Water Conservation and Efficiency Committee DRAFT 2022 Recommendation

Pilot Program: Michigan Agricultural Irrigation Water and Energy Efficiency Program

Synopsis: Irrigation plays an important role in Michigan agriculture, supporting various crops such as corn, soybean, potato, fruits, vegetables, and orchards. High-value crops including potatoes, vegetables, fruits, and seed crops, are almost 100 percent produced under irrigation and require an irrigation system upon contract (MSUE, 2014). Large buyers require these crops to be grown on irrigated land as part of their risk management process to ensure that the crop will not be compromised due to drought. In 2019, Michigan produced $579M in fruit, nut, and vegetable crops (Fruit Growers News, 2021). Agricultural irrigation accounted for 39% of Michigan's consumptive water use (EGLE, 2017), with 125 billion gallons of water withdrawn in 2020 (Eaton, 2021).

There are over 8,000 center pivot irrigation systems in Michigan, and at least one-third of the center pivots are more than 20 years old (calculation based on USDA survey from 2000 and 2018). About 10% of irrigation systems still use high-pressure sprinkler packages, which are not as energy efficient as low-pressure sprinkler packages (USDA, 2018). A preliminary study conducted in 2022 by MSU Irrigation group, shows replacing older sprinkler packages (7-year-old) with new sprinkler package saved an average of 0.2 inch for each inch applied due to improved uniformity. Assuming annual average irrigation application in corn and soybean production is 6 inches, it means that it can save approximately 1.2 inches of water per year in corn and soybean fields. Therefore, 3.2 MG could be saved on 100 acre-size irrigated field per year.

There is a need to increase education and awareness among producers and irrigation suppliers of the needs for repair, maintenance, and replacement of the center pivot irrigation system as well as, irrigation scheduling for uniformity. There is also a need for increased capacity and dedicated technical staff to do the literature review, conduct system evaluation and retrofit, analyze the results to improve agricultural irrigation efficiency and make potential recommendations for the irrigation industry including improvements in distribution uniformity and detailed recommendations for distribution and maintenance of center pivot irrigation system.

In addition to contributions to advancements in water conservation through equipment upgrades, maintenance, and advancements in scheduling, there are energy savings benefits as well. Water and energy are interlinked with 95% of the energy consumed on irrigated farms coming from the use of irrigation pumps (Ciolkosz and Go, 2022). More than 2,000 irrigation systems are powered by diesel engines, which are less energy-efficient and produce more greenhouse gas emissions than electric engines (USDA, 2018). Additionally, the energy consumption of center pivot systems, which accounts for approximately 90% of Michigan's irrigation system (USDA, 2018), is estimated at 3.7 million MWh/year, contributing to 4% of Michigan's total energy consumption (US Energy Information Administration, 2021).

Significant federal funding is available to advance clean energy solutions and address climate change. The Michigan Department of Environment, Great Lakes, and Energy (EGLE) Pollution Prevention Unit, through its Cleaner Fuels Program funded by the Diesel Emissions Reduction Act (DERA), will also be offering grants in FY23 for agricultural irrigation pump diesel engine replacement with electric equipment. Therefore, leveraging investments in new energy savings programs targeting agriculture

irrigation systems with the creation of new programs to evaluate and retrofit existing irrigation systems can provide even greater benefits toward improving irrigation water use efficiency overall and will also provide additional benefits by increasing energy efficiency, reducing greenhouse gas emissions, and ultimately contributing to the state's carbon-neutral goal by 2050.

Recommended Action: The Water Conservation and Efficiency Committee recommends developing Michigan Agricultural Irrigation Water and Energy Efficiency Program as a pilot program to evaluate and retrofit existing irrigation systems to improve water and energy efficiency. The goal of this pilot program is to expand and improve implementation of recommendations within the Irrigation Water Use Generally Accepted Agricultural and Management Practices (GAAMPs) through on-farm demonstrations, including evaluating and retrofitting the existing irrigation systems, measuring the improved water, energy use, and crop yield efficiency, and estimating the potential reduction of GHG emission and cost savings. This program entails assessing and retrofitting at least 10 center pivot irrigation systems per year. Each pivot will be measured before and after retrofits to measure improvements. Yield data will be annually evaluated to evaluate impacts on crops to demonstrate to growers that there is also no negative impact on yield. This program will help expand the implementation and continual improvement of recommendations within Irrigation Water Use GAAMPs, Michigan Agriculture Environmental Assurance Program (MAEAP), and irrigation outreach programs.

Possible retrofits or upgrades to the irrigation systems include, but are not limited to:

1) Replace high pressure with low-pressure sprinkler packages to reduce wind drift and increase uniformity.
2) Upgrade the existing sprinkler packages (e.g., over 7-year-old) to improved and more efficient sprinkler packages.
3) Repair any leaks in the system.
4) Investigate options to improve energy efficiency (e.g., installing a Variable Frequency Drive, converting diesel to electric power for irrigation pump, etc.).
5) Explore the improved design options for irrigation systems and specific crop types.

This pilot program will also include irrigation scheduling to improve farmer's irrigation practice during the growing season. Soil moisture sensors will be installed in the participant farmer's field to track the soil moisture levels and provide irrigation recommendations. Improvements in water and energy use efficiency and greenhouse gas reductions will be estimated throughout the project. Moreover, this new initiative should inspect irrigation systems to ensure proper installation, operating safety and provide safety training.

At the end of the pilot program, the WUAC Water Conservation and Efficiency Committee will evaluate the pilot program's outcomes and determine next steps to expand the program to reach the entire industry.

Implementing Organization: Michigan State University Extension (MSUE) would be the primary organization responsible for pilot program implementation. This pilot program is an ideal fit within MSUE's mission of bringing educational programs directly to individuals, communities, and businesses. MSUE operates numerous programs that complement this pilot program on irrigation, such as programs

in agricultural bioenergy and energy conservation, water management and soil health. MSUE can build on its presence in all Michigan counties, recognition among the agricultural community and extensive experience delivering educational programs in the agricultural field in Michigan to make the pilot program successful. EGLE would use existing contractual agreements between EGLE and MSUE or between MDARD and MSUE to award funding to MSUE to support the pilot program.

Cost Analysis: Requesting a total of $600,027 to cover the costs of one FTE position, part-time assistants, equipment, and supplies to implement the pilot program.

Budget	Year 1	Year 2	Year 3	Total
A. Salary and Fringe				
A1) Research Assistant[1]	$77,000	$79,310	$81,689	$237,999
A2) Undergraduate Students	$9,645	$9,935	$10,233	$29,813
B. Equipment/Materials/Supplies				
B1) Irrigation Mobile Lab[2]	$50,000			$50,000
C. Travel				
C1) Domestic Travel	$2,800	$2,800	$2,800	$8,400
D. Other Costs				
D1) Retrofit Cost-Share Program[3]	$50,000	$50,000	$50,000	$150,000
Total Direct Cost	$189,445	$142,045	$144,722	$476,212
Indirect Cost (26%)	$49,256	$36,932	$37,628	$123,815
TOTAL	$238,701	$178,977	$182,350	$600,027

[1] One FTE research assistant and hourly undergraduate students are requested. The research assistant is responsible for coordinating the meetings, evaluating the irrigation systems, preparing reports for the pilot program and promoting the pilot program to stakeholders.
[2] The fund for developing an Irrigation Mobile Lab is requested. This includes purchasing a trailer, ultrasonic flow meters, catch cans, pressure gauges, measuring devices, water quality analysis materials, and sensor monitoring systems for measuring water pressure, soil moisture levels, and environmental conditions.
[3] The retrofit cost-share program will cover up to $5,000 per participant. The average cost to replace the sprinkler packages of a center pivot irrigation system is approximately $3,500 (parts only). Labor costs are separate. The irrigation safety inspection cost is around $300. In addition, there might be some other retrofit costs (e.g., end gun, repairing joints, etc.)

If the retrofit costs more than 5k, we will leverage other cost-share programs, such as USDA EQIP and Consumer Energy Program to bring additional funds. In addition, an Agricultural Economist from MSU will estimate the potential economic (payback) and environmental benefits of the retrofits.

Timeframe: Three years to develop, implement, and evaluate the pilot program.

Legislative changes: None

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