particular, EO can provide complementary insight to current techniques by (a) increasing timeliness through earlier and more frequent identification of emerging trends (b) improving efficiency by quickly generating more extensive survey sampling frames, (c) clarifying estimate quality by providing uncertainty estimates, and (d) reducing error by detecting anomalies and discrepancies across data sources for targeted review. These applications are increasingly valuable given declining producer survey response rates: amid limited survey responses, EO can provide "information security." Even in areas with more complete survey coverage, EO can add value by offering a complementary line of evidence for either corroborating estimates or identifying potential errors both domestically and internationally.

Furthermore, because the United States has invested heavily in the public data infrastructure, satellite systems, analytic methods, and applied expertise needed for and used in EO-based agricultural monitoring—including

[1] National Academies of Sciences, Engineering, and Medicine. (2017). Improving Crop Estimates by Integrating Multiple Data Sources. Washington, DC: The National Academies Press. https://doi.org/10.17226/24892; National Academies of Sciences, Engineering, and Medicine. (2023). Toward a 21st Century National Data Infrastructure: Enhancing Survey Programs by Using Multiple Data Sources. Washington, DC: The National Academies Press. https://doi.org/10.17226/26804; Camara, G., de Simone, L., Jansen, R., eds. 2025. *UN Handbook on Remote Sensing for Agricultural Statistics*. Rome: Food and Agriculture Organization of the United Nations. https://fao-eostat.github.io/UN-Handbook/

through work supported by NASA, USGS, NOAA, NSF as well as agencies and researchers affiliated with USDA itself (e.g., NASS, ARS, NRCS, NIFA)—it is well positioned to build on that foundation and lead in demonstrating how satellite data can be integrated effectively into operational agricultural statistics. Doing so would also demonstrate continued leadership globally in the operational use of these resources for additional public benefit while building on USDA's existing use of EO for international production monitoring, helping reduce uncertainty around global supply, and aligning with the Dec. 2025 Executive Order on "Ensuring American Space Superiority," which emphasizes the role of space capabilities in securing U.S. economic interests. Below, we highlight two main application areas to support agricultural statistics, followed by recent operational precedents.

Cropland Mapping, Crop Type Mapping, and Area Estimation Support

Addresses Q2 (gaps in the agricultural data produced), Q3 (new topic areas to prioritize for data products), Q6 (improvements, changes, or consolidations could be made), & Q7 (how non-USDA data are used to supplement USDA products),

Early and accurate information in agriculture matters, and EO can provide useful insight on active vs. fallow cropland status as well as crop type and, in some cases, likely crop usage (e.g., corn silage vs. grain production), based on features such as planting/harvest timing, phenology, and management intensity. For example, modeling approaches using Landsat and Sentinel-2 have achieved accuracies above 80% for multiple crops by mid-summer, which can be used to infer initial estimates of crop acreage, support sample-frame development, and help provide robust statistical uncertainty quantification. Recent work has also shown similar performance of new methods for in-season crop type mapping across nine U.S. states as compared with In-Season Cropland Data Layer (ICDL) products, but delivered one month ahead of the ICDL release.[2] When validated against field data, 10m in-season satellite-derived maps of corn and soybeans have also achieved overall crop type classification accuracies above 95% and with standard errors below 1%.[3] These results illustrate that satellite-based crop maps can support early crop area estimation and planting progress assessment, especially for major commodity crops and even amid periods of distress.[4]

Yield forecasting

Addresses Q2 (gaps in the agricultural data produced), Q3 (new topic areas to prioritize for data products), Q7 (how non-USDA data are used to supplement USDA products), & Q10 (emerging policy or economic issues to be addressed in analysis, outlook, and forecasts)

A growing body of literature shows how satellite-derived datasets can support robust in-season yield forecasting, with rapid advances in EO-based methods increasingly complementing and extending what traditional field and producer surveys can provide. Work by authors at USDA NASS itself shows that satellite-based yield models can outperform simple trend analysis for some major crops (especially corn), though performance remains uneven across crops.[5] Another example is the ARYA framework developed through NASA Harvest that has generated wheat yield forecasts with errors of roughly 5-15% at the national level 2 to 2.5 months before harvest, with improving error rates closer to the harvest dates.[6] Although not sufficiently precise for every statistical application on its own, this level of performance can still provide valuable interim information for early-season monitoring, market intelligence, and prioritizing follow-up data collection. Another example can be seen in the European Commission's Joint Research Centre Monitoring Agricultural Resources (MARS) system, which integrates satellite observations, weather data, and crop models in a long-running operational forecasting platform for major European crops. Retrospective evaluation of MARS forecasts found errors ranging from

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[2] Zhang, H.K., Shen, Y., Zhang, X., …. Roy, D.P. 2025. Robust and timely within-season conterminous United States crop type mapping using Landsat Sentinel-2 time series and the transformer architecture. Remote Sensing of Environment, 329, p.114950.

[3] Li, H., Song, X.-P., Adusei, B., Pickering, J. … Hansen, M. C. 2026. An accurate 10 m annual crop map product of maize and soybean across the United States, Earth Syst. Sci. Data, 18, 2227–2249, https://doi.org/10.5194/essd-18-2227-2026.

[4] Lawal, A., Kerner, H., Becker-Reshef, I. and Meyer, S., 2021. Mapping the location and extent of 2019 prevent planting acres in South Dakota using remote sensing techniques. Remote Sensing, 13(13), p.2430https://www.mdpi.com/2072-4292/13/13/2430

[5] Johnson, D.M., Rosales, A., Mueller, R., Reynolds, C., Frantz, R., Anyamba, A., Pak, E. and Tucker, C., 2021. USA crop yield estimation with MODIS NDVI: Are remotely sensed models better than simple trend analyses?. Remote Sensing, 13(21), p.4227.

[6] Franch, B., Vermote, E., Skakun, S., Santamaria-Artigas, A., Kalecinski, N., Roger, J.C., Becker-Reshef, I., Barker, B., Justice, C. and Sobrino, J.A., 2021. The ARYA crop yield forecasting algorithm: Application to the main wheat exporting countries. International Journal of Applied Earth Observation and Geoinformation, 104, p.102552.

3.7% - 14.4% across seven major crops, with highest performance among the largest agricultural producers and again with performance that generally improves over the season and prior to harvest.[7]

While there is continual progress in advancing the state of yield estimation—including earlier, more frequent, and more cost-effective assessments relative to traditional ground-based approaches—it is inherently harder than area estimation. Satellites can often observe crop development and surrounding agri-environmental conditions, but final yields depend on how those conditions translate into harvested output and are shaped by management, crop characteristics, and other stressors over the season. Accuracy also varies across crops, reflecting differences in reference data availability and the maturity of crop-specific modeling approaches. As a result, EO-based yield products generally exhibit more uncertainty than EO-based acreage indicators derived from crop type classification. Even so, they can still support early warning by identifying anomalous conditions across areas and over time as well as by helping direct additional sampling toward places where conditions appear unusual or highly variable. Further, ongoing EO research is improving in its ability to map management practices—such as planting, tillage, and harvesting dates—as well as biotic stressors and abiotic stressors. Together, these advances should further strengthen yield forecasting models as well as support early warning and risk monitoring for crop pests and pathogen emergence and spread.

Relevant Operational Precedents

Addresses Q6 (possible improvements or changes could be made), Q8 (improvement in data product transparency), Q13 (improvement in forecast transparency), & Q19 (other valuable USDA data & products).

Several relevant precedents already exist for the type of operational integration discussed here:

- In 2020, Canada replaced its July survey-based yield estimates for principal field crops with model-based estimates built on earlier pilot work combining satellite, agroclimatic, & admin data. [8]
- When ground access and reporting were disrupted in wartime Ukraine, recent work found that EO-based estimates closely tracked official statistics in government-controlled areas while extending coverage where conventional reporting had broken down. [9]
- USDA also has related operational experience through the Foreign Agricultural Service's World Agricultural Production estimates that incorporate satellite imagery and near-real-time vegetation monitoring alongside other datasets for monthly global crop acreage, yield, and production estimates.

These examples indicate that operational integration of EO into official agricultural statistics is institutionally feasible, if we're willing to make the investment in sustained technical capacity. These examples also highlight an opportunity for USDA to leverage existing public investments by drawing on established efforts and cross-agency EO expertise applied to agricultural monitoring and in ways that can strategically reduce the survey burden on producers.

Recommendations

Addresses Q3 (topic areas to prioritize), Q6 (improvements or changes could be made), Q8 (improvement in data product transparency), Q13 (improvement in forecast transparency), & Q20 (the best way for USDA to receive ongoing feedback).

To strengthen the role of EO to be integrated in ways that enhance the quality and timeliness of information available to producers, policymakers, and the public, we recommend USDA formalize the role of EO in its statistics, and consider the following specific actions:

1. **Operationalize the role of EO for generating within-season crop type mapping and acreage estimates in a transparent way.** Although the USDA already generates and uses the Cropland Data

[7] van der Velde, M., and L. Nisini. "Performance of the MARS-crop yield forecasting system for the European Union: Assessing accuracy, in-season, and year-to-year improvements from 1993 to 2015." *Agricultural Systems* 168 (2019): 203-212.

[8] Statistics Canada. "Model-based principal field crop estimates, August 2025" Government of Canada. 2025. https://www150.statcan.gc.ca/n1/daily-quotidien/250917/dq250917b-eng.htm

[9] Wagner, J., Skakun, S., Nair, S., et al. 2026. Monitoring winter crop areas during wartime: remote sensing support for Ukraine's agricultural statistics. *npj Sustainable Agriculture*, *4*(1), p.1.

Layer and has supported research on applications of EO, USDA could more systematically and extensively incorporate EO-based acreage products into its estimation protocols and publish their outputs in ways that make their precision and limitations transparent.

2. **Use EO-derived crop-condition and yield estimates for early warning and sampling frame development.** EO-derived yield and crop-condition products can add value by identifying areas of emerging stress, unusual crop development, or elevated uncertainty. Globally, EO already serves as an important independent source of data in contexts where ground-based techniques are costly, logistically difficult, or data transparency is limited. Their greatest near-term value is likely as a statistical support tool: informing sample-frame updates, guiding follow-up data collection, and directing limited resources to areas where conditions are changing quickly or estimates appear less stable.

3. **Invest in sustained institutional capacity for EO integration and formalization.** Making effective use of EO in USDA statistics and exercising global leadership in the use of satellite data for agricultural monitoring and statistics implies maintaining and sustaining staff capacity, reliable technical infrastructure, clear validation standards, and committing to transparent communication about the performance of EO-derived indicators.

In summary, a formalized role for EO would create an operational pipeline more resilient to emerging agricultural threats and information gaps on agricultural production, which U.S. agriculture needs in this dynamic time. The technology is advancing rapidly, and active USDA engagement will be key to ensuring federal agricultural statistics keep pace and continue to serve their public purpose. Precedent for the use cases we describe already exist, and we stand ready to support the USDA at their request.

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