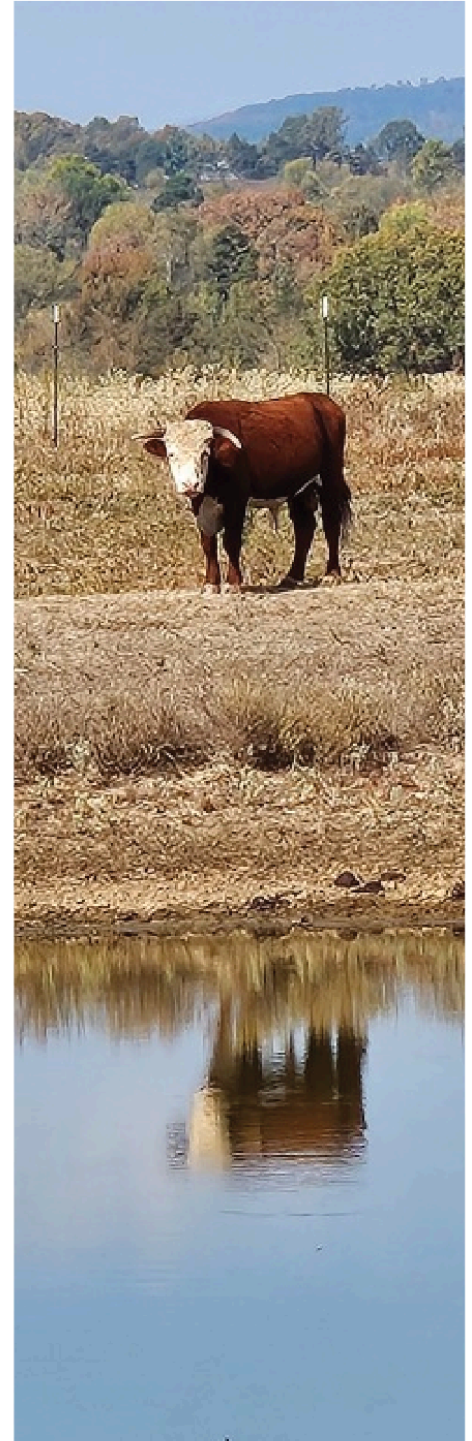


Drought Impact Reporting Processes for the Agriculture Sector

An Assessment of Approaches, Barriers, and Opportunities in the Southeastern United States



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Cover images, left to right:

Pastures provide very little or no feed in Pope County, Arkansas in October 2024.

A pool, typically full with water, is dry in Noxubee County, Mississippi in September 2024.

Hot and dry conditions caused peanut vines to dry down and start to die in Henry County, Alabama in September, 2024. All images from National Drought Mitigation Center Condition Monitoring Reports.

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Executive Summary

Despite the water-rich nature of the southeastern United States (US), extended and intense dry periods intermittently occur across the region leading to reduced soil moisture levels and surface water supplies. These drought periods affect the landscape at different scales, with agriculture experiencing impacts earlier than other sectors. State and national entities may use field-based reports of impacts to crops and pasture - in conjunction with onsite and remote sensing data products - to monitor, respond, and provide relief to agricultural producers during drought. Therefore, it is crucial that information on drought impacts on agriculture is documented, credible, and accessible.

The United States Department of Agriculture (USDA) Southeast Climate Hub collaborated with the National Oceanic and Atmospheric Administration (NOAA) National Integrated Drought Information System (NIDIS) Southeast Drought Early Warning System (DEWS) on a **joint assessment of how Southeastern states record, report, and utilize information about drought impacts on agriculture**. This assessment, conducted via interviews in 2021-2022 with federal and state entities, focused on the following:

- Understand state-specific approaches and methods involving drought impact reports
- Identify various barriers associated with the collection and utilization of drought impact reports in each state's process
- Highlight practices and approaches that have successfully improved the incorporation and use of these reports
- Identify opportunities for improving the utilization and effectiveness of impact reports

The most frequently utilized **source of drought impact information**, according to this assessment, are state extension agents. These agents are normally tasked with observing and reporting agricultural conditions at the county scale. Other sources were USDA Farm Service Agency (FSA) agent reports, National Association of State Departments of Agriculture (NASDA) enumerators, and community science observations. The predominant **impact reporting platforms** used across the Southeast were identified as the National Drought Mitigation Center's (NDMC) Condition Monitoring Observer Reports (CMOR) tool, the NDMC Drought Impact Reporter (DIR) tool, and the Community Collaborative Rain, Hail and Snow (CoCoRaHS) Condition Monitoring network. **Information on agricultural impacts are used in several ways**, including decision-making at the state level and to support weekly state recommendations to the U.S. Drought Monitor (USDM) authors creating weekly national drought maps. State and national agencies consider the USDM when triggering mitigation actions, including providing financial aid to some producers experiencing drought. Therefore, quality agricultural drought impact reports are crucial to better integrate impacts into drought monitoring and response efforts.

This assessment highlights effective practices implemented across the Southeast to share lessons learned. It also identifies existing barriers and opportunities states can use to improve collection and use of drought impact reporting in state drought processes. These effective practices are a blueprint to further strengthen agriculture-based impact reporting by working collaboratively with extension, USDA offices, and state drought monitoring efforts. It can also inform future state drought monitoring and planning efforts, local extension services, the Southeast DEWS network, and the USDA Climate Hub network.

Drought Impact Reporting for Agriculture: Barriers and Opportunities to Improve

	Barriers	Opportunities
Building and Sustaining a Strong Community of Reporters	<ul style="list-style-type: none"> ● Lack of year-round reporting and inconsistent reporting ● Lack of extension agent buy-in to reporting efforts ● Hesitancy in submitting location-based information or reports of failing crops, fearing contract termination ● Spatial gaps in reporting ● Lack of broadband connectivity and internet access in some locales ● Lack of understanding of how the information is utilized ● Lack of familiarity with state and national drought response and monitoring efforts 	<ul style="list-style-type: none"> ● Focus first on building trusted relationships between state extension services and state drought monitoring efforts ● Utilize existing practices and networks. Examples include the CMOR tool, which can be customized for each state ● Provide agents and community science observers training on the type of information needed while also highlighting the importance of reporting, appreciation for the effort, and education on state and national drought response and monitoring efforts ● Hold open forums with the public and other stakeholders ● Provide the public with valuable products like condition summaries, infographics, and webinars regularly to ensure that reporters can see the value of their submissions and efforts ● Encourage the submission of images depicting impacts
Streamlining Data Collection	<ul style="list-style-type: none"> ● Lack of a formal reporting platform or database ● Multiple requests for information ● Lack of state-tailored reporting tools and methods ● Reporting is complex and cumbersome ● Lack of training on existing tools ● Change to NASS Crop Progress reports 	<ul style="list-style-type: none"> ● Establish a formal state drought impact reporting tool and process ● Utilize both extension networks and community science platforms ● Offer continuous training to reporters ● Learn from existing tools and states that have improved reporting processes based on reporter feedback
Strengthening Institutional Capacity	<ul style="list-style-type: none"> ● Extension staffing reductions and other responsibilities taking priority over impact reporting ● Lack of a formal, authoritative process in some states for incorporating impact reports into drought monitoring and response 	<ul style="list-style-type: none"> ● Create formal state drought monitoring teams, where they do not exist ● Collaborate with neighboring states

Relevance of Assessment

The Southeastern states contribute approximately 20% of net farm income in the U.S., and individual states like Georgia and North Carolina lead the country in poultry, peanut, pecan, tobacco, and sweet potato production (Brown 2019). Despite the water-rich nature of the southeast, extended and intense dry periods occur across the region, leading to reduced soil moisture levels and surface water supplies. Reduced precipitation and high temperatures can rapidly produce dry conditions due to the high water consumption and evaporative potential of soils in the region (Costanzo et al., 2016). Droughts in the southeast can abruptly develop into severe events and then dissipate relatively quickly following a return to average precipitation, as demonstrated through part of the region during the 2019 drought (Christian et al., 2019; Schubert et al., 2019).

All states collect and assess information on drought conditions as part of their regular monitoring efforts. This process may include collecting physical data such as precipitation amounts, streamflow rates, and soil moisture measurements. In addition to the atmospheric and hydrologic conditions, state entities often monitor drought impacts through the use of field reports that describe how drought is affecting crops, livestock, and pasturelands, such as crop conditions, pond levels, and forage health. Descriptions of conditions can help inform states' drought-related responses, such as issuing a local drought declaration. State monitoring groups submit reports to the USDM that describe drought conditions across their state every week. Local impact reports may also be incorporated into monitoring at the national level as states submit this weekly data to the USDM map.

In an effort to improve drought early warning coverage across the Southeast, the Southeast DEWS network was launched in 2021 by the NOAA NIDIS program in close partnership with state and federal partners. When developing the Southeast DEWS, partners determined that reporting drought impacts on the agriculture sector would fill a sizable gap between the overall drought monitoring process and our understanding of drought events. Improving access to on-the-ground reports would also provide earlier warning of drought, as agricultural drought conditions can be identified before the appearance of traditional indicators of drought impacts, such as declines in streamflow and reservoir levels.

Objectives and Methodology

The Southeast DEWS and the Southeast Climate Hub asked a series of questions to assess drought impact reporting processes and utilization for each State in the combined Southeast DEWS and Southeast Climate Hub region: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia.

Information on Southeastern states' efforts was collected via phone interviews with 45 experts across the region from August 2021 through April 2022. Interviewees represented two main groups in the drought reporting process: those reporting drought conditions (i.e., state extension agents/groups and NASS field and regional offices) and those that use these reports in their drought monitoring processes (i.e., State climate offices, State monitoring groups, and USDM authors). These groups make up the key local, State, and Federal entities that are engaged in the different aspects of drought impact reporting such as reporting and utilizing the impact data.

Experts were asked the following questions, depending on their role in agricultural drought impact reporting:

- How are impacts to agricultural commodities and livestock documented?
- Who is providing those reports? Is this a job requirement?
- What information is being requested?
- What is the spatial and temporal resolution at which impacts are being reported?
- Is there training needed or offered before a report is submitted?
- How are agricultural drought impact reports utilized?
- What processes are working well in each state?
- What are the main gaps and/or barriers to reporting impacts?
- What are ways to reduce barriers and limitations for reporting and utilizing agricultural drought impact reports?

In addition to obtaining perspectives from experts in the Southeast, we spoke with a state drought program representative from Montana and from North Dakota to identify processes and experiences that have strengthened their drought impact reporting networks. At the national level, selected USDM authors were also interviewed as they utilize information from state agricultural drought impact reports when producing their weekly U.S. drought map.

Section 1. Overview of Regional Agriculture Drought Impact Information Approaches

Most states rely on county extension service agents from their land-grant universities to aggregate and report conditions across the state (Table 1). Drought impact reporting is voluntary for extension agents to complete in many states, and few states provide related training (Table 2). However, agents in those states are encouraged to submit information to extension directors or their representatives, state climatologists, NASS, or other groups detailing crop and livestock conditions across their county (Table 3). Condition information is primarily gathered through field observations and conversations with local producers. Agents typically have established relationships with local farmers and livestock managers, making it easier to obtain information on crop losses, herd and pastureland status, pond levels, and other qualitative metrics needed to describe the mosaic of conditions during a drought event. Extension agents typically submit these reports to NASS to be used in their Crop Progress reports. Additionally, NASS often employs a network of enumerators contracted through a partnership between NASS and NASDA to help with the data collection process. Retired producers typically fill these positions and tend to be from the area they are assigned to observe. In some states, agents from the FSA and community science observers are also used as a source of agricultural drought impact reports.

At the national level, two condition monitoring initiatives provide a publicly accessible platform for volunteers to submit impacts of weather conditions on people, plants, and animals. Condition monitoring includes all impacts, not just impacts from droughts. Farmers, livestock managers, and interested observers can provide weather impact information. One initiative is the Community Collaborative Rain, Hail and Snow Network ([CoCoRaHS](#)), a unique, nonprofit, community-based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail, and snow). A relatively recent addition is [CoCoRaHS Condition Monitoring](#), which allows observers to submit short descriptions of how the amount of precipitation they have, or have not, received has affected their local environment and community.

A second national platform is the [Condition Monitoring Observer Reports \(CMOR\)](#). Observers can use the CMOR system to report drought and other weather-related conditions and impacts within the U.S. and its territories. This nationwide service is provided by the National Drought Mitigation Center (NDMC), based at the University of Nebraska-Lincoln, and was developed in partnership with NIDIS and the USDA. The report becomes part of the permanent record, appearing immediately on an interactive map visible to the public. Observers submitting their reports to the CMOR database complete a comprehensive survey to record information about their location, date of observation, and condition descriptions. Observers also have the option to upload photos of impacts. The survey allows participants to describe weather impacts on crops, livestock, households, forestry, and other affected sectors. Both platforms, CoCoRaHS Condition Monitoring and CMOR, encourage regular monitoring of conditions, regardless of whether it is wet or dry, because continuous monitoring can help identify indicators of and recovery from drought and other weather-related conditions.

The [Drought Impact Reporter \(DIR\)](#) Dashboard is another product in the suite of tools that the NDMC has created to capture drought conditions at the national scale. The DIR has cataloged and displayed daily media reports on drought since July 2005. This information is recorded for states, counties, and cities and often contains descriptive reports of impacts on agriculture. Though the national condition monitoring platforms and tools record conditions and impacts regardless of the type of weather

observed. This assessment only examined drought impact reporting and reflects interviewee responses as of 2022.

Once condition observers collect drought impact information, each state has a unique process in which the data is accessed and used. For example, the creation of drought monitoring and response teams has been implemented in states like North Carolina and Virginia, spearheading this data transfer and synthesis at the state level. In a few cases, these state-appointed teams are given the authority to trigger drought responses based on information that includes impact reports. Other states, such as Georgia, rely on informal teams of experts to collect and analyze drought conditions that are then communicated to the USDM author or other state entities. These states have created drought monitoring and response teams, thereby streamlining data transfer and synthesis within the state. In some states like Georgia, these state-appointed teams are given the authority to trigger drought responses based on information that includes impact reports.

Table 4 highlights the main sources of drought impact information that state monitoring groups utilize in their processes. States process and use drought impact information in a variety of ways. Almost all states use this information when they submit weekly drought reports to USDM authors. States like Arkansas, Georgia, Kentucky, North Carolina, South Carolina, and Tennessee factor drought impact report information into informative resources like weekly infographics to aid in keeping the public informed on drought conditions. Impact reports were also shown to be useful for ground truthing satellite/remote sensing data metrics across most of the region.

At the national level, USDM authors rely primarily on drought condition reports from state extension agents, compiled by state monitoring groups (Table 4), in preparing a weekly map that shows where and how severe drought is across the U.S. and associated territories. Meteorologists and climatologists from the NDMC, NOAA, and USDA alternate as the lead author of the map. This map is created using a “convergence of evidence approach,” which is a blend of physical indicators (e.g., drought impacts, field observations, and local insight) from a network of more than 450 experts including those from state entities. Interviewed authors also cite community science platforms as valuable sources of condition data, specifically the CoCoRaHS Condition Monitoring reports, CMOR reports, and the DIR. Interviewees highlighted the USDM authors’ recent increased utilization of community science reports and stated that the CMOR tool is an excellent database for capturing this type of data. Authors observed an increase in the number of reports during drought periods and less reporting when conditions are normal or wet. While information from the CoCoRaHS network is sometimes used to inform weekly drought map creation, the data is primarily used for writing narrative report sections that help authors understand the monthly state of drought conditions. NASS reports were also noted as helpful to the USDM process. While the utility and consistency of NASS reports vary by state, they were said to be extremely useful for providing quantitative crop loss data and gap-filling data for specific crops across states. Social media reports are occasionally used to supplement remote sensing data, but they are not typically cited in the narrative as this source tends to have too many low-quality reports to warrant review.

Interviewed USDM authors stated that incorporating agriculture and livestock drought impact data into the weekly drought maps is crucial to the USDM process. These reports are helpful for ground-truthing drought conditions depicted by ground sampling and remote sensing data. For example, authors stated that agricultural impact reports were particularly useful during a South Dakota drought, where remote sensing was unable to capture ground conditions. Ground observation reports showed failing crops and were critical in determining the extent of damage. Referenced tables can be found in the Appendices section of this report.

Section 2. Development, Successes, Barriers, and Opportunities of Drought Impact Reporting, by State

Although agriculture producers have dealt with intermittent drought in the Southeast for centuries, only relatively recently have states begun to establish formal or informal drought monitoring reporting entities and processes. Following is an overview of the origin and operation of these entities for each of the eleven southeastern states. We also report some of the practices, lines of communication, and organizational structures that interviewees identified as contributing to well-documented, credible, accessible, and timely drought impact reports. Our conversations with state and national experts elicited their perceptions of barriers to the effective and efficient collection and use of drought impact data—and opportunities for improvement. Some of the perceived barriers apply across state lines; others are unique to a particular state (Table 5). One barrier perceived as common to many states was the already heavy workload of extension agents and other observers.

Alabama

The Alabama Department of Economic and Community Affairs created the Monitoring and Impacts Group (MIG) following the drought of 2000. This group is responsible for collecting water use data, managing the Alabama Water Use Program, providing water use considerations to the Governor's Office, and creating drought forecast products for water managers in the state such as Alabama Power, the Army Corps of Engineers, Power South, and the Tennessee Valley Authority (TVA). The group does not have a prescribed frequency of meetings. Instead, representatives convene as drought sets in, meeting every two weeks or even more frequently, as drought severity worsens. Though MIG consists of various agency representatives, reservoir operators, public water system managers, and other stakeholders, the collection and utilization of agricultural drought impact information is primarily led by the State Climate Office (SCO) housed within the University of Alabama-Huntsville. The SCO formally shares drought area considerations and impact information to USDM authors in coordination with the MIG. Impact information is currently collected through an informal process of emails and phone calls. After experiencing severe droughts from 2000 through 2014, the State enacted the [Drought Planning and Management Act](#) to guide its drought planning and response activities. This plan was revised in 2018.

Some AL state agencies identified a lack of reported drought impact data on crops, livestock, and pasturelands to inform state monitoring efforts. Establishing a formal and streamlined system of reporting agricultural drought impacts was identified as a solution to the state's challenges and would allow information flow between extension agents up to the SCO and other drought monitoring agencies. Using Mississippi's drought condition reporting process as a model or expanding Mississippi's collection effort to Alabama and using Mississippi's drought impact reporting phone application was identified as one approach to help Alabama expedite set-up of a formal reporting system. The focus would need to be applied to Alabama's extension agents, who were identified as the primary workforce in the proposed system. Steps would need to be taken to develop a simple method (similar to Mississippi's app) for agents to record observations to ensure reporting consistency and prevent agents from becoming overwhelmed with added responsibilities.

Additionally, interviewees proposed that agents be shielded from "unwanted noise" from producers and media groups within this formal process; questions and concerns pertaining to drought conditions

and monitoring should be directed to state agencies and monitoring groups. To coordinate drought monitoring efforts, facilitated communication between state and federal groups such as the SCO, USDA Natural Resources Conservation Service (NRCS), extension, and FSA was identified as an option. Adequate funding would facilitate the completion and distribution of additional educational resources for agents and the public. This funding would also be used to obtain more technology and instrumentation for physical data monitoring.

Alabama has established a reliable community science network that monitors stream and lake conditions. Monitoring groups in Alabama seek to use successes in community science reporting to incorporate more condition monitoring questions and link to the national CMOR database. The state currently has agencies that successfully monitor and regulate water systems. Interviewees recommended applying the same approaches to create a network for collecting drought impact reports. Other successful interagency agriculture-focused monitoring teams were mentioned that include agencies such as the USDA Agricultural Research Service and NRCS. Though these teams do not currently deal directly with drought and water policy, they could be a blueprint for improving collaboration between state agencies. The Auburn University Water Resources Center, in partnership with AL SCO and Alabama Extension, are jointly exploring the creation of a new drought monitoring program in Alabama.

Arkansas

Arkansas does not currently have an operational statewide drought plan or drought monitoring process. Unlike other SCOs typically housed within land-grant universities, the Arkansas SCO is a division within the Arkansas Department of Agriculture. This organizational structure brings challenges to this state's SCO that other SCOs may not experience. For example, one barrier that the interviewees highlighted is the lack of access to research capacity, readily available graduate students, and other university-based resources. The primary focus of the Arkansas SCO is to implement strategies and complete work on floodplain management programs such as the National Flood Insurance Program. As a result, the SCO may allocate only about 10% of its resources to drought-related work. After the Arkansas River flooded in 2019 due to Tropical Storm Barry, the SCO's drought monitoring efforts were severely limited as resources were allocated to issuing disaster relief and buyouts for the impacted as resources were shifted to disaster relief and compensation for flood victims. Additionally, the ongoing COVID-19 pandemic was cited as a significant challenge in improving drought monitoring.

Following a series of partner meetings in 2017 and 2018, Arkansas monitoring groups had been on track for setting up a system to collect drought impact reports from agents and producers, but staffing shortages, COVID-19, and severe flooding stalled progress. These monitoring groups, especially SCO personnel, said that they would like to resume this work by first focusing on getting drought information to the agricultural community. The first steps in this process would be to develop tailored information for producers and give them updates on conditions, what to expect, and how to respond and adapt to these conditions. Once this line of communication is established, monitoring groups would seek to establish similar connections with other water consumers. Interviewees said that a way to facilitate this process would be to obtain a "blueprint" plan for establishing a monitoring network from a state that has successfully done so. As the SCO is not a part of the Arkansas Cooperative Extension Service, facilitating communications with the agency would be of high priority. Conversations highlighted Arkansas agricultural producers' knowledge and expertise on water

resources and crop/livestock conditions, and interviewees noted that this experience would be useful in community science reporting.

Florida

Drought monitoring and water resource management in Florida are primarily conducted by the state's five Water Management Districts. The focus of these monitoring efforts is largely on hydrologic and meteorologic data and water resource conditions.

Reports by University of Florida Institute of Food and Agriculture Sciences Extension agents are the primary source of agricultural drought impact data in Florida, while CoCoRaHS Condition Monitoring and NASS Crop Progress reports supplement this information. The SCO gathers agricultural impact data from these sources and from local and trusted experts to characterize conditions across the various regions of the state. The Florida SCO leads an informal but established process to provide input into the weekly USDM map through coordination and communication with several state and local entities.

Florida monitoring groups identified communication issues as the most prominent challenge in the drought monitoring and response process. One communication challenge stems from the geographical differences across the state's regions. For example, much of southern Florida is highly irrigated, which aids in buffering drought impacts, and leads to fewer impact reports.

Offering incentives and benefits for agricultural drought reporting was suggested by Florida experts to improve reporting consistency in the state. Conversations highlighted successes such as state agencies receiving grants to fund the creation of soil moisture monitoring networks to close this gap in physical data coverage for the state. Other successes include the Florida Department of Natural Resources providing incentives for Best Management Practices programs focused on water quality and quantity. These state-funded programs provide benefits and cost-sharing opportunities to partners. In addition, groups like the Tri-State Row Crop Working Group promote communication between the SCO, extension agents, and producers on seasonal climate outlooks and past growing seasons. Greater communication has increased monitoring groups' understanding of the different hydrologic regimes of Florida's geographic regions. Interviewees noted that better communication channels improved not only the understanding of how conditions may vary across the state but also the flow of information between state agencies and offices.

Georgia

The Georgia Department of Natural Resources Environmental Protection Division (EPD) has formal responsibility for the state's drought monitoring and management. Within EPD, the Office of the State Climatologist collects and reviews data on a weekly basis and submits information to the Watershed Protection Branch. This information may include agricultural impact information. Georgia uses an informal but established process to solicit input to the USDM weekly map that includes EPD, the SCO, and several other regional, state, and local experts. This process, beginning around 2014, is currently coordinated by the Southern Region National Weather Service. This group of experts also jointly coordinates the dissemination of drought information to stakeholders and the public. Having a small group of professionals that utilizes impact and physical data mirrors the blueprint of other formal committees. Collaboration with the NOAA National Weather Service (NWS) was cited as instrumental in accomplishing drought monitoring and response. Another of Georgia's successes is the daily blog

published by University of Georgia Cooperative Extension that provides the public with useful information on conditions and how to respond to, adapt to, and report drought conditions.

Georgia state drought monitoring groups stated that the current formal state drought monitoring and response process does not adequately capture agricultural impacts, which tend to show up quickly as drought conditions appear. Instead, Georgia drought monitoring places more emphasis on assessing long-term drought indicators such as reservoir levels. This focus may discourage agents and observers from completing reports until state-designated drought conditions warrant a report, thus limiting the ability to track agricultural impacts in Georgia.

Creating a formal drought monitoring committee was cited as a first step in improving Georgia's drought monitoring and response. Agencies recommended for forming this committee include the EPD, the SCO, NWS, the U.S. Geological Survey (USGS), FSA, and Extension. Interviewees suggested that this committee might be modeled after North Carolina's Drought Management Advisory Committee, citing its success in improving that state's responsiveness and transparency.

Kentucky

Kentucky's Division of Water department exists within the Energy and Environment Cabinet and is the primary entity that collects and utilizes agricultural drought impact information. Representatives from the Division of Water routinely collaborate with NWS offices, the University of Kentucky Weather Service and University of Kentucky Cooperative Extension Service representatives, and the Kentucky SCO. In addition to participating in the formal USDM process, the Division of Water is responsible for issuing press releases during periods of drought, frequently in collaboration with the SCO and Western Kentucky University. The division works on the state's Drought Hazard Mitigation Plan and Water Shortage Response Plan, designed to implement appropriate state-specific responses to drought and incorporate agricultural drought impact information. The Kentucky Drought Impact Reporter (KDIR) was created to streamline the submission, collection, and synthesis of ground observations of drought impacts on agriculture. The KDIR functions as a Survey123 application that allows Kentucky extension agents to record impacts and observations in a similar format to the CMOR survey. The Division of Water plans to merge the KDIR into the national CMOR project database soon to further improve the resolution of the project. However, adjustments will be made following this merger to ensure that the survey is still tailored to Kentucky.

In Kentucky, one of the greatest challenges is extension agents' commitment to utilize and populate the KDIR. Currently, the drought reporter tool is operational, and the infrastructure needed to streamline the submission of reports is in place. However, extension agents' limited participation has reduced the effectiveness of the tool. The lack of reporting to the KDIR stemmed from the lack of recent severe drought events and the timing of the launch of the tool in 2019. Kentucky experienced a severe drought in 2012 and a flash drought in 2019. However, the state has not had another drought event in the last three years. In addition, the launch of the KDIR was affected by the beginning of the COVID-19 pandemic in early 2020. Therefore, reporting to the KDIR has not been a high priority for extension agents. As a result, the KY Energy and Environment Cabinet has relied on email and telephone calls for tracking drought across the state. Collecting information using this method escalates the workload while failing to yield consistent reporting. In addition, the lack of community science reporters in western agricultural areas of the state further limits the number of reports that are available to the KY Energy and Environment Cabinet.

With the KDIR online and functional, most of the solutions that Kentucky monitoring entities suggested were methods for improving buy-in and use of the tool. To minimize the redundancies reported by extension agents, monitoring groups said that they are seeking a method to incorporate NASS Crop Progress report information into the KDIR. Managers are also interested in incorporating photos taken by Kentucky Mesoscale Network (Mesonet) stations to better populate the KDIR. In addition to promoting the tool to extension agents, experts are working to involve trusted CoCoRaHS observers and other volunteers, along with Farm Bureau representatives, in submitting drought monitoring data to the KDIR. Finally, the EEC plans to roll the KDIR into the national CMOR database to improve national connectivity while preserving the state-specific nature of the tool for users. Over time, Kentucky monitoring groups have seen successes, including creation of the KDIR. A shift to targeted and personal email communication with data collectors rather than mass email threads yielded increased reporting participation and consistency. Interagency communication was also cited as a success in establishing connections, receiving more drought impact information, and ultimately creating the KDIR.

Louisiana

There is currently no operational statewide drought plan or monitoring process in Louisiana. There is also no state-level formal requirement to contribute weekly to the USDM. The University-based SCO provides state input, using quantitative indicators (e.g., standardized precipitation indices) and informal networks (e.g., NWS, Louisiana State University AgCenter Extension, NASS Crop Progress reports, CoCoRaHS CM, CMOR) to assess drought conditions. Interviewed experts identified one major challenge to drought monitoring and reporting in Louisiana as the priority given to impacts from flooding instead of drought. Consequently, Louisiana has lower participation in drought impact reporting than other states. Conversations indicated that increased communication and solicitation of impact data could potentially increase participation levels in drought impact reporting by strengthening relationships and establishing routines for reporting. Methods for improving community science reporting and utility included offering community science volunteers a more robust training program to educate observers on the basics of reporting and the importance and value of their reports. The main challenges identified with utilizing these types of reports are validity, reliability, and unbiased opinions, each of which could be improved with proper training programs. Interviewees suggested the [NWS SKYWARN](#) Storm Spotter program, a volunteer program aimed at providing citizen observers training on severe weather reporting, as a model for developing this training. Similar to SKYWARN, observers could volunteer to become certified as official drought spotters. Receiving an adequate number of reports for an area would significantly improve data resolution and improve the representation of the area on drought monitor maps and in projections.

Mississippi

There is currently no operational statewide drought plan or monitoring process in Mississippi. Agricultural impact data are readily collected by the Mississippi State University (MSU) Extension Service and the University-based SCO through a sponsored and verified mobile application. This application allows extension agents across the state to record information and photos of ground conditions and route this information back to the MSU Extension Service and the SCO for quality control and synthesis. Before using the application, agents must complete training on how to use it and what to report. The application records the latitude and longitude of where the report is taken, a perceived drought rating, a description of how the drought has increased, decreased, or maintained

severity, and up to 5 photos of agricultural impacts. Reports are then synthesized and imported into a geographic information systems (GIS) map for editing. Extension agents are urged to submit at least one report via the application per week, as submissions may sometimes factor into yearly performance evaluations. The SCO then collaborates with the NWS and other partners to produce considerations for USDAM authors.

Most of the significant barriers to obtaining and utilizing drought impact data in Mississippi pertain to the mobile application tool created for extension agents. Conversations with MSU Extension and SCO personnel highlighted that agents may not be reporting conditions correctly if they report drought from the perspective of a farmer or producer rather than completing a truly objective report. For example, one week an extension agent may report slight drought conditions to a tailored phone app. After the area receives three to four inches of rain the following week and fields are flooded, the agent may report that conditions have worsened. This report results in an inaccurate depiction of ground conditions and limits the use of this information in assessing drought conditions. Weak broadband service and connectivity in the state constrain some agents' capability to send multiple images of drought conditions through the app. Additionally, geographic gaps in available data represented an issue in assessing statewide conditions. There are areas where reporting frequency and consistency are weak, including the border with other states and the western portion of the state. The Mississippi floodplain, commonly referred to as the delta region, contains most of the state's agricultural systems. Due to decreased staffing caused by budgetary constraints. However, the responsibilities of extension agents are stretched across multiple counties. Agents have become overwhelmed and submitted fewer reports from these high-production areas.

As the application is tested and adjusted, agent training must keep up with new versions or different requirements. For example, discussions have taken place to suggest including a wetness scale in the current survey that would allow agents to report not only on drought but also on flooding. Situations in which a moderate drought is immediately followed by heavy rain could be captured by reports, and agents would be able to comment on both drought conditions and general weather conditions. Training would cover any new additions to the tool and better prepare agents to utilize the preexisting features. To adapt to the broadband challenges in Mississippi, monitoring groups said that they plan to limit reports to one image each. This restriction will result in fewer failed submissions and may prompt agents to complete multiple reports in different areas of their county to fully document impacts.

One data collection process cited as a success was creating a position within the SCO to oversee the quality of reports. Quality control personnel are responsible for reviewing and selecting high-quality reports that successfully depict the ground conditions of an area. These steps refine the information available to monitoring groups collaborating with USDAM authors and representatives of the Southeast Regional Climate Center (housed within the University of North Carolina at Chapel Hill), allowing them to make drought designations promptly, while also aligning with weekly deadlines for consideration in the USDAM map. Conversations also highlighted the benefits of importing reports into a GIS map. This action allows for easier editing and quality control. It also provides a visual depiction of which areas are and are not reporting. Finally, monitoring groups in Mississippi are open to expanding the application's coverage to neighboring states like Alabama to improve reporting frequency. Future discussions will need to occur to coordinate expansion costs, tailor surveys to accurately represent other states, and promote overall collaboration.

North Carolina

To better serve producers, water managers, and the public during drought periods, North Carolina created the [Drought Management Advisory Council](#) (DMAC). This council is composed of representatives from the SCO, USGS, NWS, public water supply organizations, North Carolina Forest Service (NCFS), North Carolina Cooperative Extension (NCCE), North Carolina Department of Environmental Quality (NCDEQ), and other organizations. The DMAC disseminates current drought status and condition information to the USDM, the Environmental Management Commission, the Secretary of the NCDEQ, the North Carolina Environmental Review Commission, and the public. The council also produces a weekly drought update infographic, developed under a NOAA-funded drought communications project. This infographic summarizes ground observations in the state, is publicly available, and is regularly distributed to hundreds of media contacts, NWS officials, and agricultural producers. The DMAC is also responsible for issuing press releases during droughts. Of the organizations that participate in the DMAC process, NCCE is the primary contributor to agricultural impact information during drought events. The council reviews both NASS Crop Progress reports and local impact reports submitted by the NCCE. It combines this impact information with various physical data such as soil moisture and precipitation rates to accurately describe agricultural conditions across the state. Like the NASS Crop Progress reports, the NCEE issues routine surveys to agents to ascertain drought impact information and improve the frequency and consistency of this type of reporting. Information from the CoCoRaHS observer network is also used in assessing agricultural conditions.

In North Carolina, conversations with monitoring groups revealed data accessibility and quality barriers and geographic data gaps across the state. While CoCoRaHS is the state's main community science reporting platform, those monitoring drought conditions mentioned the benefits of CMOR reports on data collection and utilization. However, North Carolina does not currently have many CMOR reports to use in its process.

Interviewees reported that rural areas of North Carolina were identified as areas with low reporting frequency. North Carolina monitoring groups said that they are seeking to overcome challenges to the drought monitoring process by improving communication with observers and providing them with more valuable resources. To increase the number of descriptive reports available, program leaders began issuing a survey created by the North Carolina Extension Service to agents in the state. The survey was cited as a significant success as it included drought impacts (e.g., qualitative descriptions of crop health, status of pond levels) not found in the NASS Crop Progress reports. When quality issues were identified in this process, FSA and North Carolina Department of Agriculture officials were brought in to provide full training sessions to agents. These sessions significantly improved the quality of reports available to monitoring groups. Additionally, progress is being made on a field handbook that will be offered to agents to further improve their ability to report condition observations. Other highlighted successes include the organization and structure of DMAC as the primary drought monitoring entity. Finally, the communication between multiple agencies and collaboration on resources like those developed under [Project Nighthawk](#) were cited as instrumental to implementing a drought monitoring system that accurately depicts agricultural conditions and serves stakeholders.

South Carolina

In South Carolina, the Drought Response Committee (DRC) deals with drought response and information sharing. The SCO leads the DRC process and is supported by five other state agencies: the Department of Natural Resources, the Forestry Commission, the Department of Agriculture, the Emergency Management Division, and the Department of Health and Environmental Control. Within the state, the DRC is the primary entity that issues state-level drought response procedures (separate from the USDM response) and monitors conditions. These conditions are then communicated to various stakeholders throughout South Carolina. Separate from the DRC, the SCO leads the weekly USDM process in South Carolina after synthesizing reports from various sources such as Clemson University Cooperative Extension Service, NWS offices, USGS, the South Carolina Department of Agriculture, NRCS, FSA, community science reporting platforms (CMOR and CoCoRaHS CM), and trusted social media reporters. Data are also shared from Georgia and North Carolina contacts to better characterize drought conditions along the state borders. After these considerations are submitted to the author of the weekly USDM, an infographic using North Carolina's Project Nighthawk format is posted for public use.

Barriers that interviewees identified in South Carolina include data accessibility and quality issues, geographic data gaps, and other challenges experienced in accurately representing drought conditions across the state. South Carolina data monitoring groups highlighted the success of North Carolina's Cooperative Extension service survey in helping to fill this information gap. However, the Clemson University Cooperative Extension Service does not have the authority or resources to utilize this tactic. The information the SCO receives from the extension service is voluntary, and the information submitted to NASS is privacy protected. Therefore, there is a data accessibility gap between monitoring entities. In terms of geographic gaps, the Pee Dee Region generally has fewer condition or impact reports compared to the Upstate, Midlands, and Lowcountry Regions.

Conversations highlighted South Carolina's progress since the flash drought that occurred in 2019. Since then, the state has shown considerable improvements and successes in its drought impact reporting efforts, including improving the accessibility of drought information to stakeholders, promoting and incentivizing community science reporting, and educating extension agents on state and national drought response processes. State agencies host Water and Weather webinars that update stakeholders on conditions and outlooks. The state also hosted a regional drought forum in 2020 to improve the communication between USDM authors and producers. Collaboration with neighboring states like Georgia and North Carolina has also improved the state's drought monitoring process. Contacts within the SCO stated that establishing connections in other agencies, such as the South Carolina Department of Agriculture and FSA, provides monitoring groups with even more sources of drought impact information. Through the outreach and promotion of community science reporting, the state has built a robust network of CoCoRaHS Condition Monitoring reporters who help collect impact data. Overall, South Carolina has improved its monitoring and response process markedly since 2019.

Tennessee

The [Tennessee Drought Management Plan](#) (TDMP) describes local, state, and federal agency responsibilities for drought monitoring, response, and planning. However, the TDMP does not establish any formal drought monitoring committees. The Tennessee State Climate Office (TCO)

coordinates state input into the weekly USDM map. The greatest challenge noted during interviews was the lack of communication between the Tennessee Extension Service and the TCO. Currently, most reports made by the TCO are based solely on physical data measurements and remote sensing data from sources such as Advanced Hydrologic Prediction Service (AHPS) outlooks, the North Carolina State University/Southern Regional Climate Center Integrated Water Portal (IWP), USGS streamflow data, and the National Aeronautics and Space Administration (NASA) Short-term Prediction and Transition Center (SPoRT) soil moisture data. The TCO is relatively new and does not have a strong relationship with many extension agents or representatives. Therefore, agents have no direction or process to submit drought impact information to the TCO. Most of this type of information is used in collaboration with FSA agents for emergency relief claims. Additionally, Tennessee contains two separate extension services, one associated with the University of Tennessee and the other associated with Tennessee State University. This sharing of authority adds a level of complexity to establishing relationships and coordinating data-sharing agreements. Finally, data gaps exist in the mountainous and rural areas where physical and impact data are sparse or low quality.

The TCO is currently focused on building relationships and communications with extension agents. Establishing these connections would allow for the transfer of information to monitoring groups and, ultimately, more impact information utilized in state drought considerations for the USDM. Obtaining these data will also allow monitoring groups to cooperate more with FSA representatives on emergency relief funding and the dissemination of information to stakeholders and the public during drought events. Conversations with Tennessee Extension agents indicated openness to this collaboration, where extension agents would benefit from training on collection and submission methods. Ultimately, this collaboration will greatly benefit Tennessee farmers and livestock producers by providing more accurate data on the drought conditions taken into consideration in preparing the USDM maps that trigger relief payments. In Tennessee, one cited success was the consistency and utility of physical and remote sensing data. The TCO also noted the benefits of its process for incorporating data and USDM drought maps into archived story maps, as this process helps to establish baselines that reflect previous drought events.

Virginia

The Virginia Department of Environmental Quality (DEQ) created the Drought Monitoring Task Force (DMTF) to monitor drought status across the state and trigger local-level drought responses and declarations. Within the state's policy, the DMTF is responsible for evaluating information compiled by the NASS to assess drought impacts on agricultural interests in the state. The task force comprises representatives from the Virginia Department of Agriculture and Consumer Services (VDACS), Virginia SCO, NWS, USGS, and other entities within the state. Through the NWS, agencies participating in the DMTF can provide feedback on the weekly draft of the USDM. VDACS currently uses reports from its employees throughout the state who regularly consult with agricultural producers to obtain condition information. VDACS also participates on the FSA-coordinated state emergency board. The board reviews a Loss Assessment Report when it evaluates a locality's request for a Secretarial Disaster Declaration. Drought area considerations are sent directly from the DMTF to the Governor's Office for review. The connection between the DMTF and the USDM is recent and will improve the representation of Virginia within the national drought monitoring and response process.

Discussions with monitoring groups in Virginia indicated that a lack of coordinated efforts to utilize Virginia Cooperative Extension agents for ground observation reporting might be limiting the accurate

reporting of conditions during a drought. Virginia monitoring groups face inconsistency in submitted reports. Occasionally, a region will not have any impact data due to agents' lack of response to requests for observations. In addition, reports may not be as representative of the area as needed if reporting agents are producers and solely report on the conditions of their farm or other operation.

The current MTF committee is cited as a success for the monitoring process as it establishes a small group of personnel focused on using physical and observational data to provide information for the NWS group that submits reports to the USDM. The routing of information to this group is crucial for representing Virginia's agricultural conditions during a drought.

Perspectives from the U.S. Drought Monitor

Value of State Drought Impact Information

When impact reports align with physical and remote sensing data, authors can more confidently assign a drought designation for the area. Synthesized impact data will often constitute an entire section within the USDM narrative issued with the weekly drought maps. Impact reports alone typically will not alter drought map designation lines because the USDM uses a "convergence of evidence" approach when determining the severity of an area's drought conditions. Instead, impact reports must be combined with physical and remote sensing data and drought indices approved by the USDM. When impact reports contradict indices and physical data, authors will discuss with state monitoring groups and experts to determine the cause of the discrepancy. Sufficient evidence must be present to determine whether remote sensing and physical data are not accurately capturing ground conditions. Therefore, authors look for multiple reports in the same area that corroborate one another. States that have robust extension and community science drought monitoring networks are better positioned to provide sufficient evidence to inform an area's representation on the USDM. While authors are more open to altering drought lines when a sufficient number of reports affirming similar conditions are present, they are careful when reviewing reports that detail conditions substantially different from what indices report. Instances where observers reported false observations to obtain financial aid have been reported, thereby unfortunately reducing the overall reliability of data. Despite the potential for false reporting, these agricultural impact reports are crucial to the USDM process and continue to be utilized.

In the Southeast, USDM authors identified extension agent reports as their primary source of agricultural impact data (Table 4). Interviewed authors also cited community science platforms as valuable sources of condition data, specifically the CoCoRaHS Condition Monitoring reports, CMOR reports, and the DIR. Interviewees highlighted the USDM authors' recent increased utilization of community science reports and stated that the CMOR tool is an excellent database for capturing this type of data. Authors perceived an increase in the number of reports during drought periods and less reporting when conditions are normal or wet. While information from the CoCoRaHS network is not often used to create the weekly drought maps, it is routinely used when writing narrative report sections, which help authors understand the monthly state of drought conditions. NASS reports were also noted as helpful to the USDM process. While the utility and consistency of NASS reports vary by state, they were said to be extremely useful for providing quantitative crop loss data and gap-filling data for specific crops across states. Social media reports are typically not used in the narrative section as this source tends to have too many low-quality reports to warrant review.

Opportunities and Successes

Through their direct experience working with drought experts in the Southeast and across the Nation, USDM authors highlighted good practices and opportunities for improving state networks and processes that assist them in utilizing agricultural drought impact information. Many of these observations align with opportunities already identified by the individual states (Table 6). Creating partnerships and relationships between state agencies and associations, such as between SCOs and extension, was identified as the best approach for improving agricultural drought impact reporting. Over time, these relationships can help increase the amount of reporting and two-way communication and ensure that timely and relevant information is shared. Authors recognized that this can be a challenge as many extension and FSA agents have other responsibilities that take up their time. However, their work is often closely related to the goals of state drought response teams. The collaboration is crucial, especially with the turnover rates that extension services experience, that monitoring groups and state response teams continue to communicate the type of information that is needed. These conversations should encourage and educate both community observers and agents on the importance of reporting and the appreciation of their involvement in the process. Both North Carolina and South Carolina were highlighted as states who have not only achieved success in improving their representation in the USDM drought maps but have also taken action to maintain the momentum of drought impact data collection, including from the agriculture sector.

Drought Monitor authors may utilize both extension agent and community science reports in their processes, with extension reports particularly encouraged. Authors stressed that it is crucial to standardize impact data, community science reports, and DIR to improve the quality and utility of this information. Additionally, education and outreach to agents and community reporters should be completed to reduce the potential for agent bias and to discuss a solution to reports not aligning with USDM timelines including images of drought impacts on agriculture was also identified as an opportunity to improve the quality of reports. Authors highlighted the use of pastureland and rangeland soil moisture measurements obtained from livestock producers and ranchers, as these measurements aid in ground-truthing soil moisture remote sensing data sources.

According to the interviewed authors, states that currently use a formal or informal drought monitoring team to synthesize and relay drought impact information, along with weekly considerations, in one message to the authors provide an exemplary approach to drought impact reporting. This method ensures that all available drought impact data are routed to a central entity, which summarizes the information into an accurate and straightforward report. This information flow reduces miscommunication and discrepancies, thereby allowing authors to efficiently incorporate state considerations into the drought maps. Having these coordinated groups also benefits states by giving them an entity that can inform policies or guide plans for collecting and synthesizing drought impact information. State monitoring groups are also encouraged to use media resources (e.g., local news stations and social media) to increase interest from the public in community science reporting.

States may further improve the process by moving to establish policies and state statutes that involve the collection and utilization of this type of information. Currently, fewer than half the states in the Southeast incorporate agricultural drought impact data into their plans or policy (Table 7). The enactment of these policies may help each state to define agencies' impact reporting responsibilities and to establish a reporting process that reflects current infrastructure and policy. The authors emphasized the importance of tailoring the process to the individual state as the infrastructure and

policies of one state may not apply elsewhere. Finally, authors expressed confidence that holding open comment periods with stakeholders and the public will aid in the continued success of drought monitoring programs.

Authors stated that the greatest barrier to ensuring that impact reports are utilized in the weekly USDM process is the lack of year-round reporting, especially during normal or wet conditions. Authors reported a lack of impact information from extension agents as another gap. Specifically, authors stated that a key gap is information on water levels in agriculture ponds and dugouts related to livestock and farming because these reliable and valuable data are not regularly reported. Another issue identified is that the timing of NASS reports and weekly USDM submission deadlines do not align. Impact information from each county must be submitted to the USDM each Tuesday to be included in drought area designation considerations. Information from NASS reports occasionally arrives too late in the week for authors to incorporate it into the drought map. Similar challenges with the timing of community science reports were also cited. Authors commented on the challenge of reviewing the information from such disparate sources and still meeting weekly deadlines. Authors also stated that data quality, proprietary information, and omission of narratives in the NASS Crop Progress reports limited the utility of this resource.

Case Studies From Outside the Southeast

While this assessment focused on the Southeast, several states outside of this region have made notable progress in expanding drought impact reporting from the agricultural community. Two states, Montana and North Dakota, were interviewed to document lessons and good practices that can be applied in the Southeast.

Montana

Montana utilizes the Montana Drought Reporter (MDR), a county-level drought impact report survey, to obtain information on crop, livestock, and pastureland conditions. This survey is modeled after the CMOR tool and contains similar questions (e.g., wet or dry conditions, observed impacts). However, its primary purpose is to gather and share impact information that alerts state monitoring groups to examine areas and determine whether physical data measurements match ground observations. Information from the MDR also aids in filling gaps for parts of the state that lack crucial physical data collection. Montana relies on impact reports for these areas to guide weekly USDM drought map designations. However, reports need to be examined to ensure quality. The MDR custom dashboard allows users to view statistics and locations of reports and descriptive note sections for each report, thereby increasing data transparency and allowing users to view drought progression over time by tracking the number of reports throughout the year. Monitoring groups state that beginning in 2022, Montana began routing information into the national CMOR database and using the tool as the primary reporting platform.

Monitoring groups have incorporated the MDR into their drought-monitoring processes. The drought impact report survey was launched during the 2017 drought when public interest in monitoring and response was high. State monitoring groups used constant and targeted emails to encourage participation from FSA and extension agents. These emails highlighted areas of the state where impact information was scarce to encourage agents to submit ground observation reports. The state monitoring groups also began scheduling monthly calls that are open for public input. These calls allow producers to voice their concerns, report directly to and establish connections with coordinators,

and receive education on the entire process. Additionally, monitoring groups work to issue flyers and factsheets on the process at various conferences, use news reports to promote participation, and collaborate with NWS offices to inform the public through social media.

The main challenge to Montana's approach is the occurrence of discrepancies between impact reports and physical data measurements for an area, specifically with precipitation and snowfall measurements. Impact reports are location-specific, while precipitation can occur over a large area. Therefore, spatial scales must be considered when discrepancies arise. Interviewees noted that reporters tended not to submit photos, likely because of a lack of broadband connectivity or smartphone access. To address privacy concerns, monitoring groups urge reporters using the survey to not log the exact location of the submission. Another barrier was that monitoring groups reported slight pushback and concern from producers over the length and complexity of the survey. The solution was to encourage producers to continue their participation but report just descriptive notes, as this section is still useful for monitoring groups. As with other states, extension agents' preexisting responsibilities and workloads have allowed only for limited participation. Montana monitoring groups worked to adapt to this challenge by incorporating FSA agents into the survey, as their work is more directly related to the goals of the drought impact report survey.

Montana contacts highlighted several effective practices for improving drought impact collection. The designation of one or more point people to synthesize reports and physical data measurements has been crucial to reducing the subjectiveness of reports to the USDM. Personnel dedicated to the quality control of submitted impact reports are also needed to distill information. In addition to creating a formal group or position, states are encouraged to continue to track and gather information through informal methods (e.g., email, phone calls, and meetings). However, this informal information may then be routed back to the person or group responsible for creating weekly drought map considerations. States that establish or have established a drought impact reporter survey should consider merging the tool into the national CMOR program as it has the existing infrastructure needed for effective reporting. Monitoring groups are urged to encourage year-round reporting through various methods. Finally, Montana monitoring groups cited the importance of building networks with extension directors and management and incorporating FSA agents into the reporting process.

North Dakota

North Dakota has experienced several severe and prolonged drought periods since the creation of the USDM. The longest-lasting drought occurred over 162 weeks from June 2004 through July 2005, and the most severe drought recorded for the state occurred in May 2021, where roughly 18% of the state experienced an Exceptional Drought (D4). Interviewees described their drought condition reporting process and how it has changed with the implementation of new practices and tools. Interviewees said that most reporting communication was originally conducted over weekly Google Forms where drought impacts on agriculture were discussed. Extension agents from all 53 counties were encouraged to submit information, and these data were synthesized and sent to USDM authors. In response to observers' comments that this method of data collection was time-consuming and inefficient, NDMC introduced CMOR to SCO personnel and offered education and training. Monitoring groups recognized CMOR as an efficient system for information exchange and began integrating the tool into state processes. During early implementation, monitoring groups reported pushback from extension agents. However, significant buy-in and participation occurred following training and outreach from the NDMC that focused on USDM maps and the value of reporting. The implementation

of this tool also put producers in a position to encourage agents to report in order to better represent ground conditions. In addition to increasing agent participation, the CMOR tool allowed monitoring groups to easily access and synthesize data weekly. The tool eliminated the need for monitoring groups to continually solicit impact information from county agents and allowed for useful information, such as photos of impacts, to be archived. Use of the tool greatly increased the amount of information North Dakota incorporated into its submissions to the USDM. Monitoring groups report that crop and livestock conditions are more accurately represented following this change. North Dakota interviewees stated that communicating and developing relationships with extension directors is a crucial first step in creating a successful drought monitoring program. Interviewees also cited the importance of educating agents, offering training, informing producers on the reporting process, and fostering relationships between producers and extension agents. State monitoring groups may seek buy-in from other agencies involved in tracking drought impacts, such as FSA and NRCS. This network could extend coverage to the forestry sector, including timber producers.

Section 3. Commonalities of Barriers and Opportunities across the Southeast U.S.

Our analysis of the interviews revealed several general barriers to drought impact reporting in the Southeast (Table 8) along with three closely related areas of focus to help realize opportunities for improved reporting: building and sustaining a strong community of observers, streamlining data collection, and strengthening institutional capacity (Tables 5, 8, & 9). These commonalities also incorporate experiences and lessons from outside the region and from USDM authors.

Building and Sustaining a Strong Community of Reporters

An ideal drought impact reporting process requires a robust network of observers who consistently report the conditions of an area, in wet and dry conditions, even when there is no drought. Throughout the region, condition monitoring participation tends to decrease during times of average rainfall amounts but typically increases as dry conditions begin to worsen. This trend creates a challenge where, due to a lack of data and images depicting normal conditions for an area, there is no baseline for comparison, and understanding the severity of an area's drought conditions becomes difficult.

Drought in the Southeast tends to be less persistent and severe compared to the western U.S., and most interviewees noted that most extension agents consider drought impact reporting as a relatively low priority. This perception, despite the agricultural impacts from the more common and shorter rapid-onset droughts ("flash droughts") experienced in the region, often reduces overall buy-in to drought monitoring initiatives. Taking advantage of interest during drought conditions to promote reporting is important. Reporting increases during dry conditions, but sustaining that interest remains a challenge.

News articles detailing drought impacts in states such as Alabama and Georgia often do not appear until drought severity intensifies. Interviewees also identified this lag as a limitation to relying on platforms such as the DIR that use media reports for drought early warning, but do not provide details on conditions leading up to the impact reported. This lag in reporting impacts during the early stages of an intensifying drought, or even before the drought, was one of the considerations that led to CoCoRaHS's implementation of its Condition Monitoring program. This program offers users an easy-access platform for recording observed conditions and physical data measurements throughout the year as part of their regular precipitation observations. However, developing networks of condition-monitoring observers with consistent habits also remains a challenge. Training and outreach programs that cater to specific areas, regions, states, or crop types and detail how and what to report are essential for building and sustaining a network of regular observers. Through outreach and promotion, states like North Carolina and South Carolina have created a large community of observers that report consistently.

A key opportunity to encourage regular condition monitoring reports and develop buy-in from extension and other observers is to provide targeted outreach and education designed to increase understanding of the value of the impact reports. North Carolina further increased participation in CoCoRaHS through targeted outreach to improve communication of drought-relevant information for various resource sectors across the state. Factsheets and tailored outreach communications were developed and disseminated by the state to spread awareness of the need to report drought impacts and crop conditions. North Carolina also developed a one-page weekly infographic that provides

updates on drought conditions and outlooks. It incorporates drought impacts from agriculture and other sectors. Several states in the region have adopted this approach, and now also produce weekly drought summary infographics that incorporate impact information. Other forms of outreach and communication that have been utilized effectively to encourage and improve drought impact reporting include articles, media reports, webinars, public forums on state processes and policies, social media, and local news networks.

Interviewees identified another barrier to attracting and keeping a community of observers: a lack of familiarity with how the impact reports are utilized within state and national drought response and monitoring efforts. There is currently little to no formal training on state and national drought monitoring processes, including the USDM process and its implications (Table 2). Several efforts in the past few years have been undertaken to directly address this need, such as holding regional workshops on the USDM process, integrating the USDM process and drought impact reporting advances into SE DEWS, and increasing statewide transparency such as through North Carolina's creation of a story map to illustrate its drought monitoring process.

The ability to build a sustained network of observers across the region is limited in some areas due to technical and socio-economic constraints. Lack of internet access in rural, high-production areas of the Southeast creates a sizable gap in the data available for state and national decision-making. This issue greatly limits reporting capability in states such as Arkansas, which ranks 48th in broadband connectivity in the U.S. When connectivity issues are combined with lack of reporting from extension agents (who are limited by other responsibilities and multiple county jurisdictions) in high-production areas such as the delta region of western Mississippi, the southern counties of Georgia, and the mountainous areas of Tennessee and North Carolina, reporting of drought conditions decreases.

Streamlining Data Collection

In addition to lack of awareness around the need for drought impact reports, extension and other observers identified a number of barriers in the reporting process itself. Impact observers from across the Southeast have reported that some observers find existing surveys to be too complicated to use frequently. For example, one interviewee reported that frustration with the complexity of condition monitoring report platforms has reduced community observer use of these reporting methods.

A common opportunity to address these concerns and barriers to reporting, identified by many in the region, was the establishment of a formal state-specific drought impact reporting tool or process (or both). Any such processes should utilize both extension networks and community science platforms. Developers of these tools or processes could learn from existing tools and states that have improved reporting processes based on communication and feedback. Developing a streamlined and simple method for documenting drought impacts tailored to each state could have multiple benefits, such as building familiarity and trust with state observers who are hesitant to contribute to broader national reporting processes. A formal reporting tool or process could also address the concern that extension agents are burdened with receiving multiple requests for information. For example, one agent mentioned being responsible for completing weekly condition monitoring reports for both the SCO and NASS Crop Progress reports, leading to potential redundancies and increased reporting responsibilities. A solution to this reporting load would be to create a tool that is built on a national tool but tailored to the particular state. An example is the Kentucky DIR, which modifies the CMOR survey

to accommodate state-specific needs and reporting but also has a mechanism to incorporate the reports into the national CMOR database for added value.

For existing tools, a lack of training was identified as a barrier to receiving high-quality reports and buy-in from observers. Tool development and training should address not only the mechanics of filling out the survey, but also concerns of confidentiality and resource commitment. Many producers are not only unaware of the considerable need for qualitative information but also wary of outside involvement in their operation and are reluctant to submit location-based information. Producers may be unwilling to submit reports of failing crops or struggling livestock conditions, fearing that contracts will be terminated or this information will be shown to neighboring competitors. One possible solution is not to report information at a level that can be traced to a single property but to aggregate information at the county level. The amount of time spent completing reports also needs to be considered. One interviewee commented on the hesitancy of extension agents to report impact information via community science platforms such as CoCoRaHS. The reported concern stemmed from the added responsibility and possible costs for a CoCoRaHS rain gauge.

A few barriers were specifically highlighted due to recent changes in the NASS Crop Progress reports. These challenges include the lack of county-level crop and pastureland information in NASS Crop Progress reports, the redundancy of reporting for NASS and other efforts, and the timing of the reports as they currently arrive too late in the week for USDAM authors to synthesize the information. Opportunities highlighted to address these barriers include incorporating NASS Crop Progress information directly into existing state-level reporting responsibilities, including narratives in the NASS reports, reconsidering the timing of the NASS reports, and exploring interstate collaboration on NASS Crop Progress reports.

Regardless of whether there is one state-tailored process or several existing reporting platforms, a common theme was the importance of creating training programs for both extension and community science observers on the use of existing drought impact reporting tools (i.e., CMOR, state-tailored impact observers), and ensuring that training efforts are sustained to serve new observers. Training would help address the concern that interviewees summarized about the utility and consistency of reports from community science reporting, such as CoCoRaHS Condition Monitoring and CMOR.

Strengthening Institutional Capacity

Beyond awareness of the reporting process—both why it is needed and how it is done—many extension entities reported that understaffing requires them to expand their responsibilities across multiple parishes or counties. Some states have specific situations that limit extension agent participation for reporting drought impacts. Other extension responsibilities consequently take priority over impact reporting. These institutional issues are not easy to address and need to be considered when making requests of extension. Some states have found limited success with incorporating and improving existing reporting efforts.

States use a wide variety of approaches to institutional drought monitoring policy (Table 7). For example, two states (i.e., Alabama, and North Carolina) have statutes or regulations establishing how the state contributes to the USDAM. Four states i.e., Alabama, Kentucky, North Carolina, South Carolina) have an agency staff position assigned to coordinate or provide USDAM input on behalf of the

state. In the absence of policy and directives, input into the USDM is provided by either the NWS or the SCO, often through coordination and input by various state agencies and experts. These informal efforts have been found to have effectively led to increased state participation and representation in the USDM map process as well as general increased awareness of drought impacts to agriculture. More details on when and how different states in the Southeast monitor, respond to, and plan for drought events can be found in this [2022 report](#).

Interviewees from several states have identified the lack of a formal, authoritative process as a barrier for incorporating agricultural impact reports into drought monitoring and response. Opportunities identified include the formal creation of interagency teams for state drought monitoring that consider the reporting of agricultural drought impacts in their regular deliberations, and route that information to monitoring groups and discuss drought policy and planning. One example frequently mentioned as a model for other states is the weekly monitoring process in North Carolina. Communicating and collaborating with neighboring states on a regular basis regarding USDM input, including the reporting of impacts, was identified as an effective regionwide process that has improved substantially in the past decade. Finally, there was a recognized need to provide resources, both staff time and funding, to ensure that these monitoring teams are able to access agricultural drought impact information, such as through the creation and maintenance of agricultural impact collection networks to support state monitoring efforts.

Conclusions

Conversations with dozens of state experts elicited information on how southeastern states record, report, and use information about drought impacts on agriculture as of 2021–2022. Drought conditions tend to affect agricultural lands sooner than other land types. Timely, reliable, and accessible reports on agricultural drought impacts provide important information to state and national offices responsible for drought monitoring and response efforts. Each state collects and utilizes drought impact information differently. Therefore, each state will have various challenges and potential solutions to these challenges.

	Barriers	Opportunities
Building and Sustaining a Strong Community of Reporters	<ul style="list-style-type: none"> • Lack of year-round reporting and inconsistent reporting • Lack of extension agent buy-in to reporting efforts • Hesitancy in submitting location-based information or reports of failing crops, fearing contract termination • Spatial gaps in reporting • Lack of broadband connectivity and internet access in some locales • Lack of understanding of how the information is utilized • Lack of familiarity with state and national drought response and monitoring efforts 	<ul style="list-style-type: none"> • Focus first on building trusted relationships between state extension services and state drought monitoring efforts • Utilize existing practices and networks. Examples include the CMOR tool, which can be customized for each state • Provide agents and community science observers training on the type of information needed while also highlighting the importance of reporting, appreciation for the effort, and education on state and national drought response and monitoring efforts • Hold open forums with the public and stakeholders for feedback and information sharing • Provide the public with valuable products like condition summaries, infographics, and webinars regularly to ensure that reporters can see the value of their submissions and efforts • Encourage the submission of images depicting impacts • Holding open forums with the public and stakeholders
Streamlining Data Collection	<ul style="list-style-type: none"> • Lack of a formal reporting platform or database • Multiple requests for information • Lack of state-tailored reporting tools and methods • Reporting being complex and cumbersome • Lack of training on existing tools • Change to NASS Crop Progress reports 	<ul style="list-style-type: none"> • Establishment of a formal state drought impact reporting tool and process • Utilize both extension networks and community science platforms • Offer continuous training to reporters • Learn from existing tools and states that have improved reporting processes based on reporter feedback
Strengthening Institutional Capacity	<ul style="list-style-type: none"> • extension staffing reductions and other responsibilities taking priority over impact reporting • Lack of a formal, authoritative process in some states for incorporating impact reports into drought monitoring and response 	<ul style="list-style-type: none"> • Creation of formal state drought monitoring teams, where they don't exist • Collaborating with neighboring states

This assessment highlighted effective practices that states are implementing. Our assessment also identified existing barriers and opportunities for improving the collection and utilization of drought impact information. However Regardless of state, a focus on building and sustaining a strong community of drought-condition observers, streamlining data collection, and strengthening institutional capacity can help the Southeast to expand and improve drought impact reporting networks., Applying these lessons could ultimately lead to greater reliance by agricultural producers and state entities on drought impact reports and to stronger collaboration among extension services, state drought monitoring groups, the Southeast DEWS network, regional stakeholders, and the USDA.

Literature Cited

Brown, B. (2019). New Southeast outlook and situation. *Agricultural and Resource Economics News*, 26 August.

<https://cals.ncsu.edu/are-extension/news/new-southeast-outlook-and-situation/>

Christian, J.I., Basara, J.B., Otkin, J.S., Hunt, E.D. (2019). Regional characteristics of flash droughts across the United States. *Environmental Research Communications*, 12(1).

<https://doi.org/10.1088/2515-7620/ab50ca>

Colorado Climate Center. (2023). Community Collaborative Rain, Hail and Snow Network: Condition monitoring. <https://www.cocorahs.org/content.aspx?page=condition>. [Date accessed: June 6, 2024].

Costanzo, S., Dennison, W., Walsh, B. (2016). Ecological drought in the Southeast United States: Balancing competing demands for water supplies. Southeast Climate Center Workshop. <https://ian.umces.edu/site/assets/files/11178/ecological-drought-in-the-southeast-united-states.pdf>. [Date accessed: June 7, 2024]

National Drought Mitigation Center. (2023). Drought Impacts Toolkit: Submit and view Condition Monitoring Observer Reports (CMOR).

<https://droughtimpacts.unl.edu/Tools/ConditionMonitoringObservations.aspx>. [Date accessed: June 7, 2024].

Schubert, S.D., Chang, Y., DeAngelis, A.M., Wang, H., & Koster, R.D. (2021). On the development and demise of the fall 2019 Southeast U.S. flash drought: Links to an extreme positive IOD. *Journal of Climate*, 34(5), 1701–1723. <https://doi.org/10.1175/JCLI-D-20-0428.1>

Appendix

The following tables represent the results of the 2022 assessment on how agricultural drought impact reports are used across the Southeast U.S. States within the combined National Integrated Drought Information System Southeast Drought Early Warning System and Southeast Climate Hub region: Alabama (AL), Arkansas (AR), Florida (FL), Georgia (GA), Kentucky (KY), Louisiana (LA), Mississippi (MS), North Carolina (NC), South Carolina (SC), Virginia (VA), and Tennessee (TN).

Table 1—Entities that collect and report agricultural drought impact data utilized by each state, 2022^{a, b}

Entity	AL	AR	FL	GA	KY	LA	MS	NC	SC	TN	VA
County extension agents	—	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regional extension agents/County extension coordinators	✓	—	—	—	—	—	—	—	—	—	—
Farm Service Agency (FSA) agents	—	✓	—	✓	—	—	—	✓	—	—	—
National Agricultural Statistics Service (NASS) field staff	—	—	✓	—	—	—	—	—	—	—	—
National Association of State Departments of Agriculture (NASDA) enumerators	—	—	✓	✓	—	—	—	—	—	—	—
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) observers	✓	—	—	✓	✓	—	—	✓	✓	—	—
North Carolina Department of Agriculture agronomists	—	—	—	—	—	—	—	✓	—	—	—
Community Condition Monitoring Observer Reports (CMOR) reporters	—	—	—	✓	—	—	—	—	✓	—	—

^a A checkmark (✓) indicates that drought monitoring entities utilized by the state for data collection at the time of this report.

^b — Drought monitoring entities not utilized by the state for data collection at the time of this report.

Table 2— States where monitoring entities have requirements or training for drought impact reporting^{a, b}

Provided Programs	AL	AR	FL	GA	KY	LA	MS	NC	SC	TN	VA
Incentives/Requirements	—	✓	—	—	—	✓	✓	—	—	—	—
Training for extension agents	—	—	—	—	—	✓	✓	✓	—	—	—
Training for other agencies	✓	—	—	—	—	—	—	—	—	—	—

^a A checkmark (✓) indicates that state data collection entities that route drought impact information to state drought monitoring groups provide training programs or incentives (or both) or require reporting at the time of this report.

^b A dash (—) indicates that the state did not provide incentives or training or require reporting at the time of this report.

Table 3—Specific data requested by state monitoring entities ^{a, b}

Data type	AL	AR	FL	GA	KY	LA	MS	NC	SC	TN	VA
Crop progress	✓	✓	—	—	—	✓	✓	✓	✓	✓	✓
Crop conditions	—	—	✓	✓	✓	—	—	—	—	—	✓
Livestock conditions	—	—	✓	✓	✓	—	—	—	—	—	✓
Pastureland conditions	—	—	✓	✓	✓	—	—	—	—	—	—
Soil moisture measurements	—	—	✓	✓	—	—	—	✓	—	✓	—
Location	—	—	—	—	—	—	✓	—	—	—	—
Drought rating	—	—	—	—	—	—	✓	✓	—	—	—
Drought progression/regression	—	—	—	—	—	—	✓	—	—	—	—
Surface water levels	—	—	—	—	—	—	✓	—	—	—	—
Photos of impacts	—	—	—	—	—	—	✓	—	—	—	—
Irrigation rates	—	—	—	—	—	—	✓	—	—	—	✓

^a A checkmark (✓) indicates that drought monitoring entities in the state requested this type of data at the time of this report.

^b A dash (—) indicates that the state did not request this type of data at the time of this report.

Table 4—Sources of agricultural drought impact information used by state monitoring groups, by state ^{a, b}

Source	AL	AR	FL	GA	KY	LA	MS	NC	SC	TN	VA
Extension agent reports	✓	—	✓	✓	✓	✓	✓	✓	✓	—	✓
National Agricultural Statistics Service (NASS) Crop Progress reports	✓	✓	✓	✓	—	✓	—	—	✓	✓	—
Drought Impact Reporter	—	—	✓	✓	—	✓	—	✓	—	—	—
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Condition Monitoring reports	—	—	✓	✓	✓	✓	—	✓	✓	—	—
Condition Monitoring Observer Reports (CMOR) tool	—	—	✓	✓	—	✓	—	—	✓	—	—
Social media	—	—	—	✓	—	—	—	—	✓	—	—

^a A checkmark (✓) indicates that state monitoring groups and entities that utilize drought impact data utilize a particular source of agricultural drought impact information.

^b — States that do not currently utilize this source of information in their processes.

Table 5—Perceived barriers to data collection across each state^a

State	General Barriers	State-specific Barriers
Alabama	<ul style="list-style-type: none"> • Existing workload on agents • Decrease in budget and staffing reductions • Lack of funding for drought reporting work 	<ul style="list-style-type: none"> • Emphasis is on physical data collection rather than gathering impact data
Arkansas	<ul style="list-style-type: none"> • Broadband and internet access 	—
Florida	<ul style="list-style-type: none"> • Existing workload on agents • No formal process for submitting observations 	—
Georgia	<ul style="list-style-type: none"> • Broadband and internet access • Complex submission process 	<ul style="list-style-type: none"> • Not enough guidance on how and where to report for producers
Kentucky	<ul style="list-style-type: none"> • Existing workload on agents 	—
Louisiana	<ul style="list-style-type: none"> • Existing workload on agents • Decrease in budget and staffing reductions 	—
Mississippi	<ul style="list-style-type: none"> • Existing workload on agents • Decrease in budget and staffing reductions (especially in the Delta region) 	<ul style="list-style-type: none"> • Duplication of reporting efforts between the NASS and extension mobile app
North Carolina	<ul style="list-style-type: none"> • Existing workload on agents • Decrease in budget and staffing reductions 	—
South Carolina	<ul style="list-style-type: none"> • Complex submission process (NDMC Drought Reporting tools) 	—
Tennessee	—	<ul style="list-style-type: none"> • Emphasis is on physical data collection rather than gathering impact data Lack of coverage across the state (60-70% of counties report weekly)
Virginia	<ul style="list-style-type: none"> • No formal process for submitting observations 	<ul style="list-style-type: none"> • Lack of familiarity with drought impact monitoring and the USDM process Reluctant to report for fear of losing contracts

^a — Contacts from this state did not report any general or state-specific barriers.

Table 6—Proposed opportunities and successes described by data collectors across states^a

State	Opportunities	Successes
Georgia	Simplify the process in which producers submit information; provide education on how to submit reports for producers; educate extension agents on how to report (underway)	—
Kentucky	Incorporate NASS Crop Progress information directly into KDIR to minimize reporting responsibilities and redundancies; Training on what to report catered to specific areas and crop types would provide producers and new extension agents with the ability to report better	—
Louisiana	More funding for staffing needed	—
Mississippi	Integrate NASS and Ext app reporting	—
North Carolina	—	Agents and producers widely use NASS survey; CoCoRaHS is easy to access, free, anonymous, and data is utilized
Virginia	Outreach and education on the process and the value of reporting	A growing interest in drought monitoring and recording of impacts among agents

^a — Data collectors in this state did not suggest solutions to barriers or report successes of the state’s drought impact reporting process.

Table 7—Current use of agricultural drought impact data in state plans and policy

State	State plan/policy implications
Alabama	The assessment of the drought conditions' impact will be included as part of the overall declaration assessment by the AOWR and the MIG
Arkansas	No evidence of policy requirements for tracking or collecting agriculture impact reports
Florida	No evidence of policy requirements for tracking or collecting agriculture impact reports
Georgia	No evidence of policy requirements for tracking or collecting agriculture impact reports
Kentucky	Hazard mitigation plan incorporates agricultural drought impacts
Louisiana	No evidence of policy requirements for tracking or collecting agriculture impact reports
Mississippi	No evidence of policy requirements for tracking or collecting agriculture impact reports
North Carolina	Per the NCEOP, assessments of crop and livestock loss are evaluated and factored into drought response to formulate guidance, considerations, and information for producers
South Carolina	SCDRP: Uses the Crop Moisture index and agricultural conditions in alert phases, consults with the SCDA and Clemson Extension agency, and compiles agricultural loss data from impacted areas,
Tennessee	TDA may contribute emergency designations based on agricultural losses. The U.S. Secretary of Agriculture has the authority to designate natural disaster areas when sufficient agricultural losses are suffered. This designation allows farmers to apply for various federal disaster assistance programs, including low-interest emergency loans, and crop and livestock loss payments. Generally, a county and the individual producer must show a 35 percent loss in any one area of production in order to qualify. When drought strikes, county-level farm damage assessment reports are generated by the local USDA Farm Service Agency (FSA) office and are reviewed by the FSA's State Emergency Committee. Since a disaster designation requires that the Governor make a formal request, TDA works with FSA to facilitate this action. TDA also communicates with NASS to obtain information from farmers. Lists "reduced agricultural production and crop loss" as potential drought impacts
Virginia	Virginia Drought Monitoring and Response Plan: The DMTF will evaluate information compiled by the Virginia Agricultural Statistics Service to assess drought impacts on agricultural interests in the state. The DMTF will also rely on the input of local agricultural extension agents through the Virginia Cooperative Extension Service to document actual drought impacts throughout the Commonwealth. In addition, the DMTF will evaluate the number of requests for federal drought disaster designation as reported by the Virginia Department of Agriculture and Consumer Services.

Table 8—General and state-specific barriers experienced by monitoring groups throughout the utilization process by state^a

State	General Barriers	State-specific Barriers
Alabama	<ul style="list-style-type: none"> ● No formal drought monitoring/impact collection process ● Lack of participation in reporting information to NASS ● Difficult to vet information from community science reporters ● Lack of county-level condition information in NASS Crop Progress reports 	<ul style="list-style-type: none"> ● Lag time between drought event and FSA assessment requests ● Lack of communication between agencies ● No reporting of drought impacts on agriculture, livestock, or pastureland outside of NASS reports ● Information on pastureland conditions is not being gathered/published in NASS reports
Arkansas	<ul style="list-style-type: none"> ● No formal drought monitoring/impact collection process ● Reporting inconsistency Progress slowed by COVID-19 ● IT and broadband issues limits reporting capability ● Drought monitoring is not of high-priority ● Lack of county-level condition information in NASS Crop Progress reports 	<ul style="list-style-type: none"> ● Staffing reduction within the SCO ● SCO is not affiliated with the university (not as much access to funding, grad students, research capacity) ● State Climatologist can only allocate 10% of their time to drought monitoring/response
Florida	<ul style="list-style-type: none"> ● No formal drought monitoring/impact collection process ● Lack of severe drought in recent years has impacted the consistency of reporting ● Lack of county-level condition information in NASS Crop Progress reports 	<ul style="list-style-type: none"> ● Geographic barrier: southern/southeast Florida is very irrigated, creating a buffer against drought and a lack of reporting here ● Disconnect between NWS and ground observations due to most usable sources of water managed by the Army Corps of Engineers ● Disconnect with FSA over USDA Range Disaster Assistance Program being triggered by the USDM ● Lack of soil moisture monitoring ● Florida is not represented by the DIR enough for the use
Georgia	<ul style="list-style-type: none"> ● Lack of agent buy-in ● Agents tend not to report unless dry conditions are present ● No formal drought monitoring/impact collection process ● Lack of a formal coordinating committee ● Lack of county-level condition information in ● NASS Crop Progress reports 	<ul style="list-style-type: none"> ● Geographical gaps: Harrison and Echols counties (gaps in reports) and the southern rural counties ● High turnover in extension staffing results in less established relationships and a weaker network

Kentucky	<ul style="list-style-type: none"> ● Drought monitoring and response is reactive rather than proactive ● Progress slowed by COVID-19 ● Lack of severe drought in recent years has impacted the consistency of reporting ● Lack of county-level condition information in NASS Crop Progress reports 	<ul style="list-style-type: none"> ● Kentucky Drought Impact reporter requires human infrastructure and buy-in ● Lack of community science reporters
Louisiana	<ul style="list-style-type: none"> ● Difficult to vet information from community science reporters ● No formal drought monitoring/impact collection process ● Drought monitoring is not of high-priority ● Lack of county-level condition information in NASS Crop Progress reports 	—
Mississippi	<ul style="list-style-type: none"> ● Quality of reports ● IT and broadband issues limits reporting capability ● Data contours along state boundaries are less reliable ● Lack of county-level condition information in NASS Crop Progress reports 	<ul style="list-style-type: none"> ● Geographic gaps: Western Mississippi (delta region)
North Carolina	<ul style="list-style-type: none"> ● Quality of reports ● Lack of county-level condition information in NASS Crop Progress reports 	<ul style="list-style-type: none"> ● Lack of data from CMOR ● Not enough information from livestock producers ● Geographical gaps: rural areas where reporters are sparse
South Carolina	<ul style="list-style-type: none"> ● Lack of county-level condition information in NASS Crop Progress reports ● Quality of reports ● Reporting inconsistency ● Lack of archived data 	<ul style="list-style-type: none"> ● Extension does not have the authority/resources needed to issue a drought monitoring survey to agents (similar to NC) ● Geographic gaps: Sumter County ● High turnover in extension staffing results in less established relationships and a weaker network ● Drought response committee only meets when conditions warrant ● SCDRC defines drought differently than USDM ● Reports that NDMC Drought Reporting tools take too long and are too cumbersome

Tennessee	<ul style="list-style-type: none"> ● Lack of county-level condition information in NASS Crop Progress reports ● No formal drought monitoring/impact collection process 	<ul style="list-style-type: none"> ● Lack of communication between TNSCO and extension service ● Rural and mountainous areas are not covered in reports or are hard to get physical data for ● Extension service is split between UT and TSU, making it challenging to coordinate well
<hr/>		
Virginia	<ul style="list-style-type: none"> ● No formal drought monitoring/impact collection process ● Lack of county-level condition information in NASS Crop Progress reports ● Difficult to vet information from community science reporters ● Reporting inconsistency 	—

^a—Data collectors in this state did not suggest solutions to barriers or report successes of the state’s drought impact reporting process.

Table 9—Opportunities and successes described by monitoring groups across states

State	Opportunities	Successes
Alabama	<ul style="list-style-type: none"> ● Facilitate interagency and interstate communication ● Utilize success in community science to incorporate condition monitoring questions and link into CMOR ● Establish a formal impact data collection system ● Encourage year-round reporting ● Offer training to extension agents ● Provide education and outreach on USDM and state processes ● Simplify reporting for agents and community science observers ● Shield agents from unwanted noise (questions and concerns directed to state groups) ● Gain funding for technology and instrumentation ● Develop more educational resources for agents and the public 	<ul style="list-style-type: none"> ● Creation of interagency teams (e.g., A group of members from ARS, NRCS, the Alabama Department of Agriculture and Industries, ADEM, extension, and stakeholder groups (Poultry and Egg Association, Cattlemen's Association, and Alabama Farmers Confederation) meet to discuss regulations, permits) ● Surveyed extension agents on resources they utilize, previous history with drought reporting, familiarity with the drought reporting process (USDM), recurring issues, need for further education or workshops ● Communicated with key individuals from MS and Kelly Smith from NDMC to begin this process ● Community science programs have been successful in reporting stream and lake conditions
Arkansas	<ul style="list-style-type: none"> ● Facilitate interagency and interstate communication ● Become proactive in drought monitoring/response ● Obtain a blueprint of how to structure drought monitoring/response from a state that has had success with this ● Develop tailored information for the agricultural community (give updates on conditions, what to expect, how to respond or adapt) ● Fund an infrastructure plan to improve reporting capabilities 	<ul style="list-style-type: none"> ● Ag producers are very knowledgeable and experts on water resources and conditions, allowing for a future community science network

Florida	<ul style="list-style-type: none"> ● Establish a formal impact data collection system ● Fund the creation of soil moisture monitoring networks ● Incentivize reporting for both agents and the community observers 	<ul style="list-style-type: none"> ● Florida Department of Agriculture readily promotes and incentivizes their BMP program focused on water quality and quantity (funded by the state and provides benefits and cost-sharing opportunities for partners) ● Creation of the Tri-State Row Crop Working Group that promotes communication between SCO, extension, and producers on seasonal climate outlook and the past growing season ● Increased understanding of hydrology across different geographical sections of the state
Georgia	<ul style="list-style-type: none"> ● Establish a formal impact data collection system ● Creation of a formal coordinating committee (similar to DMAC) ● Provide education and outreach on USDM and state processes 	<ul style="list-style-type: none"> ● Having a small group that coordinates with representatives from NOAA ● Generates a blog and monthly newsletter articles that disseminate useful information to the public ● Coordination with the NOAA has been useful
Kentucky	<ul style="list-style-type: none"> ● Incorporate trusted CoCoRaHS observers, Farm Bureau members, and ag-minded volunteers into the KDIR ● Incorporate Mesonet pictures into KDIR ● Incorporate NASS Crop Progress information directly into KDIR to minimize reporting responsibilities and redundancies ● Educate on and promote KDIR to extension agents ● Provide education and outreach on USDM and state processes ● Incorporate the KDIR into the national CMOR database 	<ul style="list-style-type: none"> ● Learned that directed/targeted email methods are better than mass email methods ● Developed a working drought impact reporter tool catered to the state ● Bolstered interagency communication
Louisiana	<ul style="list-style-type: none"> ● Establish a formal impact data collection system ● Offer training to extension agents and community science observers ● Solicit feedback often to establish a routine for reporting ● Facilitate interagency and interstate communication 	<ul style="list-style-type: none"> ● Physical data is predominately consistent
Mississippi	<ul style="list-style-type: none"> ● Offer adapted training to extension agents ● Provide education and outreach on USDM and state processes 	<ul style="list-style-type: none"> ● Creation of the Drought Reporter application ● Set up quality control personnel for the application ● Information is synthesized and imported into an easy-to-use GIS system for editing

	<ul style="list-style-type: none"> ● Limit agents to one picture per report due to bandwidth issues ● Expand app coverage to neighboring states 	
North Carolina	<ul style="list-style-type: none"> ● Encourage reporting in rural areas ● Increase the number of descriptive reports ● Creation of a handbook for agents to utilize in progress 	<ul style="list-style-type: none"> ● Matches USDM indices ● Extension survey helps to fill gaps created by NASS privacy issues ● NCDMAC is organized well ● Project Nighthawk
South Carolina	<ul style="list-style-type: none"> ● Offer training to extension agents ● Provide education and outreach on USDM and state processes 	<ul style="list-style-type: none"> ● Collaboration with neighboring states (GA+NC) ● Contacts within the SC Dept. of Ag send useful information for ground truthing ● Growing interest in reporting stemming from drought events ● Actively promotes reporting tools (DIR, CMOR, CoCoRaHS CM) ● Actively communicates directly to stakeholders and producers via infographic resources ● Hosts a regional drought forum allowing for education from USDM and communication from producers ● Established a robust network of CoCoRaHS reporters through continued outreach, promotion, and incentives
Tennessee	<ul style="list-style-type: none"> ● Establish a formal impact data collection system ● Establish a relationship with extension service and agents ● Integrating CMOR and CoCoRaHS condition reports into a formal process 	<ul style="list-style-type: none"> ● Incorporates data and USDM maps into an archived story map using ArcGIS ● Physical data is predominately consistent
Virginia	<ul style="list-style-type: none"> ● Provide education and outreach on USDM and state processes ● Increase the incorporation of drought impact reports into the process 	<ul style="list-style-type: none"> ● Current VDTF system and communication with directors works well

Table 10 – List of agencies and acronyms

Agency	Acronym
Advanced Hydrologic Prediction Service	AHPS
Community Collaborative Rain, Hail and Snow	CoCoRaHS
Condition Monitoring Observer Reports	CMOR
Department of Environmental Quality	DEQ
Drought Early Warning System	DEWS
Drought Impact Reporter	DIR
Drought Management Advisory Council	DMAC
Drought Monitoring Task Force	DMTF
Environmental Protection Division	EPD
Farm Service Agency	FSA
Geographic information systems	GIS
Integrated Water Portal	IWP
Kentucky Drought Impact Reporter	KDIR
Mississippi State University	MSU
Monitoring and Impacts Group	MIG
Montana Drought Reporter	MDR
National Aeronautics and Space Administration	NASA
National Agricultural Statistics Service	NASS
National Association of State Departments of Agriculture	NASDA
National Drought Mitigation Center	NDMC
National Integrated Drought Information System	NIDIS
National Oceanic and Atmospheric Administration	NOAA
National Weather Service	NWS
Natural Resources Conservation Service	NRCS
North Carolina Cooperative Extension	NCCE
North Carolina Forest Service	NCFS
Short-term Prediction and Transition Center	SPoRT
South Carolina Drought Response Committee	SCDRC
State Climate Office	SCO
Tennessee Drought Management Plan	TDMP
Tennessee State Climate Office	TSCO
United States Department of Agriculture	USDA
United States Drought Monitor	USDM
United States Geological Survey	USGS
Virginia Department of Agriculture and Consumer Services	VDACS