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# SENSOR BASED DRIP IRRIGATION USING SOLAR PUMP

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**Abstract---** Water and electricity are priced resources for agricultural production system, which correspond to each other because of parallel significance in this sector besides this around 40% of world population sustaining their livelihood on agriculture, some are living in poverty. Introducing of solar power to meet extra demand of electricity can boost the agricultural production and production system as well. This has became popular and increasing fast due to enhanced cost-competiveness, environmentally suitable, energy security, convenience, and applicable marketplace. Saurashtra, one of the major cotton growing regions in the Gujarat state. Scheduling of irrigation thus become important in cotton. Drip irrigation generally save 30% of the water for cotton. If mulch is conjointly adopted with drip system an additional 10% more water can be saved which is generally lost in evaporation from moisture bulb. Hence, this sound practice is adopted for Bt. cotton. In the present arena of climate change the temperature is going to be enhanced by 1$^{o}$C which ultimately enhance water requirement and frequency and on the other hand reduce the water availability to crops. So we are sand witched between low water availability and high crop water demand.This study was undertaken to address issues concerning the welfare of cotton growers in the Saurashtra state of Gujarat. In which,crop was irrigated with the help of soil moisture sensors based drip irrigation along with mulch. Renewable source of energy used to pump the irrigation water. Results revealed that around 60% irrigation water saved along with energy.

**Index Terms—solar energy, cotton crop,renewable energy, solar pump, soil mosture sensor,drip irrigation system**

## Introduction

Water demand has significantly increased over the last decades while available water resources are becoming increasingly scarce. Climatic change is adding another dimension to this complex nexus of soil-water-plant-atmosphere. Looking to the problem of this region, project work carried out for cotton crop. In which crop was irrigated with the help of soil moisture sensors based drip irrigation along with mulch. Renewable source of energy i.e solar energy used to pump the irrigation water. Results revealed that around 60% irrigation water saved along with energy which help to reduce effect of global warming.

## Research

The availability of power for agriculture sector is now becoming scared due to mechanized farming and sharing in industries, domestic and other sector particularly in the developing countries of the world. Water and electricity are priced resources for agricultural production system, which correspond to each other because of parallel significance in this sector besides this around 40% of world population sustaining their livelihood on agriculture, some are living in poverty. The right way to fight against poverty and stimulating socio-economic improvement needs to increase agricultural production, which can be possible by supplying more power in agricultural pumping space. The required irrigation is mandatory to improve yield by multi-cropping due to changing climate and variation of rainfall patterns. Introducing of solar power to meet extra demand of electricity can boost the agricultural production and production system as well. This has already became popular and increasing fast due to enhanced cost-competiveness, environmentally suitable, energy security, convenience, socially acceptable, supporting with dedicated policy and applicable marketplace. As food security is required in limited access to conventional energy resources, dependency of solar power water pumping nowadays increasing for small to medium scale farms and farmers, especially in developing countries. But, the solar pumping system is actually different from traditional pumping system, for which the system configuration needs to be optimized according to the requirements of water head, daily water consumption, and the local solar radiation levels. Saurashtra, one of the major cotton growing regions in the Gujarat state. Cotton in general does not withstand heavy irrigations. Scheduling of irrigation thus become important in cotton since water is valuable, costly and scarce on one hand. Water availability for agricultural use is declining all over the world due to the scarcity of water resource. Drip irrigation generally save 30% of the water for cotton. If mulch is conjointly adopted with drip system an additional 10% more water can be saved which is generally lost in evaporation from moisture bulb. Hence, this sound practice is adopted for Bt. cotton. In the present arena of climate change the temperature is going to be enhanced by 1$^{o}$C which ultimately enhance water requirement and frequency and on the other hand reduce the water availability to crops. So we are sand witched between low water availability and high crop water demand. Poor drip system operation without scientific irrigation schedules do not yield good crop revenue and productivity. Irrigation schedule needs proper irrigation regime, frequency under a particular set of conditions. This study was undertaken to address issues concerning the welfare of cotton growers in the Saurashtra state of Gujarat.

## Method / Testing and Redesign

An experiment was conducted to investigate the conjugate impact of solar pump operated drip irrigation with different mulch materials; silver black plastic mulch (20 micron LLDPE),biodegradable plastic mulch (20 micron) and wheat straw mulch on productivity of Bt. Cotton (Hybrid-6, BG-II). Irrigation scheduling was done based on actual evapotranspiration measured with the help of soil moisture sensors (Granular matrix sensor) installed at 10cm and 50cm from top of the soil near the root zone of cotton crop. The sensors were calibrated for local condition and moisture content calculated based on calibrated soil moisture characteristic curve (Fig.1). Actual crop

evapotranspiration was calculated by subtracting moisture content before and after the irrigation, multiplied with bulk density of soil and depth of root zone based on sensor based soil moisture estimates. Irrigation water was applied as per the actual evapotranspiration estimated from sensor based observations using solar pump. The solar pump was operated during peak hours i.e 10:00h to 16:00h. During this period maximum solar intensity received which in turn gives maximum output.

**Specification of Solar pump:**

The solar pumping system consists of AC pump, inverter and PV array. The system was designed to directly drive the pump-motor without battery. The PV array consists of multiple solar panels connected in series, which can supply the whole system as power source by converting the absorbed solar radiation energy to the electrical energy. Solar pumping inverter control the whole system operation, which drives the pump by converting DC power produced by the PV array to AC power. The pump driven by a 3-phase AC motor draws water from well.

| | | |
|---|---|---|
| Pump | : | 5 hp. AC |
| No. of Solar Panel | : | 20 nos. |
| Panel output | : | 240 W per panel |
| Total output | : | 4800 W |
| Depth of well | : | 30ft |
| Tracking system | : | Manual |

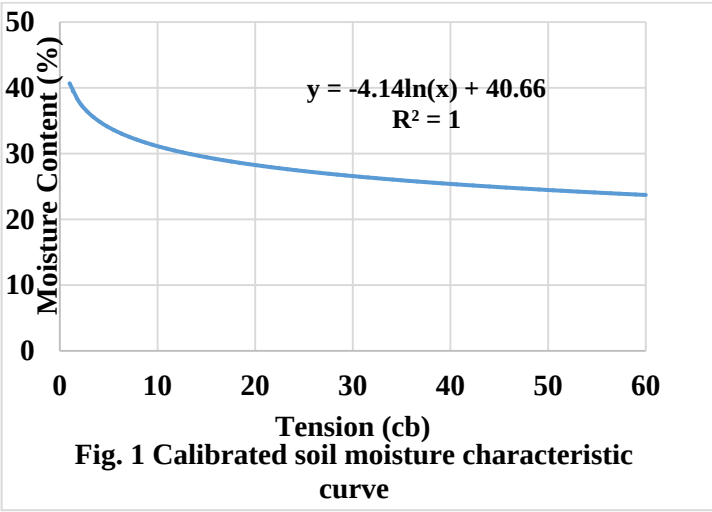


**Fig. 1 Calibrated soil moisture characteristic curve**

## Results

The results of the study revealed that

- Nearly 60% water saving was achieved compared to surface irrigation and enhanced yield per drop of water by 46%.
- Silver black plastic mulch saved irrigation water by 19.78% over no mulch. Highest seed cotton yield (4661 kg/ha), water use efficiency (10.29 kg/ha. mm) and fiber length (30.20mm) was observed in silver black plastic mulch.
- Seed cotton yield in silver black plastic mulch was 1.16 times over biodegradable plastic mulch, 1.19 times over wheat straw mulch, 1.69 times over no mulch and 3.25 fold over no mulch conditions.
- Irrigation schedule with solar pump will save irrigation water and enhance crop productivity Sensor based crop coefficients under silver black plastic mulch were lower by 72.27%, 29.04%, 15.64% and 11.72%, at initial stage, development stage, mid stage and end stage respectively over no mulch.
- Adoption of silver plastic mulch material with drip, reduce pest attack, water and energy saving.

## Conclusion

- Gujarat is having 18.5 lakh hectares under Bt. cotton. Generally a water requirement of 700 mm to 800 mm is required under surface irrigated crop.Sensor based drip irrigation along with mulch saved 60% of the water. i.e 420 to 470 mm of irrigation water.
- The total amount of water saved in saurashatra region comes to be 7770 MCM. This can irrigate

an additional area of again approximately 18.5 lakh ha.

- The additional energy saving arrives to be $932.4*10^6$ kWh which is enormous. The exchequer is benefitted by 46.62 crores of rupees in energy only
- The crop returns from additional area under irrigation will give an additional benefit of 2960 crore of rupees
- Suggested irrigation regimes for drip irrigation to Bt. cotton under different mulching materials.
- Assessed the economic returns and B:C ratio for Bt. Cotton under irrigation regimes drip irrigation under different mulching materials.
- Drip irrigation schedules based on Sensor based actual evapotranspiration values under different mulch material for advocated.

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Sowing of cotton seed and solar pump

Installation of sensors

| Data logger | Growth of cotton in different mulch |
|---|---|

Growth of cotton in different mulch