



**Project Plan from
FY2016
(Fiscal Years 2016-2017)**

Research Priority Area: 2016 Sub-Objective 1

1) Title: Irrigation Efficiency Game Changer: Celebrating 40 Years of Center Pivot Irrigation Research and Technology Transfer

2) Investigator(s) on the research team and their institutional affiliation:

Co-PD: Dana Porter, Texas A&M AgriLife Research and Extension, Lubbock

Co-PD: Freddie Lamm, Kansas State University, Colby

PIs: Susan O'Shaughnessy, USDA-ARS, Bushland

Paul Colaizzi, USDA-ARS, Bushland

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Jim Bordovsky, Texas A&M AgriLife Research, Lubbock/Halfway

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3) Summary/abstract

Low pressure center pivot sprinkler (CP) and lateral move sprinkler (LMS) irrigation systems have been widely adopted in the Ogallala Aquifer (Central and Southern High Plains) region, greatly improving achievable irrigation application efficiencies and crop water use efficiencies on a very large scale throughout the region. From early work on development of Low Energy Precision Application (LEPA) that began in 1978 and later Low Elevation Spray Application (LESA) irrigation and Mid Elevation Spray Application (MESA) to the integrated sensor/control systems mounted on CP and LMS systems, OAP affiliated programs have made important contributions to the advancement of low pressure sprinkler application systems. This project will support a large technology transfer effort beginning in 2017 and an increased effort in 2018 focused on the 40-year anniversary of LEPA and succeeding in-canopy technologies. The overall purpose of the project will be to promote adoption of advanced efficient irrigation technologies and recommended practices that will maximize benefits of these CP and LMS systems. It will highlight historic achievements that have greatly improved irrigated crop production while improving water applications and showcase promising emerging technologies associated with the "center pivot platform". An additional outcome will be a working retreat including sprinkler irrigation engineers and scientists to be held in conjunction with the regional 2017 High Plains Irrigation Conference in Amarillo, Texas with the purpose of brainstorming new research and extension activities for CP and LMS systems. Overall project focal-point public events in 2018 will be regional field days that will be conducted at Bushland, Texas and Garden City, Kansas to present the information about sprinkler irrigation. Additional

smaller focused efforts will be added to other regularly scheduled general field days at the various locations. Special technical sessions on sprinkler irrigation technologies will be proposed and coordinated by the PIs for annual international conferences of ASABE, ASA-SSSA-CSA and the IA for 2018. A logo will be developed early on to brand all the activities. As this project will address a critical technology transfer need in its entirety, a separate comprehensive economic assessment is not warranted; economic assessments (determined and reported in related projects) of technologies and recommendations will be presented as appropriate in deliverables of this project.

4) Project narrative

a) Objective(s)

The overall goal of this project is to promote high efficiency low pressure center pivot irrigation through a series of high-visibility public field days in Kansas and Texas and nationally and internationally through publications and technical sessions at professional societies. The specific objectives are:

1. Develop summary publications on sprinkler irrigation technologies suitable for public distribution and also at least one summary publication (review) suitable to scientific community.
2. Conduct a working retreat of engineers and scientists to brainstorm new opportunities for research and extension concerning sprinkler irrigation.
3. Highlight and celebrate sprinkler irrigation research and extension accomplishments of the last 40 years and showcase emerging technologies.

This project primarily will address the OAP sub-objective 1) develop and evaluate water management strategies and technologies that could reduce water withdrawals for irrigation by 20% in 2020 compared to 2012, while maintaining and/or enhancing the economic viability of the agriculture industry and the vitality of the Southern Ogallala Aquifer Region. While the project will not develop new strategies and technologies, it will promote technologies and strategies recently developed, adapted, and evaluated by OAP affiliated programs and with OAP sponsored projects. It will show producers and other decision makers that past research and extension have improved irrigated crop water use efficiency and water application and suggest that further improvements are clearly on the way to fruition. The goal to maximize impact of the OAP program will be supported through promotion of appropriate technologies and BMPs. Target audiences will include agricultural producers, landowners, irrigation professionals, crop consultants and other technical service providers and decision makers.

b) Rationale/Literature Review/ Conceptual framework

The Kansas and Texas High Plains / Southern Ogallala Aquifer Region are noted for limited and declining groundwater resources (Konikow, 2013) and relatively high rate of adoption of efficient advanced irrigation technologies (Wagner, 2012; Colaizzi, et al., 2009). One of the earliest advanced sprinkler irrigation technologies, Low Energy Precision Application (LEPA), was first researched in the OAP region near Halfway, Texas by William Lyle and James Bordovsky beginning in 1978. Low pressure center pivot irrigation, including LEPA, Low Elevation Spray Application (LESA), Mid-Elevation Spray Application (MESA), and other variations have become the most widely practiced irrigation methods in the region

(Colaizzi, et al., 2009). This is due in large part to the suitability of the technologies to the crop production systems in the region; relevant applied research programs; collaborations among research and extension programs and with industry; effectiveness of cost-share programs, and the willingness of agricultural producers in the region to adopt technologies and BMPs to adapt to limited water conditions (Wagner, 2012).

While low pressure center pivot irrigation is widely practiced in the region, applied research continues to refine recommendations, so these events will provide opportunities for end-users to hear up-to-date recommendations to aid in their irrigation decisions. There is much less understanding by “non-practitioner audiences” (landlords, ag lenders, crop insurance agents, policy makers), so these events will help to improve their understanding of the state of the art, considerations for irrigation management, and appreciation for the advances in agricultural irrigation technology, management and efficiency. The technology transfer effort also will facilitate collaboration of engineers and scientists to synthesize “what we know” into more accessible publications and media and provide a venue to brainstorm additional improvements to systems and technologies.

c) How the objective will be met

The project can be envisioned as occurring in two phases, 1) planning, document preparation and scientist-to-scientist exchanges in 2017, and 2) celebration of historical improvements, promotion of current technologies and illustration of future technologies in 2018 through public events and professional society technical sessions.

In Phase 1, PIs will develop summary publications suitable for distribution to irrigators and the general public highlighting the successes of the last 40 years, the current BMPs and a projection of future technologies. The summarization process will also generate one or more technical review journal articles. Planning for the 2018 public and professional scientific events will also take place. In addition a scientific retreat will be held in conjunction with the regional High Plains Irrigation Conference in Amarillo, Texas to brainstorm future cooperative sprinkler irrigation research and extension activities. In phase 1, we will also develop an appropriate logo for promotion and inclusion in all of the activities of the proposed plan. This will help us to demonstrate continuity of long term research and extension efforts as well as provide a visible connection to extend the plan and impact beyond the life of the project.

The second phase will be met through a series of at least two public field days, to be held at USDA-ARS Conservation and Production Research Laboratory and Texas A&M AgriLife at Bushland, Texas and Kansas State University Research-Extension Center at Garden City, Kansas. The field days will provide overviews of the history of center pivot irrigation and associated research in the High Plains; updates on the state of the art in center pivot irrigation; summaries of research accomplishments and ongoing research and extension efforts of OAP affiliated research programs; and helpful information about applicability of specific technologies and BMP recommendations (valuable take-home messages) for audiences.

The public events will be promoted through local and regional mass media outlets; OAP, Kansas State and AgriLife media teams; social media outlets; trade associations, and other

means. Special effort will be directed toward involving local television stations, groundwater conservation districts/ groundwater management districts, regional/national trade journals and media outlets to maximize public exposure to the information. Special invitations will be extended to agricultural organizations (commodity groups, etc.), vocational agriculture teachers, crop insurance providers, agricultural lending professionals, policy makers and other audiences to help draw emerging audiences in addition to our traditional field day audiences.

The field days will include special presentations; posters and demonstrations; and “hands on” activities, as well as trailer/bus rides to research sites. Informal communication between researchers and audience members will be encouraged through site layout (traffic pattern) of the poster/exhibit area; refreshment breaks; and a noon meal. Higher level engagement of the audiences through different communication formats is expected to increase effectiveness and impact of the event. Additional smaller focused efforts will be added to other regularly scheduled general field days.

In addition to the public events in 2018, the PIs will propose and coordinate technical sessions on sprinkler irrigation from the OAP at international meetings of appropriate professional societies (ASABE, ASA-SSSA-CSA and IA).

Activities	Year 1				Year 2			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Conduct field research at the tour locations (funded by other projects)								
Catalog highlights (history, research results, recent and ongoing studies, commercial developments, state of the art of center pivots)								
Scientific retreat to plan / coordinate research and extension activities; develop logo for promotional / packaging efforts								
Plan subject matter for tours; select tour dates; identify and invite speakers								
Invite special guests, media; develop promotional materials; make local facility and refreshment/meal arrangements; begin promoting events								
Promote and conduct the field days								
Reporting, presentations, publish results								
Technical Sessions at regional, national and international conferences								

d) Expected outcomes including publications, economic assessments and technology transfer activities.

Summary publications suitable for public distribution will be developed. The summarization process will also produce one or more technical reviews related to sprinkler irrigation. A number of proceeding papers will be developed for the professional society technical sessions.

Expected outcomes will also include greater public awareness of OAP affiliated research programs; increased appreciation for the nature and level of collaboration among OAP affiliated researchers and institutions; better public understanding of the state of the art of agricultural irrigation; improved practitioner knowledge of technical subject matter; and improved awareness of information available for decision makers (producers, ag lenders, landowners, policy makers). It is anticipated that one value of the historical celebrations will be to illustrate the long term nature of research and extension efforts culminating in significant on-farm crop production improvements. Quality improvement instruments will be used to assess effectiveness of the events for communicating the intended messages with the target audiences.

5) Relevant publications

- Bordovsky, James P, Joseph T Mustian, Glen L. Ritchie, Katie L. Lewis. 2015. Cotton irrigation timing with variable seasonal irrigation capacities in the Texas South Plains. *Applied Engineering in Agriculture*. 31(6): 883-897. (doi: 10.13031/aea.31.10953).
- Kisekka, Isaya, Jonathan P. Aguilar, Danny H. Rogers, Johnathon Holman, Dan M. O'Brien, Norman Klocke. 2016. Assessing deficit irrigation strategies for corn using simulation. *Transactions of the ASABE*. 59(1): 303-317. (doi: 10.13031/trans.59.11206) @2016
- Kranz, W.L., R. G. Evans, F. R. Lamm, S. A. O'Shaughnessy, R. T. Peters. 2012. A review of mechanical move sprinkler irrigation control technologies. *Applied Engineering in Agriculture*. Vol. 28(3): 389-397.
- Lamm, F.R., K.C. Stone, M.D. Dukes, T.A. Howell, Sr., J.W.D. Robbins, Jr., B. Q. Mecham. 2016. Emerging technologies for sustainable irrigation: selected papers from the 2015 ASABE and IA Irrigation Symposium. *Transactions of the ASABE*. Vol. 59(1): 155-161 2016 American Society of Agricultural and Biological Engineers ISSN 2151-0032 DOI 10.13031/trans.59.11706
- Porter, Dana, Dan Rogers, Thomas Marek, Freddie Lamm, Terry Howell, Mahbub Alam, Norm Klocke. 2010. Technology transfer: promoting irrigation progress and Best Management Practices. *Invited paper*. ASABE Paper No. IRR10-9641. Proceedings of the 5th Decennial Irrigation Symposium, The Irrigation Association and American Society of Agricultural and Biological Engineers, Phoenix, AZ. December 4-8, 2010.
- Colaizzi, Paul D., Steven R Evett, Terry A Howell, R Louis Baumhardt. 2010. Crop production comparison with spray, LEPA, and subsurface drip irrigation in the Texas High Plains. 5th National Decennial Irrigation Conference Proceedings, 5-8 December 2010, Phoenix Convention Center, Phoenix, Arizona USA IRR10-9704.(doi:10.13031/2013.35818).
- Colaizzi, P.D., P. Gowda, T.H. Marek, and D.O. Porter. 2009. Irrigation in the Texas High Plains: A brief history and potential reductions in demand. *Journal of Irrigation and Drainage*. 58(3):257-274.
- Porter, Dana and Thomas Marek. 2009. Center Pivot Irrigation and Soil Moisture Management. Proceedings of the 21st Annual Central Plains Irrigation Conference, Colby, KS. 02/24/09 – 02/25/09.

O'Shaughnessy, S.A., S.R. Evett, A. Andrade, F. Workneh, J.A. Price and C.M. Rush. 2016. Site-Specific Variable Rate Irrigation as a Means to Enhance Water Use Efficiency. *Trans. ASABE* 59(1):239-249. DOI 10.13031/trans.59.11165

6) Resources and Budget

a) Resource and budget narrative.

Funds are requested for summarizing and preparing the summary publications and for planning and conducting the public and scientific-exchange events. Funds will be used for the following categories:

- Synthesizing sprinkler irrigation results and document preparation
- Subsidized travel for other select U.S. sprinkler irrigation engineers and scientists to scientific retreat at regional irrigation meeting.
- Student labor to assist PIs in achieving objectives of plan.
- Travel for Kansas collaborators to attend the Bushland event and for Texas collaborators to attend the Garden City event.
- Travel for collaborators to present results at a regional meeting.
- Non-alcoholic refreshments, snacks and a light meal for each event.
- Rental of portable restroom facilities, seating, trailers/buses for tours, poster frames, exhibit tables, sound equipment, etc. as needed.
- Advertising, mail-outs, promotional materials and promotional items, handout materials for events.
- Printing of posters, purchase of materials to set up demonstrations, reproduction costs.
- Vehicle mileage, communications, and other "other direct" costs.

Sponsorships from trade associations, groundwater management districts and/or agribusiness will be sought to upgrade refreshments, noon meal, and/or local meeting accommodations (better rented restrooms and buses). The effort will summarize and synthesize some research efforts going back nearly 40 years, so there will be a large leveraging of past pre-OAP efforts in this technology transfer effort. Ongoing OAP funded projects will be highlighted; hence this technology transfer project also will leverage existing research projects (at Bushland, Garden City and other locations – Lubbock, Halfway, Colby, Manhattan...) and enhance ongoing technology transfer projects.

7) Literature Cited / References

- Colaizzi, P.D., P. Gowda, T.H. Marek, and D.O. Porter. 2009. Irrigation in the Texas High Plains: A brief history and potential reductions in demand. *Journal of Irrigation and Drainage*. 58(3):257-274.
- Wagner, Kevin. 2013. Status and Trends of Irrigated Agriculture in Texas. Special report EM-115 by the Texas Water Resources Institute. Texas A&M University System, College Station.
- Konikow, L.F., 2013, Groundwater depletion in the United States (1900–2008): U.S. Geological Survey Scientific Investigations Report 2013–5079, 63 p., <http://pubs.usgs.gov/sir/2013/5079>.