Developing Agricultural Solutions for the Southern Plains: Responding to Climate Change and Resource Constraints

A Research and Extension Roadmap for Agriculture and Forestry

Based on outcomes of the *Resilient Southern Plains Agriculture and Forestry in a Varying and Changing Climate* conference held in El Reno, OK, July 18-19, 2017

Texas A&M AgriLife · USDA United States Department of Agriculture Southern Plains Climate Hub · Kansas State University · Oklahoma State University

Introduction

In July 2017, a conference entitled *Resilient Southern Plains Agriculture and Forestry in a Varying and Changing Climate* was held in El Reno, OK. The goal of the conference was to bring together stakeholders, researchers, and extension faculty to identify regional research and extension priorities and develop a 10-year strategic roadmap for ensuring resilient agricultural and forestry systems in the face of varying and changing climatic patterns. A conference report and accompanying white papers are available at http://twri.tamu.edu/el-reno.

This roadmap, which follows directly from the initial work of the 2017 conference, is targeted at the development of research and extension priorities for agriculture and forestry in the Southern Plains states of Kansas, Oklahoma, and Texas. Production agriculture in the Southern Plains is characterized by both environmental and economic risk, including variations and changes in weather, climate, commodity prices, technological innovations, population growth, water demand, and management practices. It is incumbent upon the region's leading research and extension programs to invest in science and adaptive management efforts, particularly those that are multidisciplinary and systems-based, that can be readily transferred to production agriculture. Questions regarding crop and grazing management choices, changing geographic distribution of agricultural systems, diversification of operations, and risk reduction are examples of those that need to be considered in light of the above risks. This roadmap, and the accompanying foundation laid at the 2017 El Reno conference, will serve as a guide for addressing many of these issues.

Within this roadmap, several foundational considerations serve as a framework for the priorities and recommendations that follow:

- **Minimize redundancy:** Determine research and extension needs not already being done.
- **Be synergistic:** Capture talent across state, federal, private sector, and stakeholder interests in the Southern Plains region.
- **Generate knowledge:** Determine key, unresolved science and management questions.
- **Be inclusive:** Consider the perspectives of farmers, ranchers, CAFOs, and forested landowners by leveraging lessons learned with a common sense approach.
- **Identify ways forward:** Link specific science and services gaps to relevant existing capacity and potential new resources.

Continuing Updates and Modifications

An integral on-going responsibility in developing priorities for research and extension is being acutely aware of evolving situations and issues. This roadmap reflects a snapshot at a specific time, and it can and should continue to evolve as a dynamic regional resource through the following iterative mechanisms:

- **Listen and Observe:** Be aware of discussions within stakeholder groups ranging from farmers to climatologists to gain insight on evolving issues.
- **Evaluate:** Identify those parts of vulnerable agriculture and forestry systems where adaptation is most promising.
- **Relate:** Study operations in other locations with varying and changing economic and natural resource conditions, assess how they adapted, and consider applying those methods to the Southern Plains where possible.
- **Omissions:** Look for knowledge gaps, omissions, and overlooked information that might not be evident with a cursory review but can be valuable in solutions-oriented thinking.
- **Develop:** Implement research to facilitate adaptation for long-term sustainability.
- **Public Trust:** Address issues related to the public trust and goods where possible.
- **Communicate:** Engage a wide spectrum of stakeholders in discussions of changing economic and environmental drivers, vulnerabilities, and possible adaptations, including demonstrations.

Southern Plains Capacity

The Southern Plains region has a strong base from which to address future challenges facing production agriculture, including a wide array of research and extension programs. Furthermore, the region has displayed a strong alliance of partnerships across federal, state, and other organizations to address challenges. Listed in the Appendix is a sample of those with capacity and ability to forge a strong future for the Southern Plains.

General Needs

Some production issues in the Southern Plains cross nearly every agricultural demographic and serve as overall priorities for research and extension programs to consider. These include:

Need: Timely, authoritative, and reliable weather and climate forecasts and tools

Continued improvements in short-, medium-, and long-range forecasts will allow producers and decision-makers to be more proactive to changing environmental conditions. This could include expanding the use of locally based climate monitoring systems (e.g., CoCoRaHS, Mesonet) to more closely examine data from historical records in helping improve the reliability of predictive models. The delivery of forecast information is also critical, such as through a portfolio of social media and electronically based approaches (e.g., apps, blogs) targeted at the next generation of agricultural decision-makers.

Need: Soil health protection, enhancement, and sustainability

Soil is an interdependent environment of organisms serving as a greater whole. Soil health by necessity is a major priority to maintain production capacity for irrigated and dryland crop production, but it is also critically important to grazinglands and forestry. Maintaining or improving soil health requires a long-term planning horizon and a sustainable systems approach. Typically, this is a management requirement, which for crop production involves crop rotations, integrating small grain production with stockers, reductions to no-till practices, use of green manure crops, cover crops, grazing systems to protect the soil resource, and understanding the connection between vegetation management, soil health, and on-farm economics.

Need: Water quality, supply, and sustainability

Water is an integral part of all Southern Plains agriculture production. A major water supply is the Ogallala Aquifer; its depletion is creating long-term viability issues for some agriculture operators and associated rural communities. Water conservation is a broad priority, relating to irrigation as well as dryland crop production, rangelands management, and forestry. A broad suite of new adaptive management measures, such as desalination of brackish groundwater, could potentially and markedly reduce drought risks and improve profitability.

Needs by Topic

The basis for this roadmap is linking gaps to capacity and resources. Partial resource capacity is listed above with gaps and needs identified at the 2017 El Reno conference. The organization of this roadmap is based on four major areas of regional agricultural production:

- Irrigated and Dryland Food and Fiber Production
- Range, Grassland, and Livestock Management
- Forestry and Silviculture Management
- Concentrated Animal Feeding Operations (CAFOs)

The goal is to present a gap or need, along with an opportunity, for each of these topics, taking into consideration anticipated stresses due to limited resources as well as weather and climate risks and changes. Regarding the latter, models and observations suggest an increase in dry periods for this region, which, coupled with high confidence in projected temperature increases, could dramatically increase the demand for water both during drought events and more generally over a longer-term time horizon. This future, challenging scenario for agricultural production due to climate drivers further necessitates a proactive approach to sustaining the future of agriculture and forestry in this region. Additional climate-based considerations include pest factors, such as potential immigration and emigration, survival of pests, overwintering impacts, outbreaks, and even beneficial impacts.

Irrigated and Dryland Food and Fiber Production

The primary focus for research and extension in the Southern Plains related to crop production has been irrigation, including technology, systems, and management. Great strides are evident in irrigated agriculture; the work continues on topics such as drip systems, supplemental irrigation, breeding programs, crop rotations, and striving for drought and pest tolerance. The continuation of this work is essential given projections of highly variable weather patterns and implications of climate change. With stakeholder input collected during and after the 2017 El Reno conference, there were opportunities identified where added emphases in research and extension would be valuable.

Need: Conservation of irrigation water
Although there is a strong program for making the best use of irrigation water, there is room for improvement considering technology and management strategies. This could include improved crop rotations, crop breeding for drought and pest tolerance, and progress with a dashboard concept to aid the producer. One promising area of research is the application of Unmanned Aerial Vehicles with sophisticated sensors providing details of the status of a crop, including origins of stress such as disease, insect pests, or water availability. Two associated challenges will be handling huge data files in a timely manner and providing recommendations to decisions makers.

Need: Dryland crop production
The attention to dryland crop production has not been a high priority in the region. However, there are vast areas currently in dryland crop production with more that will convert from irrigated to dryland in the coming decades. Opportunities in this area range from utilizing new cropping systems including tillage to breeding programs for heat, drought, and pest tolerance.

Need: Transition from irrigated to dryland or rangeland production
Many areas across the Southern Plains that are irrigated from the Ogallala Aquifer will be converting from irrigated to dryland crop production or to grazinglands as the Ogallala becomes more limited. It will be necessary to address both profitable dryland production systems as well as identify optimal path(s) of moving from irrigated to dryland for the Southern Plains to maintain a highly productive agriculture sector.

Need: Integrated crop and animal production systems
Over the past few decades, there has been an integration of grazing with small grain production. This provided some hedge for the producer via initial weight gain of the stockers on the small grain, and then an option for a late decision of taking of the stockers and having a wheat grain crop or actually grazing out the small grain. Economic and weather conditions typically provide a basis for making that decision; considerations of future climate change therefore must be accounted for. There is a need to return to the past with research and demonstration on optional strategies that combine stocker grazing with small grains plantings. Insight is needed on balancing the decision for grain or for graze-out considering prices of beef and grain, weather conditions, and other factors.

Need: Risk management tools
It is well known that agriculture production is a highly risky endeavor due to price fluctuations of inputs and products and threats to yields. Farmers and ranchers continually search for tools to help manage the risk. The

Risk Management Agency (RMA) and Farm Bill insurance programs are great tools to aid agriculture, but there is a need to continue work on strategies for risk management by continuing to review farm programs, implications of alternative choices, and financial options to reduce exposure. It is suggested that RMA availability of training and education funds be accessed in the Southern Plains, a region of major risk for producers.

Range, Grassland, and Livestock Management

The majority of agricultural land in the Southern Plains is pasture, whether native or improved. These lands serve many purposes including grazing for livestock, habitat for a wide variety of flora and fauna, a source of hunting revenue, and a viable ecosystem contributing to carbon capture, water filtration, soil stabilization, and soil health. With such a critical resource covering a major part of the region, there are numerous opportunities to address improvements and to work with ranchers and other resource managers.

Need: Conduct long-term research for long-term results

A major issue among grazinglands stakeholders is a deficit of long-term research to gain insight on how systems perform over time. Too often, the driving force of research and extension is contract-funded programs with a narrow vision and limited time frame. This leaves many unanswered questions and lacks validity as to the long-term consequences. Many critical issues for production agriculture require focusing research teams over several years to reach credible solutions. In addition, administrative commitment to maintaining long-term research capacity is mandatory. Therefore, there is a need to return to the Land Grant philosophy and goal of the Agricultural Research Service to conduct research to gain knowledge and provide sustainable solutions that are time tested. Incorporated into this long-term program would be pasture rotations, goals of soil health (productivity and sustainability), drought management strategies, and similar concepts. Examples include work to identify genetic trait combinations that provide animals with the ability to maintain production under a variety of climatic conditions, and long-term grazing strategy research to discover impacts on components of sustainability.

Need: Address as a holistic/systems approach

An overarching take away from the 2017 El Reno conference was the need to approach research and extension with a systems approach. Grazinglands for the rancher is indeed a system, including the above issues but also integrating the roles of cattle genetics, wildlife, water management, ranch productivity, soil health, grasslands characteristics, and management with livestock stocking and pasture rotations for generations of sustainable production. This is often approached in an agreement with a ranch where science is brought to the rancher, and while observing advances, the rancher learns by trial and error. In this way, there is a blend between what the scientist brings with what the rancher has experienced. This approach can be linked with designed research trials in a fashion to maximize information development. This involves the potential of producing cattle along with sheep or goats and managing for both livestock and wildlife diversification.

Need: Long-term projections of climate change on rangeland resources

To some extent, estimating the impact of climate change or variable weather patterns on grazinglands is an "if-then" approach. This is the place that daily time-step models can be applied to grazinglands with scenarios of alternative weather patterns to project the status of the land under alternative management strategies. Not only is there an opportunity to project impacts on land, there is also an opportunity to be proactive and estimate implications of innovative management strategies on production, wildlife, and economics. Development of valid, relevant, and robust production models will facilitate estimation of impacts and development of strategies to accomplish goals in the face of changing weather patterns.

Need: Development of drought, flood, and wildfire response plans

Across universities, state agencies, and federal agencies, there are detailed response plans for emergencies. The important components of these include surveillance with early warning systems and timing for response depending on the emergency. For livestock systems facing agricultural emergencies such as severe drought, example actions include reducing stocking level, moving livestock, and reducing potential fire threats by managing fuel. It is recommended that these plans be revisited and modified based on recent experiences across the Southern Plains, going from surveillance to tactical science for best management practices based on exposure. Included in such plans would be the necessary effective and timely jobs of restoration along with the roles of the private sector and state and federal governments. For example, this could include identifying integrated grazing management strategies and technologies for restoring drought

damaged rangelands and pasturelands.

Need: Innovative approaches to land fragmentation
There is a strong economic incentive to subdivide large ranch holdings into ranchettes. This reduces large ecosystems to small fenced plots with challenges to diversity and sustainability. Research is needed to determine, by location, the minimum area needed to maintain ecosystem diversity and sustainability. Accompanying this research investment needs to be education for small landholders and new agreements whereby there is sharing across sufficient land area to achieve a sustainable and viable ecosystem. Primary challenges to addressing this need will include securing agreement among multiple landowners and maintaining the economic returns to owners.

Need: Risk management tools for decision-makers
Many of the suggestions made regarding risk management for crop producers are also applicable to grazinglands and livestock production. An opportunity for agriculture also lies in horizontal and vertical integration; although there has been research on implications of integration, there are unknowns related to risks, investments, and operations. Development of models and related management software are key elements to address this need.

Need: Address animal welfare and health
Of special emphasis related to animal health and welfare are issues of pests and disease, and alternative avenues of addressing these challenges. Development of integrated pest management systems to reduce stress to livestock, whether as a nuisance or health threat, provides benefits to the animals and the producers. Often disease is vectored by insects; examples include the cattle fever tick as well as flies and mosquitoes. Other health issues such as the shipping fever complex, tuberculosis, and reproductive diseases including leptospirosis, trichomoniasis, and brucellosis should not be ignored. Issues such as antimicrobial resistance, impact of stress on immune function, and process verification in conventional, natural, and organic beef production systems are also pertinent to this need. Programs of research and extension to discover solutions to these complex issues should be a priority for long-term health of the industry.

Need: Focus on optimal production, not maximum production
Too often in production agriculture, the objective is to maximize production without proper regard for the impact on the resource (e.g. sustainability) or the economic implications. This recommendation suggests evaluating alternative production/sustainable intensification strategies at the ranch level that would not exceed a conservative, long-term carrying capacity of the ranch. Strategies should be identified to enhance lifetime reproductive performance of the breeding herd, such as development of new technologies (for example, neuroendocrine regulation of reproduction), use of more efficient nutritional supplementation, or identifying genetic markers for enhanced productivity.

Need: Role of forages in livestock systems
Across the United States, work on forages has been dramatically reduced compared to previous decades. The Southern Plains incorporates forages into livestock systems management with the approach of "more grass, less gas." There is a need to develop improved cool season forage crop varieties for increased quality of hay and forages and for reduction of grain inputs for finishing traditionally fed beef cattle. Grazing and stocking strategies for integrated rangeland- and forage-based systems that reduce land area required per unit of protein produced should also be identified, although this is a major challenge.

Forestry and Silviculture Management

Climate change is especially challenging to Southern Plains forestry systems due to increasing temperatures and increasingly variable soil moisture. As a result, the risk of catastrophic loss from insects, pathogens, invasive plants, and wildfires is heightened. As climate change progresses towards expected future conditions, proper forestry management becomes an increasing higher priority to sustain wood yields, ecosystem diversity, and resiliency.

Need: Improved monitoring and control of exotic and native invasive species in forested systems
Expectations of greater climate variability creates a need to develop pest control options and prescriptions leading to improved techniques, rates, timing, and chemistry that better control unwanted pests without further stressing crop trees. In addition, new and/or updated tools and techniques to minimize/reduce proliferation of invasive species are needed.

Need: Greater adoption of forest management practices
Tracking performance of forest management for public and private lands under variable climatic conditions to provide improved management opportunities is needed. Baseline stand-level growth models, coupled with general response functions to guide thinning, competing vegetation control, and fertilizer applications are required to provide more accurate estimates of plantation forestry productivity for varying levels of management.

Need: Models of carbon and nitrogen pools
There is a need to quantify above- and below-ground carbon and nitrogen pools and fluxes, along with key biological and ecological modeling parameters, which vary with climate, soils, stand development, and management factors. Forestry is a major sink for carbon and contributes to mitigating climate change, suggesting an analysis of management strategies for maximum effectiveness would be helpful.

Need: Seed source
The best seed source for major timber-producing species, one that will be most effective in resisting the impacts of climate change and variability while contributing to positive ecosystem benefits as well as economic value, should be identified.

Need: Greater hardwood forests management resources
Development of additional knowledge and management strategies dealing with climate change and associated impacts on species suitability, growth, survivability, and wildlife outputs related to hardwood forests are needed. These will provide higher ecosystem service values in this region.

Need: Markets for forest ecosystem services
It is common to overlook the contributions of forest systems on water quality, water supply, soil health, air filtration, biodiversity, and carbon sequestration. Many of these services are non-marketed but exceptionally valuable to society. To justify forestland management, a scientific estimate of the value of forests to the different components is highly warranted.

Need: Programs to incentivize small parcel landowners
Similar to rangelands, the forests of the Southern Plains are being divided into increasingly smaller parcels. Due to economy of scale limitations with current service providers, implementing the appropriate silvicultural treatment on these small tracts is increasingly problematic. There is urgency to estimate the impact of small parcels on the viability and contribution of forests, and in turn develop aggregation and incentivizing community management programs that protect forests and their societal value.

Need: Policy review
Management of forest activities is highly dependent on rules and regulations. A grass roots review of policies and associated incentives and disincentives is needed to identify antagonistic rules causing unintended consequences.

Need: Marketing
Timber products have value both environmentally and economically. Since the vast majority of forestland in the region is privately owned, economically strong markets for wood fiber are often required to drive appropriate forest management activities. A need exists to expand existing and develop new, high value-added markets both locally and globally.

Concentrated Animal Feeding Operations (CAFOs)

Concentrated animal feeding operations (CAFOs) serve as a vital business model for animal protein production as well as dairy products in the United States. Due to the concentration of animals within certain regions in the Southern Plains, steps to address long-term, economical production inputs is essential in the presence of future altered weather patterns. Efforts emphasizing 1) water resource conservation and 2) more efficient use of on-farm and related cropping systems supporting feed needs must be advanced for the long-term viability of livestock operations in the Southern Plains.

Need: Facility structure designs
Appropriate structural design of CAFOs (beef and dairy) has been an important part of the overall business system for decades. It is important that future designs take into account the potential for a changing climate with the goal to reduce weather-related stress on the animal. This means cooling in the summers, particularly in the southern part of the region, and warmth in the winter. There is a tendency to take a successful design and continue to duplicate it without considering a longer-term view. For feedlots, dairies, and other CAFOs, there is an opportunity to rethink the design of facilities for improved efficiency and animal comfort. An evolving technology that holds significant promise is robotics, as a part of the facility that impacts efficiency and labor needs directly.

Need: Cooling and dust control
For cooling and dust control, an appropriate facility design can play a major beneficial role. However, additional management strategies for animals and handling dust generation is needed in addition to facility design. These can be considered elements of an integrated system addressing optimal facility design as well as management strategies for animal comfort and environmental stewardship.

Need: Sustainable feed/forages for CAFOs
There is confidence that CAFOs will continue within the Southern Plains. However, an issue is the continued decline of the Ogallala Aquifer and production of feed resources such as silage and feed grains. Feed grains are less of an issue than silage, since they can be transported more economically to CAFOs. Silage is a higher moisture feed that requires production in close proximity to a CAFO. This suggests a far-reaching program in feed

grains and especially silage with the goal of enhancing sustainable dryland production. This will include genetics/breeding advancements as well as advanced techniques such as CRISPR (a family of DNA sequences in bacteria) and gene editing to achieve drought and heat tolerance.

Need: Application of animal genetics and nutrition
This is related to the above need but expanded to include a goal of reduced time on feed and improved health. Selection of animals for heat tolerance that can efficiently grow and be less susceptible to disease in future environments is a critical long-term need.

Need: Pest management
Whenever there are animals in a relatively confined area, there will be pests. The decrease in animal comfort and performance from biting could become worse with changing climate conditions. In addition, pests are vectors of certain disease transmissions that threaten the economics of the overall operation. Insight into management practices that reduce the attractive environment for pests would be an appropriate first step; subsequent steps would include effective, environmentally sound, and cost-efficient treatment strategies with animal wellbeing at the forefront.

Need: Energy and water conservation
As part of the facilities structure design considerations, it is critical to include implications for energy and water use. Innovative facility designs and associated management practices for efficient water use, collection, and reuse are a priority. Energy conservation requires an annual approach regarding the balancing of summer cooling and winter heating needs. Careful design of facilities can best address maintenance of temperature conditions even in a changing climate.

Need: Animal Health
All facets of CAFO facilities and management reflect on animal health. Of special concern with many animals in a confined area is the potential of foreign animal diseases, foot and mouth disease, reproductive diseases, wildlife vectored diseases, ticks, antimicrobial resistance, and a host of other potential impacts. An example solution for protection of animals in the Southern Plains is eradication of the cattle fever tick; this may involve a vaccine requiring associated research investments. More generally, there is a need for sensors for early diagnosis of animal illnesses.

Need: Waste Management
CAFO waste management with an increasingly greater density of animals creates both a challenge as well as an opportunity. This is a region with a comparative advantage for CAFOs due to an accommodating climate and large, open spaces. At the same time, there is an issue with over-application of nutrient-bearing manure. Effective disposal strategies are needed whereby land is fertilized appropriately, thus benefiting crop production while minimizing odor and reducing nitrogen loss.

Need: Preharvest food safety
Postharvest food safety is often a major focus, but it is also important to emphasize opportunities related to preharvest management and technology strategies for food and dairy product safety. These include appropriate animal handling, feeding, and caring from birth to harvesting, and consider such factors as minimum animal stress at all phases and appropriate nutrition. Preharvest food safety management is also linked to improved consumer acceptance.

Need: Policy issues
There are regulations in all phases of animal production that impact management and cost of production. For example, environmental regulations and standards impact manure storage and land application, while transportation regulations impact loading and unloading of animals and length of time on the road. Working with the federal and state environmental agencies to develop sustainable methods and management practices would be of great benefit to CAFOs and touch on many of the points above. One need is to review and estimate the value of selected regulations by developing potential language adjustments. In addition, international trade is critically important, suggesting a need to be involved in agreements and policies on that scale as well.

Need: Consumer perception and marketing education
The animal industry is committed to marketing and addressing consumer perception of meat products. There is a strong role for universities and federal agencies in providing a third person approach to identifying health benefits of products, further improving quality, as well as demonstrating industry acceptance of animal welfare strategies. Protein is essential for human nutrition, but there is a misconception by a segment of consumers on how CAFOs negatively impact animal welfare and the environment. Further efforts to educate consumers on the real world benefits of CAFOs as a means to produce safe, wholesome food is needed now and in the future.

Appendix

Southern Plains Research and Extension Capacity

Universities

- Land Grant Universities
- Non-Land Grant Universities
- Agricultural Experiment Stations
- Agricultural Extension Services
- Water Resource Centers/Institutes
- Community Colleges

Federal Agencies

- U.S. Department of Agriculture
    - Agricultural Research Service (including Climate Hub)
    - Agriculture and Food Research Initiative/National Institute of Food and Agriculture
    - Natural Resources Conservation Service
    - Foundation for Food and Agriculture Research
- National Science Foundation
- U.S. Department of Energy
- U.S. Department of Transportation
- U.S. Geological Service
- U.S. Environmental Protection Agency
- Others as applicable

Foundations and Nongovernmental Organizations

- Center for Climate and Energy Solutions
- Noble Foundation
- The Nature Conservancy

Other

- Oklahoma Established Program to Stimulate Competitive Research (EPSCoR)
- Water conservation districts
- Cooperative producer researcher demonstrations

State Agencies, Commissions, and Organizations

Kansas Natural Resource Agencies

- Kansas Department of Agriculture
  - Kansas Division of Conservation
- Kansas Department of Health and Environment
- Kansas Water Office
- Kansas Forest Service

Kansas Commodity Associations and Organizations

- Kansas Corn Commission
- Kansas Corn Growers Association
- Kansas Wheat Commission
- Kansas Association of Wheat Growers
- Kansas Grain Sorghum Producers' Association
- Kansas Grain Sorghum Commission
- Kansas Livestock Association
- Kansas Farm Bureau
- Kansas Feed and Grain
- Kansas Farmers Union
- Kansas Pork Producers Council
- Groundwater Management Districts 1, 2, 3, 4, 5
- Kansas Water Authority

Oklahoma Natural Resource Agencies

- Oklahoma Department of Environmental Quality
- Oklahoma Department of Wildlife Conservation
- Oklahoma Water Resources Board
- Oklahoma Tourism and Recreation Department
- Oklahoma Department of Agriculture, Food and Forestry
- Oklahoma Conservation Commission

Oklahoma Commodity Associations and Organizations

- Oklahoma Oilseed Commission
- Oklahoma Forestry Services
- Oklahoma Wheat Commission
- Oklahoma Sorghum Association
- Oklahoma Pecan Growers Association
- Oklahoma Cattlemen's Association
- Oklahoma Farm Bureau
- Oklahoma Farmers Union
- Oklahoma Pork Council
- Oklahoma Panhandle Agriculture and Irrigation Association
- Lugert-Altus Irrigation District
- Native American tribes

Texas Natural Resource Agencies

- Public Utility Commission of Texas
- Railroad Commission of Texas
- Texas Department of Agriculture
- Texas Water Development Board
- Texas Commission on Environmental Quality
- Texas A&M Forest Service
- Texas State Soil and Water Conservation Board
- Texas General Land Office
- Texas Parks and Wildlife Department
- Texas Department of State Health Services

Texas Commodity Associations and Organizations

- Groundwater conservation districts
- Independent Cattlemen's Association of Texas
- Plains Cotton Growers
- Edwards Aquifer Authority
- Texas and Southwest Cattle Raisers
- Texas Beef Cattle Association
- Texas Grassfed Association
- Texas Beef Council
- Texas Cattle Feeders Association
- Texas Sheep and Goat Raisers Association
- Texas Wheat Growers Association
- Texas Corn Producers
- Texas Sorghum Association
- Texas Peanut Producers
- Texas Association of Dairymen
- Texas Pork Producers
- Texas Forestry Association
- Texas Farm Bureau
- Texas Wildlife Association
- Texas Nature Conservancy
- Texas Rural Water Association
- Texas Conservancy Alliance
- Texas river authorities