The U.S. Drought Monitor began in 1999 as an experimental depiction of drought, produced jointly by the National Drought Mitigation Center (NDMC), the National Oceanic and Atmospheric Administration, and the U.S. Department of Agriculture. It served as the key mechanism for distributing more than $8.34 billion from 2011 through February 2022 in relief payments to agricultural producers through the Farm Bill. It also serves as a planning asset for agricultural producers and an essential climate reference across American economic sectors.

Since 2014, a partnership between the USDA’s Office of the Chief Economist and the NDMC at the University of Nebraska-Lincoln has focused on refining existing analytical and monitoring tools associated with the USDM and on developing new ones. Related efforts focus on helping agricultural producers and others plan for and respond to drought. The major recent accomplishments of that collaboration are highlighted in the pages that follow.

The USDM’s weekly display of drought conditions is an important drought early-warning tool for agricultural producers and USDA professionals. Stakeholders that now rely on the USDM include:

- **National policymakers** who use the USDM as a measure for allocation of relief dollars;
- **State governments** that refer to the USDM to trigger drought response measures;
- **Planners and researchers** studying the effects of past droughts;
- **Media professionals and educators** looking for graphic representation of complex climate interactions.
ENHANCEMENTS TO SERVICES FOR USDM USERS

The Drought Monitor website, hosted on the NDMC’s web servers at the University of Nebraska-Lincoln, generates 7.5 million page views in a typical year. Each week, processing the USDM results in 1.5 to 1.75GB of new data, tens of thousands of statistical records and 34,000+ files. It creates 14,172 map files and 16,104 change map files per week.

2021: TRIBAL REGIONS

USDM maps were introduced for all 323 tribal regions.

Drought alerts let users sign up for notifications when their county hits a certain level of drought. https://droughtmonitor.unl.edu/About/AbouttheData/AlertRequest.aspx

2021: USDM INPUTS

Responding to requests from the public for greater transparency, the weekly suite of indicators and indices used in the production of the U.S. Drought Monitor is now publicly available on the USDM website, under Conditions and Outlooks > Weekly Drought Indices. The archive is now back-populated through 2016. http://globalcdi.unl.edu/usdm/US_Maps/US_Maps_current.pdf
2019: PACIFIC ISLANDS AND VIRGIN ISLANDS

The U.S.-Affiliated Pacific Islands were added to the weekly depiction of drought in April 2019. The U.S. Virgin Islands were added to the weekly depiction of drought in June 2019.

2018: SPANISH

The NDMC added Spanish-language versions of the USDM map, narrative and other materials on the website; on Facebook and Twitter; and in printed brochures and planning guides.

2018: TUTORIALS

Enhanced tutorials explain the USDM: https://drought.unl.edu/Education/Tutorials.aspx

2013: CHANGE MAPS

Change maps show where drought has improved or grown worse during various time intervals. With change maps developed by the NDMC, users can easily assess changes in conditions at the regional, state or county level.
New objective blend maps bring finer resolution to weighted combinations of drought indicators. Objective data is the backbone of the U.S. Drought Monitor process, and the mix, or blend, of objective data varies by region and season. Since the USDM went operational in 1999, its authors have followed a similar blueprint for examining data they use to build the weekly map that shows the latest drought conditions across the country and its territories. They study key indices that provide information about precipitation, soil moisture, snowpack and other drought indicators to see where drought conditions could develop or persist, and they compare that information with on-the-ground reports. Even when there were fewer drought indicators, it was a lot to assimilate. USDM authors sought to develop a tool that could help them. The author-led effort, which began during the first USDM Forum in 2000, led to the creation of a weekly product that would provide short-term and long-term depictions of drought conditions based on a weighted model that blended several sets of climate division data together. The “objective blends” were born. NOAA’s Climate Prediction Center, which developed the product based on the authors’ input, houses the original blends online. Over the past 22 years, more data have started feeding into the USDM process at a higher resolution, and the network of observers has grown, leading to a higher resolution depiction of drought conditions across the country. The new objective blends reflect that change.
The Ranch Drought Monitoring Dashboard aims to provide information that will help ranchers reduce risk ahead of time. The dashboard features the latest data on drought and precipitation conditions, outlooks, on-the-ground reports, vegetative stress, forage productivity and more, organized around the key questions. A user who clicks on the question about drought severity, and how it compares to past droughts, is led to an interactive display that presents current U.S. Drought Monitor conditions and allows for historical comparisons. Other common questions lead users to other vital resources that can be displayed on a U.S. map, and used together, the map’s layers provide a clear picture of current drought conditions and expectations.

The dashboard builds on the enhanced Managing Drought Risk on the Ranch site.
Economist Renata Rimsaite joined the NDMC to connect with the Robert B. Daugherty Water for Food Institute (DWFI) on state-of-the-art research into incentive-based water management (e.g., water markets) and drought. The collaboration provided an opportunity to launch a new economic analysis team composed of staff, faculty, and students from the NDMC, the DWFI, and the Department of Agricultural Economics at the University of Nebraska-Lincoln (UNL) that focuses on research and engagement efforts to improve drought and agricultural water management. More specifically, the team managed by Rimsaite has been seeking to better understand the values of agricultural land and water, how drought and water risk are incorporated into these values, and how policies managing water and drought could be improved. To answer these questions, the team has been applying economic and interdisciplinary analysis tools, engaging with personnel in academic, government, public, and private organizations and building capacity through stakeholder engagement. Fact sheets and interactive maps facilitate shared understanding.

One of the findings of the economics team is that irrigation can add significant economic value to farmers even in regions where production is predominantly rainfed.

Agricultural water management regulations and drought mitigation plans in these areas are often rudimentary or absent. We suggest that, given climate change predictions and the likelihood of future droughts, water and drought policies would benefit from establishing mechanisms to address potential water shortages and disputes among different water users. See Rimsaite, R., Gibson, J., & Brozović, N. (2021). Informing drought mitigation policy by estimating the value of water for crop production. Environmental Research Communications, 3(4), 041004.
The project team met with specialty crop growers in three Midwestern states (Iowa, Wisconsin and Missouri) and conducted focus groups to learn what they considered to be the most important decisions they made, when they made them and how those decisions led to better vegetable and fruit production outcomes during drought. Findings are described in cyclical decision calendars and fact sheets.

The associated fact sheet on drought and climate tools for perennial fruit production provides growers with information on using tools such as the U.S. Drought Monitor (USDM), Evaporative Stress Index (ESI), and maps of soil moisture, soil temperature, and snowfall at appropriate times throughout the year to inform decision-making. The Midwest Climate Hub collaborated with the NDMC to gather input from specialty crop producers. The project was funded by the National Oceanic and Atmospheric Administration’s Sectoral Applications Research Program.

We are also working with specialty crop producers in the Northwest.
**GRASS-CAST**

**2020:** The NDMC begins hosting Grass-Cast website  
grasscast.unl.edu

Every spring, ranchers figure out how much grass will be available for livestock to graze during the summer. The NDMC worked closely with Colorado State University, the U.S. Department of Agriculture, the University of Arizona and the NDMC. Colorado State originally hosted the product, which transitioned to the NDMC website in 2020. It is now operational for the Northern Plains, Arizona and New Mexico.

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**Forest Drought Response Index (ForDRI)**

The overarching goal of ForDRI tool development research is to aid USDM authors in characterizing and identifying drought across forest areas in the U.S. The tool is expected to improve drought monitoring efforts by specifically addressing gaps in current monitoring of drought impacts on forests. The current prototype incorporates satellite, climate and biophysical parameters that characterize forest drought response on the order of weeks to months or years. Efforts are being made to evaluate the ForDRI model using several ground observations, including tree rings, and expand it to include all forested regions of the United States.
DROUGHT IMPACTS

2022: Drought Impacts Multi-Tool

go.unl.edu/multi-tool

All of the layers of impacts-related data that have been built at the NDMC over the past few years are displayed on a single map, the Drought Impacts Multi-Tool, with links back to each layer separately displayed in fuller detail. The default view displays crowdsourced Condition Monitoring Observer Reports and citizen science observations from CoCoRaHS, mapped by the dry-to-wet scale that they share.

The Drought Impact Reporter’s display of data was updated in 2022 with the launch of the DIR dashboard and accompanying web app. https://go.unl.edu/DIRdash

The Media Drought Index, launched in 2021, is displayed on a dashboard, with timelines showing rising and falling levels of drought news for the country as a whole and for individual states. A process developed at the NDMC filters news to stories published within the state that they are discussing. An accompanying time-sensitive map of news stories, by place of publication, lets users click through to read individual stories. https://go.unl.edu/droughtnews

Drought Tweets are similarly mapped by place of publication, allowing users to click through to content. Tweet maps became publicly visible in 2021. News and tweet maps are updated weekly. https://go.unl.edu/DIRdash

2019

The NDMC augmented its table of potential impacts associated with each USDM drought severity level with historically observed impacts associated with each USDM drought severity level, in new state drought impact tables. https://droughtmonitor.unl.edu/DmData/StateImpacts.aspx

2018

The NDMC replaced the “Submit a Report” link on the Drought Impact Reporter with the Condition Monitoring Observer Report (CMOR) form. Observations appear immediately on an interactive map. go.unl.edu/CMOR_drought
**2018–2022: Visual Drought Atlas**
droughtimpacts.unl.edu/Tools/VisualDroughtAtlas.aspx

Work began in 2018 to transfer the archive of “Field Days” photos collected by CoCoRaHS and the Southern Climate Impacts Planning Program to a permanent home at the NDMC. The collection launched what is now the Visual Drought Atlas, with photos accessible via a time-sensitive, interactive map. Well-trained CoCoRaHS volunteers continue to contribute photos over President’s Day, Memorial Day, July 4 and Labor Day. The NDMC has added photos from its own Photo Gallery and CMOR to the Visual Drought Atlas, and is exploring the addition of photos from other sources, such as historic archives and Phenocam. Users can search photos based on U.S. Drought Monitor status, land use, subjective dry-to-wet assessment, and location and date.
The NDMC worked with Farm Service Agency staff to develop an online tool that agriculture producers can use to determine their eligibility for relief via the Livestock Forage Disaster Program, which uses the USDM as a trigger. Through the farm bill, the disaster program paid out more than $8.3 billion through February 2022. This tool is utilized by the FSA headquarters, field offices, and stakeholders.

Agricultural Commodities in Drought
aginddrought.unl.edu

(ag in Drought, produced by the NDMC and the USDA, shows the location and percentage of various U.S. agricultural commodities being affected by drought. Data for the percent of crop or livestock area in drought can be viewed in tables, graphs, map overlays, or a series of animated maps. The tool will be updated to use 2020 census data when it is available.)
ENGAGING CLIMATE HUBS

The NDMC collaborates with USDA’s Regional Climate Hubs on outreach, events and research relevant to individual service regions, and participated in several of the hubs’ five-year reviews. The NDMC has worked with hubs to present information for regional audiences on topics such as the U.S. Drought Monitor process and Condition Monitoring Observer Reports (CMOR).

**Northern Plains**

Grass-Cast: Early in 2017, the NDMC, the Northern Plains Climate Hub and Colorado State University began discussions on the development of a forage-estimation tool for the Plains. The tool is now known as Grass-Cast (see page 9.) Along with the University of Colorado, the NDMC and the Hub are working to estimate the economic value of Grass-Cast to cow/calf operations.

**Southwest**

Drought Learning Network: In 2020, the NDMC worked with the Southwest Hub to launch the Drought Learning Network, creating a structure to share lessons learned from drought experiences.
**California**

In 2019, the NDMC, the California Climate Hub and others coordinated four California workshops for ranchers. In 2018, the NDMC and the Hub held a workshop in Ogden, Utah.

**Southern Plains**

The NDMC and the Southern Plains Hub presented a workshop on the USD in Amarillo in 2018. Through collaborations with the Southwest and Southern Plains climate hubs in 2017, the NDMC organized six La Niña Outlook forums and other topical workshops for producers and stakeholders in New Mexico and Texas and co-hosted a meeting for ranchers at the Agricultural Research Service Center in Colorado.

**Midwest**

Midwest Specialty Crops: A partnership between the NDMC and the Midwest Climate Hub is working to help producers of specialty crops in Michigan, Ohio, Indiana, Wisconsin, Illinois, Iowa, Missouri, and Minnesota identify and report how changes in weather and climate conditions are affecting crop health, growth and productivity. The NDMC developed a survey of producers’ weather observations, climate-related concerns and information needs that was presented at regional field days and other events, and made available online. The survey results are being used by the NDMC and the Hub to develop resources that meet the unique drought monitoring and planning needs of specialty-crop producers in the Hub service region.

**Northwest (Alaska)**

The NDMC and the Northwest Climate Hub held a workshop in Alaska in May 2019 to help participants understand drought in a temperate rainforest. The information gathered became the basis for the Southeast Alaska addition to the state drought impacts tables.

**Southeast**

More than 65 people attended a two-day workshop in February 2020, in West Columbia, South Carolina, to learn about the U.S. Drought Monitor.

**Northeast**

The ForDRI project began in collaboration with the Northeast Climate Hub, after identifying drought proved elusive in forested areas in the Northeast.

**Caribbean**

The NDMC has worked with the Caribbean Hub to develop a Drought Learning Network, provide rain gauges to enhance CoCoRaHS reporting of precipitation and condition monitoring, and incorporate Spanish translations by hub staff of the Condition Monitoring Observer Report (CMOR) form and outreach materials. The NDMC also worked closely with the Hub to get the U.S. Virgin Islands included in the USDM, with initial meetings in St. Croix and San Juan.
The NDMC collaborated with USDA Communications to produce an Ask the Expert column for Farmers.gov, a fact sheet correcting misperceptions about the U.S. Drought Monitor, and other timely content.

The NDMC regularly updates content for the “About USDM” page and associated fact sheets, infographics and brochures to reflect answers to the latest questions about how to participate in the USDM process and other updates, and to provide a single spot to find downloadable information. The most recent addition is a 2021 fact sheet on using the Drought Severity and Coverage Index to summarize drought over time.

In addition to weekly dissemination of U.S. Drought Monitor maps and highlights via Twitter and Facebook, in English and Spanish, NDMC Communications produces a “Hot Topic” graphic and tweet focusing on an area of interest.
Drought Information Services
For U.S. Agriculture

Photo: Drying pond in Ellsworth County, Kansas, March 3, 2022. Photo submitted by a CMOR user.