International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 06 | Jun 2022 www.irjet.net p-ISSN: 2395-0072

DEVELOPMENT AND FABRICATION OF CENTER PIVOT IRRIGATION SYSTEM - A REVIEW

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Abstract - *Center pivot irrigation has been the most hastily increasing form of irrigation within the agriculture region. center pivot irrigation systems commonly practice a fairly uniform amount of water to fields that are frequently inherently variable, which could cause substantial waste of water and strength. To address this trouble efficient water manipulation needs to be considered during irrigation. The water distribution uniformity of middle pivot irrigation systems is influenced by the sprinklers used. The center pivot's sprinkling uniformity is critical for the yield and pleasantness of flora on a large scale. In this work, Center pivot irrigation-related journal papers are reviewed, analyzed, and summarized by all the researchers that dealt with Center pivot irrigation*

Key Words: *Center pivot irrigation, agriculture, manipulation, uniformity, sprinkling.*

1. INTRODUCTION

Because of the widespread trend of lowering water inherence and decreasing energy costs, which determine the feasibility of irrigated agriculture in many parts of the world, efficient water and energy use is becoming increasingly important in agriculture. [1] A wide range of sprinkler irrigation systems, including structures with a center pivot, side travel, complete set, side rollers, running, and manual travel, are widely available. The pivot irrigation system has proven to be the most water and labor efficient of these irrigation systems, and it can easily irrigate vastly flat and wide areas.[2] Managing soil water levels is significantly easier because of the semiautomatic functioning of center pivots and lateral movements. Almost any vegetation, including sugar cane, orchards, and vines, as well as more traditional crops like maize, potatoes, minor grains, alfalfa, and vegetable crops, can and have been irrigated successfully with middle pivot water software systems under a wide range of conditions. A few types of center-pivot irrigated vegetation necessitate unique cultural techniques, such as planting in circles or using small pits or reservoirs within the furrows to aid infiltration and minimize surface runoff on heavy soils. Depending on control and a well-designed website installation, application efficiency can range from 80 percent to more than 80 percent.[3] Central pivot systems, as against to surface irrigation systems, reduce the amount of labour required for irrigation and distribute water more efficiently and evenly over crops.

Reduced well capacity in many irrigation areas, as well as manufacturers' preference to reduce stress necessities to reduce irrigation pump costs, has led to the development of diverse water supply programs for relevant loop structures, whilst the capacity to successfully and evenly distribute constrained water substances, has precipitated the development of diverse water supply packages for important loop structure[4] With the help of farmer Frank Siebach, the center Pivot Irrigation system was built in Strasbourg, Colorado in 1940. Since its development, this system has evolved into a very effective way of delivering water to irrigate fields. Because of its arrangement, this type of irrigation is also known as a sprinkler irrigation system. This is because this device is made up of multiple pipe segments that are joined together using trusses to keep them balanced. The entire assembly is mounted on the tire and revolves in a circle around a pivot point. Sprinklers are a system in which the tool's arm is attached to a series of pipes that are separated by a constant horizontal distance. The management Unit can control the amount of water that a sprinkler emits regularly. Various system adjustments have been made from time to time to benefit from the machine's true global performance and to accommodate the diverse topographical and climatic conditions in the various locations across the world The centre Pivot irrigation is classified as Self-Propelled Irrigation Structures, and in the United States, these self-propelled irrigation devices account for roughly 29% of total irrigation. Irrigation in this manner is mechanised, which results in higher yields while using less water[5] It is critical to identify efficient and effective strategies to avoid this problem as the world's population continues to expand. Irrigation is still managed using a variety of conventional ways. These techniques are inefficient and time-consuming. All irrigation-related indicators may be monitored and the entire irrigation process can be managed thanks to new technologies like the Internet of things (IoT). The Internet of things (IoT) is a platform for connecting all Internet-connected objects. IoT devices can be controlled and monitored from any location on the planet[6] Irrigation control is to determine the best irrigation time and quantity for the greatest efficiency. Irrigation management that is done correctly reduces crop losses due to water scarcity, increases crop response to one-of-a-kind management approaches, and maximizes the yield of crops per unit of the water applied. These elements are all benefactors to the farm's prosperity. Irrigation management that uses water inefficiently or excessively might severely impair your potential to profit. Irrigation control that is set up correctly decreases runoff, soil erosion, and pesticide release into surface water and groundwater.[7]

2. Design of Hardware

Lyle and Bordowski (1986) created and tested a linear irrigation system using a multifunctional irrigation device (MFIS). The MFIS system delivered water at a rate of three.14 cl/ha (340 gal/acre) and chemical at a rate of 21.5 cl/ha (2300 gal/acre) or aerial spray at a rate of 0.028 cells/ha (3 gal/acre). A sprayer drip nozzle must align with the crop row, according to MFIS. As a result, the irrigation machine should be a linear motion system; alternatively, for irrigation systems with useful circular movement, the rows must be employed in a circle. Variable and equally distributed sprinkler systems have been erected on the same four-tower span of center pivot system at the Coastal test Station in Tifton, Georgia, to evaluate the application homogeneity among systems. The variable distributed device was also placed on a 0.61 hectares single-span center-pivot tower on the Bellflower field near Tifton, Georgia. The single pivot tower measures 44.5 meters (146 feet) in length and moves at 9.7 meters per minute (34 feet per minute). The diameter and spacing of sprinkler nozzles, as well as the pivot booms sprayer, were identified by calculation of water extent required for 1.8 kl/ha for the field and the sprinkler role's trip velocity (variable space format). The distance between sprinklers increases from three to three and a half inches to three and a half inches[8]

Among the exceptional producers, there are significant differences in the development of those big equipment. A center-pivot or lateral move, on the other hand, is essentially a pipeline (lateral) attached to motorized structures (towers) with wheels for movement. A center-pivot machine revolves near a "pivot" point in the middle of the field, whereas a lateral pass device follows a direct path and has its steering mechanism. Sprinkler outlets are connected to a pipe that is carried by metal trusses between tower components. Every tower has a 1 hp engine and sits on two large rubber or iron tires, and they are normally 90 to 200 ft (30 to 60 m) apart. A span is the intersection of pipes, trusses, and sprinklers between two towers. Every tower has a flexible coupler that joins the pipes of two adjacent spans. The maximum span is determined by the pipe length, thickness (power), the slope of the area, and topography. High-capacity give-up guns and nook systems can also be connected to the system's give-up to expand the corner's wetted area or to cover more locations

Although a few manufacturers use more expensive hydraulic vehicles, the majority of machines are powered by electricity. Each turret is propelled at a constant speed of 1 horsepower by an electric or hydraulic drive motor. Turret engines are frequently required to extend the life of the turret. Hydraulic strains run the length of the apparatus, with each tower having a controlled box or valve. The Primary part of a center pivot (CP) device as shown Figure 1.

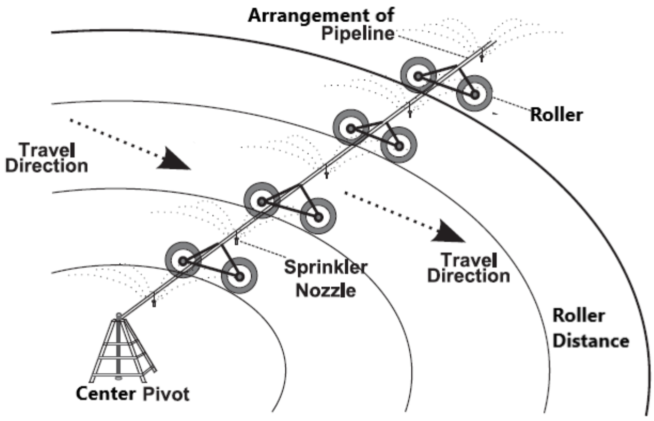

Fig -1: Primary part of a center pivot (CP) device[7]

For lateral motion, the primary control console is usually positioned on the pivot base or engine. Hydraulic force structures have better upfront rates, but annual fees may be lower due to fewer maintenance and operating costs. Many manufacturers are considering using more expensive variable-speed cars to reduce the impact of starting and stopping on uniformity, particularly in chemical applications. "Effect" and "spray" heads are the two types of sprinklers used in the middle pivot and linear systems. A shock (earlier style conventional surprise actuator) is a low-angle (6° to fifteen°) low-strain head mounted directly on the pivot side tube's pinnacle. Atomizers and "rotators" are two types of spray heads. All motors, gears, alignment systems, couplings, seals, and different components, no matter device kind, require a strict annual or weekly protection and lubrication schedule. Sprinkler heads and pressure regulators need to get replaced frequently, typically each 3-4 years.[3]

3. IoT application for irrigation purposes

The internet of things is anticipated to have a significant impact on smart water management application automation. The creation of IoT-enabled apps, on the other hand, is still ongoing due to a lack of suitable equipment in recent years, a lot has been accomplished. Emphasized the potential applications of IoT in conjunction with the cloud-based facilities and also big data systematics(analytics).

Understanding the demanding scenarios and riveting affect of IoT in big-scale smart agriculture experiments may be a current challenge in Europe. Brewster et al. discussed the implementation of big-scale IoT projects in agriculture, as well as the technologies used in specific food domains like dairy, fruit, crops, and the meat and vegetable delivery chain.[9] Farmers and consumers must be attached to the internet direct to irrigate land using middle pivot irrigation. And you want to be able to take fast, informed resolution based on the facts in your area so that you can make time for the things that are precious to you and your family and other aspects of your agricultural operation. And none of this would work if our paintings didn't have a web of elements. The following benefits can be acquired by linking this tool to IoT:

• Remote monitoring functionality is offered, allowing for the reduction of water sources and manpower, resulting in cost savings.

• It also promotes an increase in subject productivity, which is critical in the manufacturing industry.

• The pivot screen and controller, as well as moisture content reciters and other sensing devices used in farming actions, allow users to watch and control the center pivots system for Irrigation IoT.[5] Currently, there are a few obstacles to overcome that prevent you from fully utilizing IoT for particular irrigation. To begin with, software buildout for IoT-established intelligent systems, such as irrigation for agriculture, is not automated. Second, better IoT software programmes are still required for automating a portion of the procedure and combining specialized technologies like IoT, big data systematics, cloud-based computing, and fog computing to implement pilot applications for intelligent water control. Finally, appropriate standards and statistical models are required when combining heterogeneous and superior sensors. The SWAMP challenge is improved and evaluated an IIoT-based intelligent water governed program for rigor irrigation in agriculture with a hands-on application based on four pilots in Brazil, Spain, and Italy. SWAMP structures can be built and installed in a variety of ways, resulting in one-of-a-kind SWAMP structures tailored to the needs and constraints of international locations, weather, soils, and plants, necessitating a high level of flexibility to conform to a variety of stationed layouts.[9]

4. Sensor Integration

An implanted or base station laptop, community coordinator, sensor nodes, and routers made up the WSN's overall components. The pivot factor was powered by 120 V AC and the base station was placed there. It collected, stored, and processed details from the weather station and Wifi sensor nodes, and used an RS232 serial link to the central pivot control panel to control central pivot motion for website-particular irrigation control.[10] One of the most important characteristics to consider in crop management is the plant top. Plant peak height or plant yield charge can be utilized as an identifier for plant health and growth potential. To carry out real-time in situ calculations of plant top and shade temperature for VRI, a wifi statistics acquisition (WDAQ) equipment was built. An ultrasonic distance sensor, an infrared temperature sensor, a statistics logger, a GPS receiver, an expansion-spectrum radio, and a solar energy source were all part of the system. The ultrasonic distance sensor used to determine plant height was mounted above the plant cover at the pivot. The space between the sensor and the plant shade was measured with this sensor. By subtracting the calculated distance from the recognized distance between the floor and the sensor, the plant top pivoted. The infrared temperature sensor calculated plant can copy temperature utilizing changing the thermal energy radiated from the shade in its subject of view to an electrical signal[11]

5. Center pivot Irrigation system losses and efficiency:

The water emission system that allow the supply of water to an area from the center pivot irrigation system are commonly referred to as the sprinkler bundle, even if the water distribution systems is not similar to the standard sprinkler device. Effect sprinklers, continuous plate spray nozzles, and shifting plate spray nozzles, as well as other water distribution systems like drag hose and/or drip pipe, may be used in sprinkler or water transportation applications[4] Sprinkler irrigation's spray losses and plant interception losses must be measured in order to compare sprinkler and other types of irrigation performance.[12] To reduce water losses, manufacturers of center pivot water utility components are improving equipment and refining machine design and nozzle selection processes. Many elements influence the effectiveness of an irrigation system. Water losses are caused by a variety of agronomic and cultural factors that are dependent on utility technology and operation[13] The flow of fluid through the discharge pipe is determined by the opening size and operating pressure, each type of sprinkler nozzle's operation is predictable.[4]

Water runoff is a big issue when employing center pivots. A few clay loam, silty clay loam, and clay soils consume far less water than the irrigation application rate. On sandy and sandy loam soils, runoff is often substantially lower. Tendencies in center pivot water applicators that allow for a reduced mainline train while reducing evaporation rate also tend to pay attention to water in a smaller region, and as a result, the water application rate (inches per hour) on the area included increases as a result. When spray nozzles are used instead of impact sprinklers, the wetted sample is smaller.[14] The water loss between the ground surface and sprinkler nozzle has been taken into account in this study due to the sum of evaporation loss and wind drift loss. The evaporation loss was calculated by dividing the total amount of water discharged through the nozzles and subtracting the volume of water extending the floor by the total amount of water released[15] One of the most efficient irrigation systems available today is center pivot irrigation. Low energy Precision Application (LEPA) Irrigation has a high water efficiency and a minimal working strain.[16] To make optimum use of water, both rainfall and irrigation, the LEPA irrigation system blends mechanical irrigation structures with soil ground management[17] Center-pivot sprinklers are becoming more common in the Southern High Plains, and LEPA utility techniques are being used to reduce water utility losses, apply low well yields, and reduce pressurization energy source of requirements. LEPA irrigation was created to reduce sprinkler watering losses due to the vapour evaporation and drift in the high winds that are common in this area, saving water and energy from the start.[14]

6. Experimental Result And Analysis

The center-pivot irrigation system is self-propelled which revolves constantly to provide the water required for the irrigation. Then the provided water also goes through the pivot pipe's tip through sprinklers. In pivot, every tower aligns as a consequence in among small intermediate gaps with no collision. The middle quadrant of the pivot pipe is set at one stop from which each system gets commenced. it's miles a critical components of this middle pivot irrigation machine as handiest through this pivot pipe water is supplied. Center pivot irrigation device may be nearly suitable in all unique kinds of agricultural land and choppy topographic discipline can also be irrigated through pivot irrigation. As there are not any crop boundaries to making use of this tool because it irrigates almost all form of flora together with sugarcane, cotton, carrots, onions, asparagus, cucumbers, melons, pumpkins, strawberries, sweet corns, tomatoes, peppers, and potatoes. The middle pivot machine can cowl an average price a self-propelled middle as much as 160 acres of the field. The survey suggests that the center pivot gadget can irrigate 126 acres land along the road from the one hundred sixty acres discipline, approximately 78% of place is blanketed via everyday round irrigation without setting a quit gun with the middle pivot device. System with low stress and spray with electricity, saving ability are used. With a purpose to keep away from the drift of wind in a reduced way placing pipes are used because it sprays the water towards the plants for better yield of crops. This center pivot system lasts for about 20 years of existence span without any harm or corrosion. The life span of the tool may be decreased because of salt constructing up which accumulates salt at the dividing line among the irrigation regions occur in reducing the existence span of the center pivot machine[5] In the course of the irrigation session, the amount of water carried out has to no longer exceed the amount of water that the root area can soak up. Deep infiltration occurs when too much water is applied, resulting in water loss and a reduction in efficiency of overall irrigation . Different soil types have different characteristics. The soil's ability to retain water. It's best to keep soil healthy for the best crop growth results Moisture levels between field capacity and about half of the water available in the Reservoir Irrigated soil-type crops' root area These figures are primarily based on the voltage had to operate water extraction from the soil. Field ability is regularly described as the level of water last in the root region of the soil about three days after a major irrigation or rainfall occasion. Permanent wilting is described as the soil water level at which flora are not able to extract water from the soil and plants cannot continue to exist. The soil water among the sector potential and the permanent wilting point is the amount of water available for crop use. Making use of greater water than the sector capability causes runoff and soil saturation. Infiltrated water is much more likely to be lost through deep infiltration. making use of too little water will cause plant stress. Irrigation planning control tactics can be done to monitor soil moisture ranges. The Water Holding Capacities of Soils as shown in Chart-1.

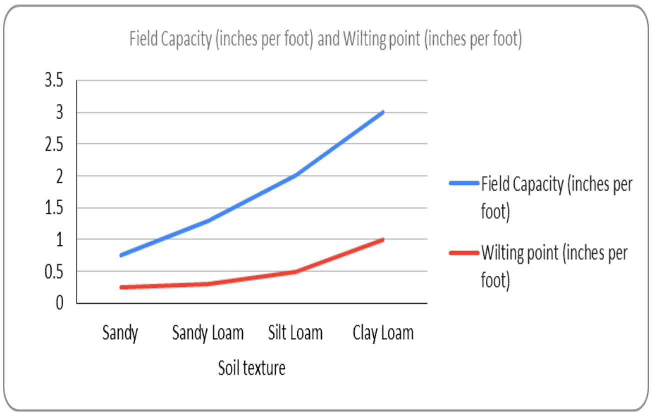

Chart -1: Water-Holding Capacities of Soils[18]

7. Conclusion

This research review demonstrates a modern agriculture method called center-pivot irrigation system through the integration of electronic sensors and the equipment controls, and also have been developed to meet all the growing interest in the site-specific irrigation using center pivot irrigation system. There is a significant possibility available for farmers to exercise the modern-day method of irrigation, as there's more advantage in comparison with a different device, as this center pivot form of device is a self-propelled which revolves constantly to provide the water needed for irrigation. And farmers can relieve the more burden on the lookout for hard work energy. wherein a large place at the location is saved using the center pivot and it notably avoids the land from digging the trenches and getting wasted, and soil erosion. latest studies trends inside the center pivot irrigation device have caused contractual relationships among after-marketplace providers and irrigation machine manufacturers that need to guide similar improvement of the site-particular utility of water, vitamins, and pesticides inside the destiny.

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