IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 17, Issue 4 Ser. 1 (April. 2024), PP 01-10
www.iosrjournals.org

Study On Smart Drip Irrigation System

Sharmistha Behera[1], Chittaranjan Swain[2] Dr Pranati Mishra[3],
Dr Brajendra Kumar Mishra [4]
[1 2 3 4] Sophitorium, Khordha,Odisha

Abstract
In India, agriculture plays an important role for development in food production. Land and water are essential for agriculture and the nation's economic growth. Over 80% of the exploitable water resources in the nation are used for agriculture. Making wise use of the water resources at hand is crucial to the overall expansion of the agriculture industry and the targeted GDP growth rate. This led to the creation of the Irrigation Scheme, which aims at increasing the area under efficient methods of irrigation viz. Drip irrigation. Providing irrigation water directly to the soil at the plant's root zone with drip irrigation is an effective way to reduce traditional losses including deep percolation, runoff and soil erosion. Together with irrigation water, it also facilitates the use of herbicides, fertilizers, and other water-soluble chemicals, which produces produce of higher quality produce and yields. Many issues in dry land agriculture are thought to have a solution with drip irrigation systems, which also increase the productivity of irrigated farmland. With all of this in mind, the current study set out to determine the barriers that farmers faced while implementing drip irrigation for horticulture crops as well as the level of benefits that can be obtained from it.

Keywords: *Water scarcity, Drip irrigation, Dry land agriculture, Smart Drip Irrigation, Wireless Sensors Network (WSN).*

Date of Submission: 22-03-2024 Date of Acceptance: 02-04-2024

I. Introduction

Agriculture is the backbone of the nation's economy contributing enormously to the GDP. In order to increase the productivity per yield, there is a need to maximize the efficiency of irrigation techniques, some of which have long been practised by traditional farmers.

There are two main methods through which farmers can water their agricultural land i.e. rainfed farming and Irrigation. Rainfed farming depends on direct rainfall where the risk of contamination is less. But it faces inadequacy of water levels when there is no or very scarce rainfall. On the other hand, irrigation refers to the artificial application of water through different methods. An irrigation system protects plants from frost and dust suppression while allowing crops to be grown with the least amount of water feasible. Due to developments in technology and a seemingly sharp decline of available manual labour adversely affecting the agricultural yield, the need for a proper utilization of available resources is imminent.

The Internet of Things (IoT) is assisting in the transformation of agriculture by giving farmers access to a variety of methods, including a collection of information about the local climate, condition of the soil, moisture, temperature and fertility of the soil. Crop online monitoring includes weed detection, water availability measurements, insect identification, animal infiltration, and other aspects that impact plant health.

This system consists of moisture sensor and temperature sensor. It collects data from the listed sensors and turn on and off the pump based on the data of the sensors. The servo motor is used for angular position of the pipe for equal distribution of the water to the soil.

The paper has based an irrigation system which uses a central controller and several sensors like water flow sensor, temperature sensor, and soil moisture sensor. The data collected by the sensor is fed to this and It uploads this information to the webpage using Wi-Fi module. A web page contains standard values of the different factor required by a crop. A user can control the operation of pumps and sprinklers remotely.

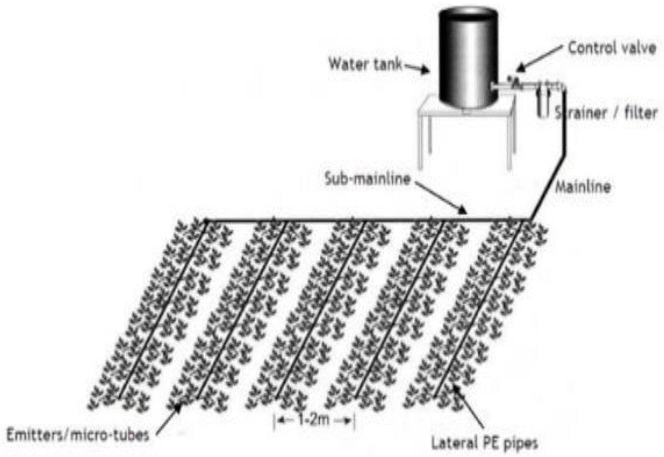


Fig: Block diagram of Drip Irrigation System

Objective:

Keeping all these in view, the present study was designed to study the extent of benefits derived from drip irrigation in horticultural crops and to identify the constraints encountered by farmers in adopting the drip irrigation for horticultural crops.

II. Literature Review:

The proposed study incorporates some relevant literature according to the objective of the study.

1. Yahasaswini Sharma et al (2015) proposes that the use of precision farming will Increase the productivity, decrease the production cost and minimize the environmental impact of farming.
2. Crookston (2006) says that the precision farming is one of the top 10 revolutions in the history of agriculture and precision farming is doing the right management practices in the right location, right time and right rate.
3. V. M. Abdul Hakkim et al (2016) concluded precision farming is still only a concept in many developing countries like India.
4. Mulla et al (1996) proposed that precision farming has several advantages, including increased efficiency in farm management inputs, increased agricultural output, improved crop quality and less fertilizer transportation.
5. Keyurbhai A. Jani provides insights into the preventive maintenance of drip irrigation systems to ensure their optimal functionality with the help of IoT technologies.

Types of Drip Irrigation:

According to emitters which control the quantity and rate of water discharge, trickle or drip irrigation systems can be divided into four types:

- Point-source emitters (drip bubbler)
- In-line drip emitter
- Basin bubbler
- Micro spray sprinkler

Fig A: Point-Sources Emitters

Fig B: In-Line Drip Emitters

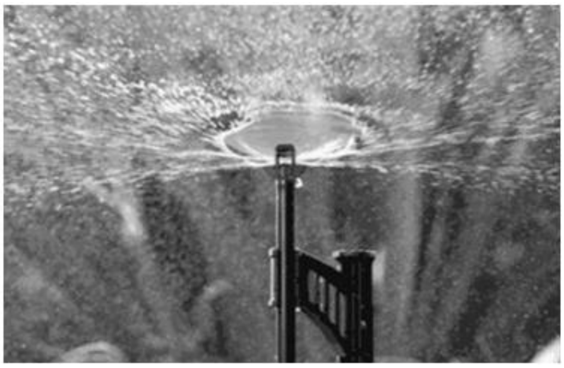



Fig C: Soaker Hoses As The Type Of Basin Bubblers **Fig D: Micro Spray Sprinkler**

- Drip irrigation is one of the most efficient types of irrigation systems. The efficiency of applied and lost water as well as meeting the crop water need ranges from 80 to 90%. What does this mean? Well, its efficiency is the result of only two factors:
- Applying water drop by drop, the soil soaks it before it evaporates
- Water is applied to the crop root zone (localized) where it is needed most

System Developed:

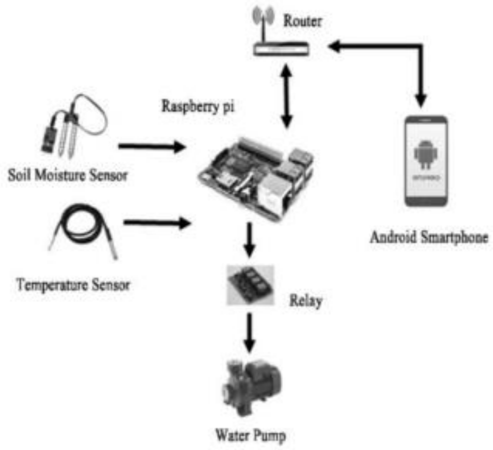
A study site was chosen to carry on the present investigation which is located inside the campus area of SOPHITORIUM GROUP OF INSTITUTIONS. The area of the drip irrigation study site is about 25m *18m which is an ideal size for carrying out the experiment, the distance of the pipe was maintained at 1foot difference, the emitters were also fitted at a distance 1foot. The diameter of the main pipe is 2inch and the smaller ones are 0.5inch in diameter.

Fig: Smart Drip Irrigation At Sophitorium Campus

Fig: System At Sophitorium Campus

Components Used in the System:

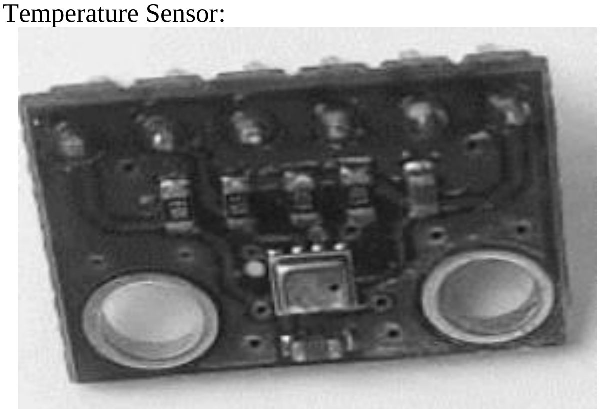
An attempt is made in this project to design a Holistic Smart Drip Irrigation System using WSN based, smart irrigation systemalgorithms, automated irrigation system, remote data transmission, and monitoring, power consumption during drip irrigation, cost-effective smart irrigation for major types of crops.



Soil moisture sensors:

Specifications: Range: 0 to 45% volumetric water content in soil (capable of 0 to 100% VWC with alternate calibration)
Accuracy: ±4% typical
Typical Resolution: 0.1%
Power: 3 mA @ 5VDC
Operating temperature: –40°C to +60°C

Atmospheric Humidity and Temperature Sensor:



Humidity is the concentration of water vapor present in the air. Water vapor, the gaseous state of water, is generally invisible to the human eye. Humidity indicates the likelihood for precipitation, dew, or fog to be present. Relative humidity is normally expressed as a percentage; a higher percentage means that the air–water mixture is more humid. At 100% relative humidity, the air is saturated and is at its dew point.

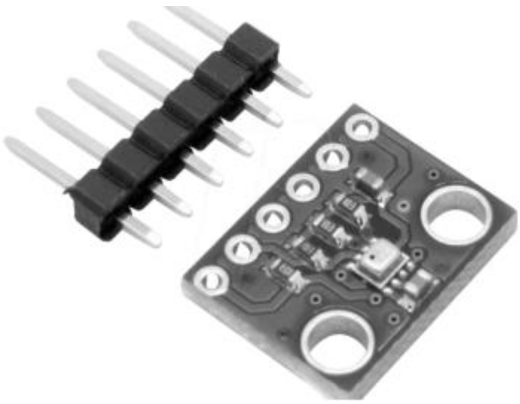
Water Flow Sensor:

To monitor the amount of water being supplied and used, the rate of flow of water has to be measured. Water flow sensors are used for this purpose. Water flow sensors are installed at the water source or pipes to measure the rate of flow of water and calculate the amount of water flowed through the pipe. For the best accuracy measure the flow 3 or 4 times and average the times together. The formula to find GPM is 60 divided by the seconds it takes to fill a one-gallon container (60 / seconds = GPM). Example: The one-gallon container fills in 5 seconds, breakdown: 60 divided by 5 equals 12 gallons per minute.

Water Tank filter:

Most filters feature a chamber containing biological filter media, often in the form of plastic balls with a high surface area to volume ratio. The water simply flows through the network of holes and gaps these balls create, but come into contact with cultures of nitrifying bacteria that colonize the balls (bio media).

BME 280 Sensor:



The BME280 sensor module reads barometric pressure, temperature, and humidity. Because pressure changes with altitude, you can also estimate altitude. There are several versions of this sensor module. The BME280 sensor uses I2C or SPI communication protocol to exchange data with a microcontroller.

Solar Panel:

150 WP solar panel may generate only about 50watt or lower in the morning and before sunset. So, only at it's peak you can use total 150W electronic appliances. Based on that, people can use battery for storing energy every day. That's why people can use the solar energy even no sunshine at all (night). Therefore, a 100ah (amp hour) battery will last for 1000 hours. A slightly different example is a 60 watt fridge running on a 12 volt power source uses 60 /12 = 5 amps, but only while the motor runs.

Raspberry Pi:

Raspberry Pi, as shown in Fig. 2, is like a tiny single-board computer to learn programming skills, hardware projects purpose, automation, implement cloud clusters and Edge computing, and even use in industrial applications.

Besides these our system consists of the following equipments:

- Pump unit - The pump unit takes water from the source and provides the right pressure for delivery into the pipe system
- Control head - The control head consists of valves to control the discharge and pressure in the entire system. It may also have filters to clear the water. Common types of filter include screen filters and graded sand filters which remove fine material suspended in the water. Some control head units contain a fertilizer or nutrient tank. These slowly add a measured dose of fertilizer into the water during irrigation. This is one of the major advantages of drip irrigation over other methods.
- Main and submain lines - Mainlines, submains and laterals supply water from the control head into the fields. They are usually made from PVC or polyethylene hose and should be buried below ground because they easily degrade when exposed to direct solar radiation.
- Laterals - Lateral pipes are usually 13-32 mm diameter
- Emitters or drippers - Emitters or drippers are devices used to control the discharge of water from the lateral to the plants. They are usually spaced more than 1 metre apart with one or more emitters used for a single plant such as a tree. For row crops more closelyspaced emitters may be used to wet a strip of soil. Many different emitter designs have been produced in recent years. The basis of design is to produce an emitter which will provide a specified constant discharge which does not vary much with pressure changes, and does not block easily.

Soil Moisture Content

Soil moisture is a key variable in controlling the exchange of water and heat energy between the land surface and the atmosphere through evaporation and plant transpiration. As a result, soil moisture plays an important role in the development of weather patterns and the production of precipitation.

Surface irrigation can be used for all types of crops. Sprinkler and drip irrigation, because of their high capital investment per hectare, are mostly used for high value cash crops, such as vegetables and fruit trees.

They are seldom used for the lower value staple crops.

Drip irrigation is suited to irrigating individual plants or trees or row crops such as vegetables and sugarcane. It is not suitable for close growing crops (e.g. rice).

For optimal plant growth and development, different levels of soil moisture are required throughout the different plant growth stages. For grains, Total Soil Moisture should be maintained at ~40% of Field Capacity. For fruit, Total Soil Moisture should be maintained at ~30% of Field Capacity.

All plants need to be in a specific soil moisture range — the majority of plants thrive in soil with a moisture level that ranges between 20% and 60%.

Crops suitable for Drip Irrigation System:
Orchard Crops: Grapes, Banana, Pomegranate, Orange
Vegetables: Tomato, Chilly, Capsicum, Cabbage
Cash Crops: Sugarcane, Cotton. Flowers: Rose, Carnation, Gerbera,
Plantation: Tea, Rubber, Coffee, Coconut etc.
Spices: Turmeric, Cloves, Mint etc.
Oil Seed: Soyabean, Sunflower, Sesame etc.

Various Plant's Soil Moisture content:

The plants listed below represent commonly found species.
All vegetables require soil moisture between 41% - 90%.

Flowers	0% - 20%	21% - 40%	41% - 60%	61% - 80
Agave	•	•		
Aster		•		
Astilbe			•	
Big Blue Stem		•		
Bleeding Heart			•	
Butterfly Weed		•		
Cactus	•	•		
Catmint		•		
Christmas Fern		•		
Coneflower		•		
Daffodil		•	•	
Dalia		•	•	
Daylilly		•	•	
Gaillardia		•		
Heaths/Heathers		•		
Hellebores			•	
Hosta		•	•	
Hyssop		•		
Iris		•	•	
Ironweed			•	
Jack In Pulpits			•	
Joe-Pye Weed			•	
Lavendar		•		
Lemon Balm		•		
Lily		•	•	
Lobellia			•	•
Lupine			•	
Marigold		•		
Marsh Marigold				•
May Apple			•	
Meadow Rue			•	•
Monarda		•		
Ornamental Grasses		•		
Penstemon		•		
Peony		•	•	
Petunia		•		
Poppy (general)		•		
Purple Coneflower		•		
Queen of the Prairie			•	
Red Milkweed			•	
Sedges		•	•	•
Sedum	•	•		
Sod/Turfgrass				
Pansy		•	•	
Tulip		•	•	
Violet		•	•	
Yarrow	•	•		
Yucca	•	•		
Zinnia		•		

Arborvitae		•		
Azealeas		•	•	
Bald Cypress		•	•	•
Barberry		•		
Bayberry				
Birch			•	
Black Tupelo		•		
Chinese Juniper		•		
Clematis		•	•	
Common Boxwood		•		
Common Elderberry			•	
Common Lilac		•		
Cotoneaster				
Crab Apple		•		
Crape Myrtle		•	•	
Dawn Redwood			•	•
Dogwood			•	•
Eastern Red Cedar		•		
Elderberry		•	•	•
Elm		•	•	
Frazier Fir		•		
Gardenia		•		
Ginkgo		•		
Hawthorn		•		
Holly		•		
Honey Locust		•		
Horse Chestnut		•		
Hydragea			•	
Juniper		•		
Lilac		•		
Maple (general)		•		
Mockorange		•		
New Jersey Tea		•		
Oaks (general)		•		
Ohio Buckeye		•		
Potentilla	•	•		
Red Cedar			•	
Red Twig Dogwood			•	
Rhodendron			•	
Roses		•		
Rugosa rose	•	•		
Saucer magnolia		•		
Serviceberry		•	•	
Silver Maple		•	•	
Spirea		•		
Spruce		•		

Maintainance of Drip irrigation:
Drip Maintenance can be divided mainly into two categories.

- preventative
- corrective

Preventative maintenance ensures a drip irrigation system's long-term performance and efficiency. Here are the critical steps of preventative maintenance for a drip irrigationsystem:

Regular Inspections

- Perform inspections at regular intervals of the entire system to identify any signs of wear, damage, or malfunction. This includes checking filters, valves, tubing, connectors, emitters, and other systemcomponents.
- Look for leaks, cracks, blockages, or other system performance issues.
- Address any problems promptly to prevent further damage or inefficiency.

Check and Maintain Filters

- Filters are essential for removing debris and sediments from the water supply. Regularly check and clean or replace filters to ensure unobstructed water flow.
- Inspect screens, disc filters, or other filter types for clogging or damage.
- Clean filters according to the manufacturer's recommendations or guidelines.

Maintain Pressure Regulators

- Pressure regulators help maintain optimal water pressure throughout the system. Inspect and adjust pressure regulators as needed to ensure consistent pressure.
- Verify that pressure readings are within the recommended range for your specific system.
- Repair or replace faulty pressure regulators to prevent over- or under-pressure situations.

Prevent Root Intrusion

- Roots can infiltrate the drip irrigation system, leading to blockages and damage. Take preventive measures to avoid root intrusion.
- Install root barriers or use root guards near the system components to prevent root growth towards the pipes or emitters.
- Regularly inspect for any signs of root intrusion andremove any roots that have entered the system.

Monitor and Adjust Water Distribution

- Regularly monitor and adjust the water distribution pattern to ensure even and uniform irrigation.
- Verify that all emitters or drippers are functioning correctly and delivering the intended amount of water.
- Adjust emitters' flow rate or spacing to meet the plants' changing needs.

Protect the System from Physical Damage

- Safeguard the system against physical damage, such as accidental impacts, vandalism, or extreme weather conditions.
- Ensure tubing, connectors, and other componentsare adequately protected and insulated.
- Repair or replace damaged components promptly to maintain system integrity.

Seasonal Adjustments

- Adapt the system settings and schedules based on seasonal changes, weather conditions, and plant requirements.
- Adjust the irrigation frequency, duration, and timing to optimize water efficiency and meet the plants' changing needs throughout the year.

Regular Cleaning

- Periodically clean system components, such as emitters, connectors, and tubing, to prevent the buildup of sediments, organic matter, or biofilm.
- Follow the recommended cleaning procedures and use appropriate cleaning solutions or detergents.
- Keep the system clean and debris-free to ensureproper water flow and prevent clogging.

By implementing these preventative maintenance steps, you can proactively address potential issues, prolong the lifespan of your drip irrigation system, and maintain its efficiency and effectiveness over time.

III. Results & Discussions:

It is important to note that the majority of flowers, trees, and shrubs require moisture levels between 21% - 40%, while all vegetables require soil moisture between 41% and 90%. The soil type in our study site is brown forest soil, which also contributes to the soil moisture content of that particular area.

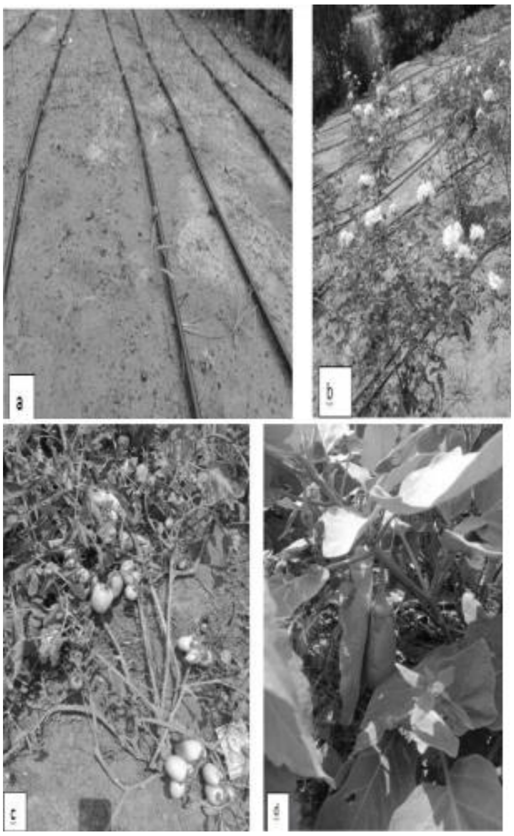


Fig: Different Flowering Plants And Vegetables Grown In The Study Sites A. Grass Plant B.Rose Plant C. Tomato D. Egg Plant

IV. Conclusion:

From various research papers reviewed above, it may be concluded that:

- Farmers with less income or small farmers who are marginalized have less tendency to obtain drip irrigation systems in any form. The major reason for it is the high initial costs and short lifespan of pipes in this system. Also, since most of these small farmers do not have large enough land holdings, therefore investing in drip irrigation techniques becomes not viable for them.
- Drip irrigation was found to be better than most of the other irrigation methods due to its multiple advantages and adaptability in the current scenario in the irrigation system. It is simple and needs little training to implement. The government in many states also promoted the procurement of the same by providing subsidies.