PLANTS | WATER MANAGEMENT

Center Pivot Irrigation

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SECTIONS

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INTRODUCTION

One of the most important aspects of crop production is ensuring that water is available when crops need it most. Since rainfall can be unpredictable, planning for irrigation is a smart step to help protect your crops and yields. In Michigan, center pivot irrigation systems are the most commonly used method, covering about 76% of all irrigated farmland, according to the **USDA NASS, 2022 Census of Agriculture**.

Center pivots are popular because they can water large areas efficiently and require less labor and setup than systems like drip irrigation. When properly managed, they can reach 75–85% water application efficiency. This type of system works especially well for field crops and some vegetables, such as potatoes and carrots. In addition to watering crops, center pivots can also be used for fertigation, a method of applying fertilizer through the irrigation water.

How to Get Started

Center pivot irrigation is a significant investment that requires careful planning to avoid costly mistakes in the future. Before moving forward, start by asking yourself: What is my primary reason for irrigating? Ideally, the goal should be to increase net farm income compared to dryland production, especially if you're growing high-value specialty crops.

A well-planned irrigation system can provide a good return on investment, but only if it’s designed and managed correctly. If you’re confident in your decision to irrigate, the next step is to carefully consider several key factors in the planning process.

SECTION 1

IRRIGATION PLANNING

A reliable water supply is the foundation of any irrigation system. It's essential to consider irrigation water requirements, identify available water sources, and understand regulations and registration processes before getting started.

Primary Considerations

Irrigation Water Requirements

The first question to ask is: **Is there enough water available to meet your crop's irrigation needs?** In Michigan, peak crop water use driven by evapotranspiration can range from 0.25 to 0.30 inches per day for several days during the summer. To meet a 0.25-inch/day water demand, your system must deliver at least 5 gallons per minute per acre (gpm/acre). For 0.30-inch/day, you'll need around 7 gpm/acre. Reaching this level of supply often requires continuous pumping 24 hours a day, 7 days a week during drought conditions.

Ground Water Availability:

Irrigation cannot be profitable without a reliable and adequate water source. Nearby large volume irrigation, municipal or industrial wells are an excellent source of water availability. Local well drillers with experience in high-capacity wells are also valuable resources, they can provide insight into groundwater depth, yield, and quality in your specific location. Additionally, Michigan offers tools that can help evaluate potential water withdrawal sites before investing in a system.

Surface Water Availability:

If you're considering using surface water for irrigation, it's important to ask: Is there a reliable and sufficient supply available during peak demand? In Michigan, maximum irrigation needs typically occur in late July through early August, which is also when surface water levels are at their lowest. To avoid running short, you should evaluate stream or pond flow during the summer before you plan to begin irrigating. In most areas, you are not allowed to reduce stream flow to the point where it harms neighboring users or the environment. For example, water from state drainage ditches may already be allocated or insufficient during dry periods. Additionally, be aware of food safety concerns. Surface water sources can be vulnerable to contamination, especially when used for irrigating or cooling vegetables or other food crops.

Water Quality:

Both groundwater and surface water should be tested for water chemistry to ensure they are suitable for agricultural use. It's also important to consider food safety, especially when using surface water, which is more prone to contamination and poses risks when applied to vegetables or other food crops for irrigation or cooling. Additionally, water high in minerals can lead to clogging in drip and sprinkler systems, reducing their efficiency and lifespan.

Water Rights and Regulation:

Before installing an irrigation system, it's essential to understand your rights and responsibilities regarding water use in your state. For example, Michigan is a riparian rights state when it comes to surface water, meaning only property owners whose land directly borders a water body have the legal right to use that water. However, groundwater (well water) may be transferred between properties, depending on specific conditions. To learn more about Michigan water rights, refer to the Water Rights in Michigan guide produced by Michigan State University (MSU) Extension.

Water Registration:

Irrigation is almost always classified as a large-volume water use, defined as any system with the capacity to pump more than 70 gallons per minute. In both Indiana and Michigan, new large-volume water uses must be registered before installation. In Michigan, users must complete the ***Water Withdrawal Assessment Tool (WWAT)*** to evaluate whether the proposed water use may negatively affect nearby streams, lakes, or other water users.

Based on the results:

- You may be approved to register your system online, or
- You may be required to request a site-specific review by the Michigan Department of Environment, Great Lakes, and Energy (EGLE).

If a site-specific review is needed, EGLE may:

- Approve the withdrawal and allow registration, or
- Initiate a process involving other large-volume users in the watershed to negotiate reduced water use and create space for the new withdrawal.

For detailed guidance, refer to MSU Extension's Irrigation Fact Sheet #7, which outlines the Michigan water use registration process step by step.

Process for Getting Started

Map Your Irrigation Ideas:

Start your planning by obtaining an aerial map of all the land you're considering for irrigation. You can use online tools such as Google Maps, or request a paper map from your local USDA Farm Service Agency. Use it to locate large fields near water sources, identify obstacles like woodlots or fences, and note drainage issues that could impact system layout and cost. In addition, consider that slopes can affect runoff, water pressure and system efficiency.

Sharing Irrigation Equipment:

Irrigation systems are often scale-dependent, meaning their cost-effectiveness improves with larger operations. One way to reduce individual costs is to share irrigation expenses by jointly investing in equipment with a neighbor.

Power Sources:

Identify available power sources for your irrigation system. The most cost-effective option is a three-phase power line located within half a mile of your water source. Liquid fuel storage near wells or surface water can pose environmental risks and result in higher equipment, maintenance, and fuel costs, making engine power a secondary option in most cases.

Get Multiple Bids:

Leverage the expertise of irrigation professionals by consulting with at least two irrigation sales/design specialists. They often have access to advanced mapping and planning software, and their experience in system design far exceeds that of most producers. Compare the designs they propose based on cost per irrigated acre for a typical year of irrigation. This will help balance your investment in equipment, energy costs, and labor requirements, ensuring you make the most informed decision. Another cost-saving option is to consider purchasing used equipment, which can significantly reduce initial expenses. With some repairs or maintenance, used systems can often be restored to function properly.

Irrigation Economics:

When considering irrigation, focus on increasing your average net income per acre after accounting for the additional costs associated with the system. To achieve positive results, you'll need to accurately estimate both fixed and variable costs. A helpful tool for evaluating the economic feasibility of your investment is the **Irrigation Capital Model - Spreadsheet to determine capital investment**.

Crop Rotation and Tillage Preferences:

Irrigation has proven most economically beneficial for commercial corn and alfalfa among traditional crops. However, small grains and soybeans tend to yield the lowest returns on irrigation investment. Adding irrigation often leads to changes in crop rotations, but it's important to note that irrigated fields tend to have a lower proportion of no-till systems compared to non-irrigated fields, possibly due to the excess corn residue produced on irrigated land.

Specialty/Vegetable Crop Options:

In Michigan, contracted specialty crops, such as vegetables and hybrid seed corn, dominate irrigated lands. These crops benefit from sandy soils, which reduce risks related to early planting, provide fewer delays due to rain, and lower the chances of flooding damage. The ability to alleviate drought stress also attracts high-value crops to the region. However, these favorable conditions are not available everywhere in Michigan and Indiana. Be sure to research the realistic and feasible options for your specific operation before investing in specialty crops.

Plan Ahead:

Installing an irrigation system requires careful planning well before the growing season begins. Take the time to evaluate your crop needs, choose the right system, and account for potential delivery and installation timelines, which can take several months. Fall delivery is often ideal, allowing for assembly during the off-season so the system is ready by spring. Rushing the process can lead to costly mistakes and delays.

Align Your Farming and Family Goals with Irrigation Plans:

Before committing to irrigation, consider how it aligns with both your farming and personal goals. Irrigation requires significant summer labor and can cut into personal time, especially during the busy growing season. The need for skilled irrigation labor is another consideration, as qualified help can be hard to find. Misjudging your available labor and management time could lead to operational challenges.

Disclaimer: For a specific list of resources in the above description, view the Necessary Resources area of this section.

PIVOT IRRIGATION

COMMON QUESTIONS

01 What type of irrigation system is best for my farm?

The best type of irrigation system for your farm depends on several factors, including:

- **Crop type:** Sprinkler systems like center pivots are commonly used for field crops such as corn, soybeans, and wheat due to their wide coverage and lower maintenance. Drip irrigation provides precise water application and reduces disease risk, making it ideal for vegetables and high-value crops.
- **Soil type:** Sandy soils require more frequent irrigation, so systems that allow for controlled, frequent applications, such as drip or sprinkler systems are preferred.

- **Water source and availability:** If water supply is limited, drip irrigation is the most efficient choice. For farms with more available water, sprinkler systems can be more feasible and easier to manage.
- **Topography:** Flat fields can accommodate most irrigation types, but sloped or uneven terrain often benefits from drip irrigation to minimize runoff and erosion.
- **Initial Cost:** Sprinkler systems typically have lower upfront costs. Drip systems require a higher initial investment and maintenance but offer long-term water savings.
- **Energy source:** The type of energy used for pumping whether electric or diesel along with associated costs and maintenance, should be carefully considered. Center pivots often require higher horsepower and may need a three-phase power supply. In contrast, drip systems operate at lower pressure and generally have lower energy requirements.
- **Labor:** Consider how much time and effort you're able to invest. Drip systems may require more frequent maintenance, while center pivots can be more automated.

02 How do I know if I have enough water available to irrigate?

Before investing in irrigation, it's important to assess whether you have enough water available for agricultural use. Michigan offers online water resources to help estimate large-volume water availability in the area. Well log databases are available in **Michigan's Scanned Water Well Record Retrieval System**. These databases provide information on well depth, location, and capacity. However, most records are for domestic wells, which typically require lower capacity and may not reflect the true potential of local aquifers for high-volume agricultural withdrawals. These wells are not always drilled into the most productive part of the aquifer or to the depths typically needed for irrigation.

When planning for irrigation, consider that most systems in Michigan are designed to apply at least 1 inch of water every four days; a rate that supports peak crop water demands during the growing season. To achieve this, you'll need a pumping capacity of about 5 gallons per minute (gpm) per acre. For example, a field of 100 acres would typically require a 500-gpm water supply to meet irrigation needs efficiently. For more information, refer to **adequate water supply is the heart of an irrigation system** article.

03 How much does it cost to install and operate an irrigation system?

The cost of installing and operating an irrigation system can vary significantly because each system is highly customizable. Several key factors influence the total cost, including:

- Field size, which determines the size and coverage of the system
- Terrain, as uneven land may require additional preparation or grading
- Sprinkler type, since spray patterns and features vary in efficiency and cost
- End gun inclusion, which adds coverage but also cost
- Control panel features, ranging from basic timers to fully remote, automated systems

Each of these components can be tailored to meet specific farm needs and budgets. To help estimate operating costs, there are tools and examples available. For instance, a **40-acre center pivot cost example** outlines a typical setup scenario and **Analyzing the costs of energy for irrigation in Michigan**.

04 What tools or technologies can help me schedule irrigation?

There are various tools available to help with irrigation scheduling from simple methods like checking the crop water use and rainfall to more advanced technologies like soil moisture sensors and mobile apps. The right choice will depend on your time, budget, and management style. MSU Extension's fact sheet "**Irrigation Scheduling Tools**" provides an overview of available options. Additionally, many irrigation companies offer apps and sensors that can integrate directly with your system.

RESOURCES & PARTNERS

Necessary Resources

- Michigan Water Withdrawal Assessment Tool
- Michigan Registration for New Agricultural Withdrawals
- Estimating Annual Irrigation Costs
- **Spreadsheet to determine capital investment**
- Efficient Irrigation Management with Center Pivot Systems

Partners

- Conservation Districts
- Irrigation dealerships
- Michigan Department of Agriculture and Rural Development
- USDA-NRCS
- Michiana Irrigation Association