

# International Journal of Innovative Research in Science, Engineering and Technology

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## Studies on Solar Powered Irrigation System

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**ABSTRACT:** Development of a solar powered irrigation system has been discussed in this paper. The deficit in electricity and high diesel costs affects the pumping requirements of community water supplies and irrigation; so using solar energy for water pumping is a promising alternative to conventional electricity and diesel based pumping systems. Solar water pumping is based on photovoltaic (PV) technology that converts solar energy into electrical energy to run a DC or AC motor based water pump. Agricultural sector is backbone of Indian economy as population increases demand of water also increases. Usually lots of water wastage takes place in the land, due to improper method of irrigation. By using solar energy, we can save the electrical energy. Along with the analysis of performance, various socio-economic aspects of the surrounding communities are also looked at, we have come up with a list of recommendations mainly focused on development of solar irrigation system.

**KEYWORDS:** irrigation solar energy, solar water pumping, drip irrigation solar power, motor.

### I. INTRODUCTION

#### 1.1 IRRIGATION

The irrigation system is defined as a system that distributes water to targeted area. Basically, it is meant for agriculture purposes. The efficiency of the irrigation is based on the system used. Since antiquity, the human life is based on agriculture and the irrigation system is one of the tools that boost agriculture. There are many other types of irrigation system all over the world but these irrigations are encountering many problems.

#### 1.2 DRIP IRRIGATION

The drip irrigation is also known as trickle irrigation, water is applied in the drops directly near the base of the plant. Water is conveyed through a system of flexible pipe lines, operating at low pressure, and is applied through plants through drip nozzles.

#### 1.3 SOLAR ENERGY

Solar energy, radiant light and heat from the sun, Solar energy is the most abundant source of energy in the world. Solar power is not only an answer to today's energy crisis but also an environmental friendly form of energy. Photovoltaic generation is an efficient approach for using the solar energy. Solar panels (an array of photovoltaic cells) are nowadays extensively used for running street lights, for powering water heaters and to meet domestic loads. The cost of solar panels has been constantly decreasing which encourage its usage in various sectors. One of the application of this technology is used in irrigation systems for farming. Solar powered irrigation system can be a suitable alternative for farmers in the present state of energy crisis in India. This a green way for energy production which provides free energy once an initial investment is made.

Solar irrigation system is an introduction of solar system in irrigation system.

These would be done for conservation of electricity & take a proper utilization of sun rays for producing energy.

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## 1.4 OBJECTIVE

The objective of this study is:

- 1- Socio-economic development
- 2- Fulfill the requirement of water

## II. LITERATURE SURVEY

According to the survey conducted by the Bureau of Electrical Energy in India in 2011 there are around 18 million agricultural pump sets and around 0.5 million new connections per year is installed with average capacity 5HP. Total annual consumption in agriculture sector is 131.96 billion KWh (19% of total electricity consumption).As cited in paper [1]

Photovoltaic (PV) power for irrigation is cost-competitive in comparison to traditional energy sources for small-scale water pumping requirements. With the continuous increase in fossil fuel cost and reduction in peak watt cost of solar cells due to mass production, the photovoltaic power is to become further economical in future [12].

Studies have been carried out on performance evaluation, optimization, sizing techniques, efficiency improvement, and factors affecting system performance, economical and environmental aspects of PV pumping systems. The highlights of the research investigations are presented in this section

## III. PURPOSED SYSTEM APPROCH

This deals with the details of background information about *the solar energy, the solar water pump, its work drip irrigation system, its advantages and disadvantage, limitation and efficiency*. The analytical tools and techniques employed and definition of term and concepts presented under the following heads:

### 3.1 SOLAR ENERGY AND SOLAR POWER

Solar energy is a heat and radiance from the sun that humans have used for light, heating, and cooking from their earliest beginnings. Now solar energy and solar-power secondary resources like biomass, wind hydroelectricity, and wave power account for a large part of the obtainable renewable energy sources on Earth. There has been a growing interest in the benefits of solar energy mainly because of three increasingly detrimental issues: depleting reserves of fossil fuels, rising energy charges, and the impact of burning fossil fuels on the environment.

*Solar power* deals with all of these concerns because it makes use of sunlight to produce energy. The entire process is free of cost and free of risk to the environment. Because of its cleanness and low cost, many commercial and domestic establishment are shifting to this source of energy to meet their energy needs.

Another obvious benefit of solar energy is that it can be used in remote places where conventional power source are unavailable. Even owners of luxury boat and RV are beginning to use solar energy.

*There are many uses for a solar powered pump including:*

1. *Swimming pools*
2. *Fountains or streams*
3. *Farm water (small pumps to carry water from nearby lakes or water holes for cattle)*

#### 3.1.1 APPLICATION

Solar pumps are used principally for three applications:

- Village water supply
- Livestock watering
- Irrigation

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### 3.1.1.1 VILLAGE WATER SUPPLY

A solar pump for village water supply is shown schematically in the village will have a constant water demand although there is need to store water of low isolation (low solar radiation). In environments where rainy seasons occur of this demand can be met by rain water harvesting during rainy season.

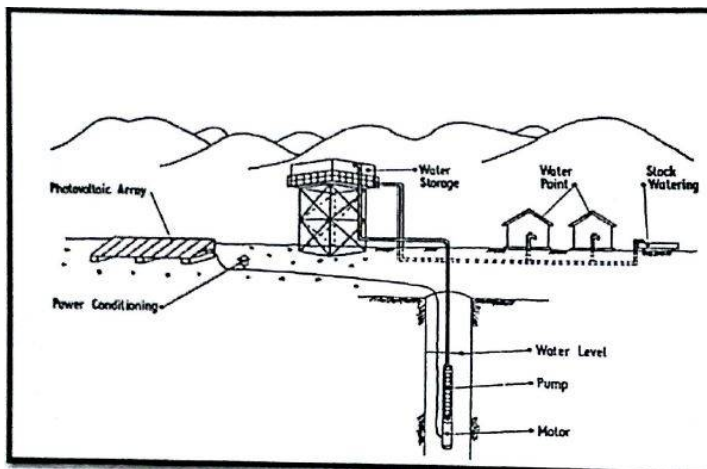


Fig:1 Village water supply

### 3.1.1.2 LIVE STOCK WATERING

The main application for solar water pumping are for livestock watering in the rural area. In some areas the systems are used for village water systems and live stock watering. While application of solar water pumping for irrigation are on the increase especially in India.

### 3.1.1.3 IRRIGATION

A solar irrigation system needs to take account of the fact that demand for irrigation water will vary throughout the year. Peak demand during the irrigation seasons is often more than twice the average demand. This means that solar pumps for irrigation can be under-utilized for the most of the year although there can be a reduction in strength of the sun during these reducing supply side of the equation.

Attention should be paid to the system of water distribution and application to the crops. The system should minimize water losses, without imposing significant additional head on the pumping system and be of low cost.

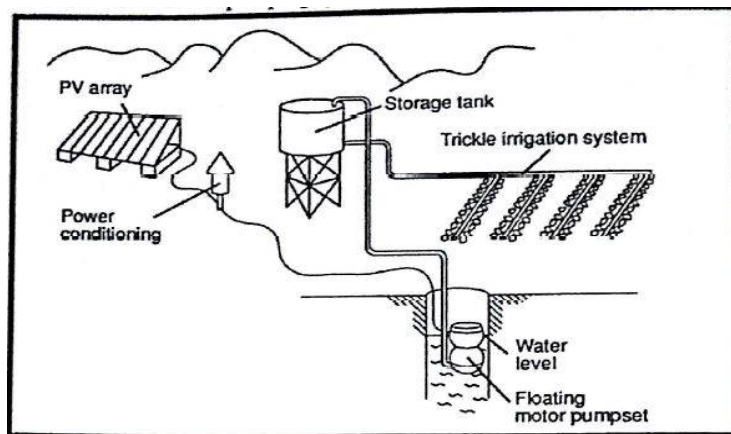


Fig :2 Irrigation system

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## 3.1.2 THE TECHNOLOGY OF SPV PUMP

Photovoltaic pumps are made up of a number of components. There is a photovoltaic array which converts solar energy directly into electricity as DC. The pump will have an electric motor to drive it. The characteristics of these components need to be matched to get the best performance. The pump motor unit will have its own optimum speed and load depending on the type and size of the pump.

## 3.1.3 MOTOR

1. This can be DC and AC .
2. If an AC motor is used then an inverter is also needed AC motors are more widely available.
3. Inverter have become cheap and efficient and solar pumping systems use special *electronically controlled variable-frequency inverter* which will optimize matching between the panel and the pump.
4. A typical AC system would also need batteries which require maintenance an add to the cost as the system is less efficient and would need a larger array.
5. The most efficient type of DC motor is a permanent magnet motor. DC motor may have carbon brushes which replacing when they wear out. If a brushed DC motor is used then the equipment will need to be pulled up from the well (approximately every 2 years to replace brushes).
6. Brushless designs of DC motor exist where electrical circuits are used instead of commutators and brushes. These are becoming popular in solar pumping system.
7. Brushes DC motors would require electronic commutation.

## 3.1.4 SOLAR PANEL

Some models use a GPS sensor to provide latitude, longitude and time data to enable the controller to calculate the position of the sun and position the solar array.

Solar panels are typically installed on rooftops, building tops, or stand –alone facilities. It is vital to install your solar panel so that it gets the most direct sun exposure – you want to make sure your solar panel is maximally effective year round. To do this, there are several web-based solar resources to help you properly set up and install your solar panels by tracking the position of the sun in the sky the course of the year.

### 3.1.4.1 POSITION: SOLAR PANEL IN DIRECT SUNLIGHT

Solar panels perform at optimum capacity when placed in direct sunlight. Try to position your photovoltaic array directly under the noontime sun for maximum efficiency from your photovoltaic unit.

### 3.1.4.2 OBSTRUCTION TO SUNLIGHT

Remove all unnecessary items or trim branches that may be blocking sunlight to your solar unit. Trace the path of the sun in the sky to determine if an object is casting a shadow over your solar photovoltaic panels. If the is the case, then the operating efficiency of your unit will undoubtedly suffer.

### 3.1.4.3 MOUNTING YOUR SOLAR PANEL

Solar panel mounts are used to install photovoltaic solar panels. Solar panel mounts come in three main varieties: pole mounts, roof –ground mounts and flush mounts. Using these mounts , you can install your solar panel onto an RV, on top of or against the side of a pole, on your roof ,or even install them as a free-standing unit. You can learn more about installing solar panels using mounts in our mounts section.

### 3.1.4.4 SOLAR PANEL INSTALLATION TECHNIQUES

Solar photovoltaic panels can be installed on many different types of roofs.

Panel can be flush mounted as well as tilted up.

Whenever possible it is best to install solar panel mounts while a home is being reroofed.

Solar mounts “flushed-in” during the roofing process will eliminate any possibility of roof leaks.

It is also much easier to locate rafter when the roof is off.

All mounts need to be secured onto the roof with stainless steel lag bolts bolted through into rafters.

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Having structural points “flashed-in ” is a wise method of installing solar panels, and the future cost of removal and re-installation of solar panels can be avoided for decades.

Composition shingle roofs are the easiest to work with. tile roofs are more challenging and carrying solar panels across them can be like walking on egg shells.



Fig 3: Solar panel set up

### 3.1.4.5 WATER PUMPING WITH SOLAR PANEL

A good way to put solar panels to use is to install a solar powered water pump for your well. Although windmills have traditionally been used to power such system, a solar –powered system works just as well , and equally friendly to the environment.

### 3.1.4.6 WELL PUMP

It is important to choose a quality well pump for use with solar powered well pump system, one that makes the best use of your power and doesn't require an in efficient, wasteful transformer. Your well drilling provider is likely to offer you the industry standard well pump, a 220 volt alternating current model. The problem with such a high voltage pump system is that the required transformer is extremely wasteful and can be a huge strain on your inverter during startup. This can cause the power to home to dip, and the lights to dim, which can cause a full-out inverter failure unless you have a top-quality inverter. Avoid such a high voltage system if you can instead ,opt for a 120 volt AC model ,which is much more efficient and does not put nearly as much of a burden on your inverter.

### 3.1.4.7 THE SOLAR PANEL AND METERIC METER

Your solar panel does not have to have a very high wattage rating in order to run your solar pump, just check with your well-drilling, company to determine what wattage rating you need from your solar panel. An important consideration when setting up an outdoor solar panel system for your well pump is to ensure that you purchase a mounting rack that offers plenty of clearance between the ground and your solar panel and keep in it an open area away from trees. You don't want any large pets, flood water, or falling branches to damage your solar panel.

Also, we recommend using a true sine wave inverter with solar powered pump system .true sine wave inverters tend to work better when motors are involved (such as those found in a water pump).

If you are interested in reaping benefits from solar panel investment ,read on to discover how you can turn your power meter backwards.

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## 3.1.4.8 FACTORS OF SOLAR CELL COST

Solar panels of the same size may produce variable amount of electricity- this discrepancy arises from variation in the functioning age of the solar cells, the quality of the solar cells, and with what technology they were produced. Early solar cells, for example, are not quite as efficient as modern solar cell, so you'll find that with a trusted solar panel manufacturer, quality increases as the technology involved become more advanced and precise.

As another example, two identical solar cells are purchased. One is left in storage and the other has been in use for three years. Solar panels have an effective life span of about 20 to 25 years, and their value and wattage output decreases steadily over time. The solar cell that has been in storage will be more valuable than that has been actively converting sunlight to electricity for a long time.

In summary, although two solar panels may seem identical, there are a number of the other factor you need to take into consideration, just because a given solar cell is more expensive per square centimeter than another solar cell, it does not mean that the second one is a bargain. Quality, age and technology all play a role in the cost of the solar cell.

## 3.1.5 PUMPS

3.1.5.1 Types of pump and the system configuration are described below

### i. Submersible pumps

Submersible pump often with electronic load controlled. The pump will be submerged while the load controller is above ground.

The advantage of this configuration are that it is easy to install, often with lay-flat flexible pipe work and the motor pump set is submerged away from potential damage.

### ii. Multistage centrifugal pumps

The centrifugal pump will start torque and can be matched with the solar array without electronic controllers. The pumps are not as an efficient as positive displacement pumps using cheap electronic load controllers. It's suitable for smaller heads. Older type set with AC motor operates at heads of 10-25 m.

### iii. Positive displacement helical pumps

Helical pump have the best efficiency and the smallest PV panel for the same specs of water delivery volume pressure and head. They have low rotational speed. The pump is made up a metal helical rotor which rotates in a rubber casing. It is suitable for bigger heads.

A mono solar pumps will slow down when it is cloudy, but because it has no minimum speed (unlike a centrifugal pump) it will keep delivering water.

Submerged pump with surface mounted motor.

The main advantage is the easy access to the motor for maintenance. The low efficiency from power losses in the shaft bearings and the high cost of installation has been disadvantage, In general this configuration is largely being replaced by the submersible motor and pump set.

### iv. Floating motor pump sets

The versatility of the floating unit set makes it ideal for irrigation for canals and open wells. The pump set is easily portable and there is a negligible chance of the pump running dry.

Most of these types use a single stage submersed centrifugal pump. The most common type has a brushless dc motor. Often the solar array support incorporates a handle or 'wheel barrow' type trolley to enable transportation.

### v. Surface suction pump sets

This type of pump set is also suitable for low head application. It is not recommended except where an operator will always be in attendance for maintenance and security of exposed systems.

Although the use of primary chamber and non-return valves can prevent loss of prime, in practice self-start and priming problems are experienced. It is impossible to have suction heads of more than 8 meter.

Less common types of solar powered pumps include solar PV powered reciprocating piston (nodding donkey) pumps and solar thermal pumps or thermo siphon pumps exits but are not commercially used.

## 3.1.5.2 PERFORMANCE OF SUBMERSIBLE PUMP

Solar pumps are available to pump from anywhere in the range of up to 200m head and with outputs of up to 250 m<sup>3</sup>/day.

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Solar pumping technology continues to improve. In the early 1980s the typical solar energy to hydraulics (pumped water) energy efficiently was around 2% with the photovoltaic array being 6-8 % efficient and the motor pump set typically 25% efficient.

Today, an efficient solar pump might have an average daily solar energy to hydraulics efficiency of more than 9% but lower efficiencies of 2-3 % are still common.

It is important to get the most efficient pump available as the difference in cost between the poor pump and a very efficient pump is much less than the additional cost required for a larger PV panel. Accurate sizing of the array is important in keeping costs down.

A good sub system (that is the motor, pump and any power conditioning) should have an electrical to hydraulic efficiency of around 70% using positive displacement pumps. With diaphragm pumps the efficiency will be around 45% and centrifugal pumps might have an efficiency of 20% procurement.

### 3.1.6 ASSESSING REQUIREMENT

The output of a solar pumping system is very dependent on good system design derived from accurate site and demand data. It is therefore essential that accurate assumptions are made regarding water demand / pattern of use and water availability including well yield and expected drawdown.

Domestic water use per capita tends to vary greatly depending on availability. The long term aim is to provide people with water in sufficient quantities to meet all requirements for drinking, washing and sanitation. WHO guidelines aim for a per capita provision of 40 to 50 liters per day for domestic use only, thus a village of 500 people has a requirement of 20 cubic meters per day. Most village have a need for combined domestic and livestock watering which will require much greater amount of water.

Irrigation requirement depend upon crop water requirement, effective ground water contributions and efficiency of the distribution and field application system.

Irrigation requirement can be determined by consultation with local experts and agronomist or by reference to FCO documents.

#### 3.1.6.1 ASSESSING WATER AVAILABILITY

Several water sources parameter need to be taken into account and where possible measured. These are the depth of the water source below ground level, the height of the storage tank or water outlets point above ground level and seasonal variations in water level. The draw down or drop in water level after pumping has commenced also needs to be considered for well and borehole supplies. This will depend on the ratio between pumping rate and the rate of refill of the water resources, and should be measured and/or provided by those who drill borehole In addition:

*There is usually a seasonal variations in the water levels, and a long term trends in the water table level dropping.*

The patterns of water use should also be considered in relation to system design and storage requirements and short periods of cloudy weather. Generally, two to five days water demand is stored.

#### 3.1.6.2 SIZING SOLAR PUMPS

1. The hydraulic energy required (kWh/day)  
= rate of flow (m<sup>3</sup>/day) × head (m) × Water density × gravity / (3.6 × 10<sup>2</sup> × 3)  
= 0.002725 × discharge (m<sup>3</sup>/day) × head(m)
2. The solar array power required (kW<sub>power</sub>) = Hydraulic energy required (kwhour/day)
3. Av. Daily solar irradiation (kwhour/m<sup>2</sup>/day × F × E

Where,

F= array mismatch factor= 0.80 on average ( a safety factor for real panel performance in hot sun and after 10-20 years)

E= daily subsystem efficiency = 0.25 – 0.40 typically

#### 3.1.6.3 ECONOMICS

In general photovoltaic pumps are economic compared to diesel pumps up to approximately 3 kWp for village water supply and to around 1 kWp for irrigation.

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## 3.1.7 BENEFIT OF SOLAR ENERGY OVER COMMERCIAL ELECTRICITY SUPPLY

Using the commercially available solar cells (as of 2005) and system technology leads to system efficiencies between 5 and 15% . as of 2005.

Electricity generation will cost ranged from – Rs.25/kWh down to – Rs. 12/kWh in regions of high solar irradiation which comparable with the prevailing retail electric pricing (as of 2005) worldwide.

While calculating costs, several internal cost factors have to be considered .( Note the use of ‘cost’, which is not the actual selling price , since this can be affected by a variety of factors such as subsidies on some energy and sources and taxes on other):

- i. Capital costs (including waste disposal and decommissioning costs for nuclear energy - tend to be low for fossil fuel power stations; high for wind turbines, solar PV and nuclear: very high for waste to energy , wave and tidal ,solar thermal.
- ii. Fuel costs –high for fossil fuel and biomass, very low for nuclear and renewable.
- iii. Factor such as the costs of waste (and associated issue) and different insurance costs are not included in the following; works power, own use or parasitic load – i.e. the portion of generated power actually used to run the stations pumps and fans has to be allowed for.

## 3.2 DRIP IRRIGATION

Drip irrigation is sometimes called trickle irrigation and involves dripping water onto the soil at very low rates (2-20 liters/hour) from a system of small diameter plastic pipes fitted with outlets called **emitters** or drippers. Water is applied close to plants so that only part of the soil in which the roots grow is wetted (Figure 4), unlike surface and sprinkler irrigation, which involves wetting the whole soil profile. With drip irrigation water, applications are more frequent (usually every 1-3 days) than with other methods and this provides a very favorable high moisture level in the soil in which plants can flourish.

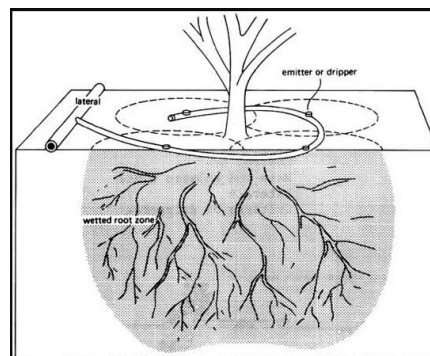


Fig:4 Drip Irrigation

### 3.2.1 COMPONENT & OPERATION

#### 3.2.1.1 Components (listed in order from water source)

A typical drip irrigation system is shown in Figure 5 and consists of the following components:

- Pump unit
- Control head
- Main and sub main lines
- Laterals
- Emitters or drippers.



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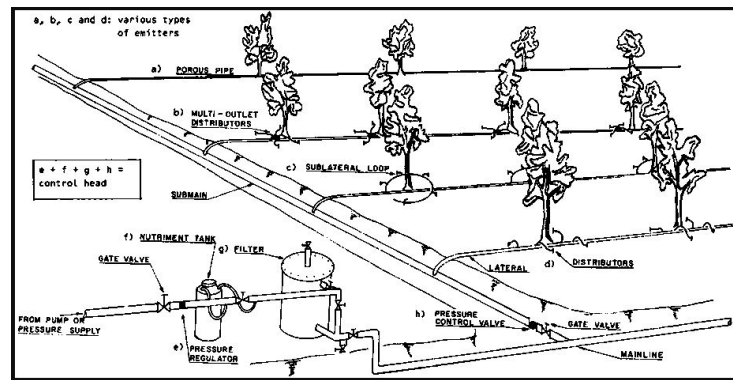


Fig:5 Component of drip Irrigation

The **pump unit** takes water from the source and provides the right pressure for delivery into the pipe system. 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.

**Mainlines, sub mains 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. Lateral pipes are usually 13-32 mm diameter.

**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 meter apart with one or more emitters used for a single plant such as a tree. For row crops more closely spaced 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. Various types of emitters are shown in Figure 5 and Figure 6. Figure 6 gives an example of sub lateral loops.



Fig:6 Emitter

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### 3.2.1.2 OPERATION

A drip system is usually permanent. When remaining in place during more than one season, a system is considered permanent. Thus it can easily be automated. This is very useful when labour is scarce or expensive to hire. However, automation requires specialist skills and so this approach is unsuitable if such skills are not available.

Water can be applied frequently (every day if required) with drip irrigation and this provides very favorable conditions for crop growth. However, if crops are used to being watered each day they may only develop shallow roots and if the system breaks down, the crop may begin to suffer very quickly.

### Wetting patterns

Unlike surface and sprinkler irrigation, drip irrigation only wets part of the soil root zone. This may be as low as 30% of the volume of soil wetted by the other methods. The wetting patterns which develop from dripping water onto the soil depend on discharge and soil type. Figure 7 shows the effect of changes in discharge on two different soil types, namely sand and clay.

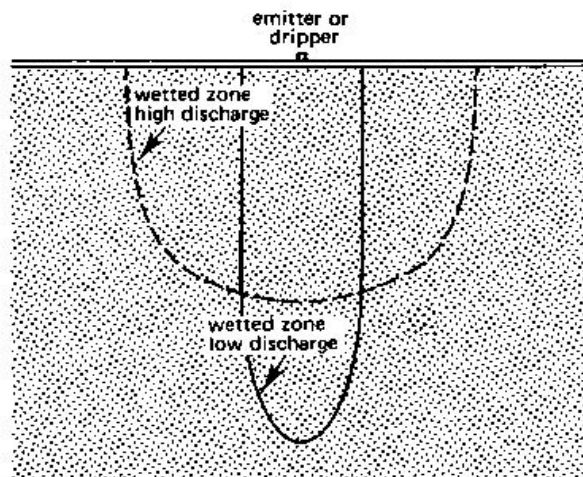


Figure 7 Wetting patterns for sand and clay soils with high and low discharge rates (SAND)

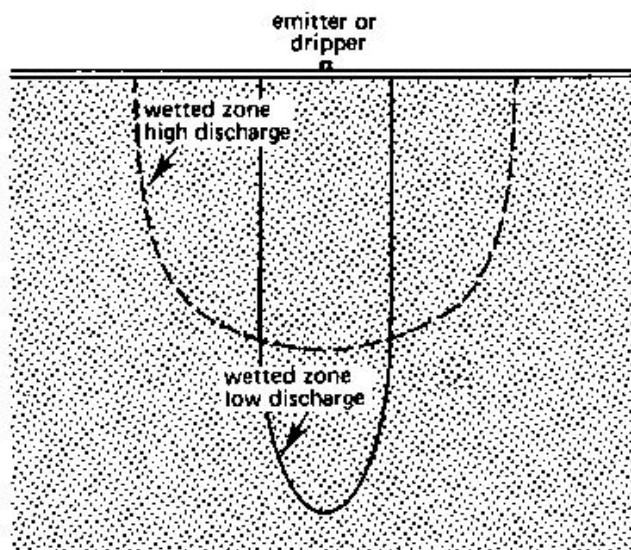


Figure 8 Wetting patterns for sand and clay soils with high and low discharge rates (CLAY)

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Although only part of the root zone is wetted it is still important to meet the full water needs of the crop. It is sometimes thought that drip irrigation saves water by reducing the amount used by the crop. This is not true. Crop water use is not changed by the method of applying water. Crops just require the right amount for good growth.

The water savings that can be made using drip irrigation are the reductions in deep percolation, in surface runoff and in evaporation from the soil. These savings, it must be remembered, depend as much on the user of the equipment as on the equipment itself.

Drip irrigation is not a substitute for other proven methods of irrigation. It is just another way of applying water. It is best suited to areas where water quality is marginal, land is steeply sloping or undulating and of poor quality, where water or labour are expensive, or where high value crops require frequent water applications.

## 3.2.2 ADVANTAGE & DISADVANTAGE

- **Advantages of Drip Irrigation:**

- 1. Maximum use of available water.
- 2. No water being available to weeds.
- 3. Maximum crop yield.
- 4. High efficiency in the use of fertilizers.
- 5. Less weed growth and restricts population of potential hosts.
- 6. Low labour and relatively low operation cost.
- 7. No soil erosion.
- 8. Improved infiltration in soil of low intake.
- 9. Ready adjustment to sophisticated automatic control.
- 10. No runoff of fertilizers into ground water.
- 11. Less evaporation losses of water as compared to surface irrigation.
- 12. Improves seed germination.
- 13. Decreased tillage operations.

- **Disadvantages of Drip Irrigation:**

- In spite of the fact that drip irrigation has so many potential benefits, they're a certain limitation also, there are as follow:
- 1. Sensitivity to clogging
- 2. Moisture distribution problem
- 3. Salinity hazards
- 4. High cost compared to furrow.
- 5. High skill is required for design, install and operation.

## IV. METHODOLOGY

In these project our aim is to minimize the amount of water for irrigated consider area.

The methodologies which we use are on the basis of *solar drip irrigation system & solar sprinkler irrigation system*. It will help to promote the sustainable use of water and energy in between the small farmer of our state.

### 4.1 INTRODUCTION

Irrigation is necessary in the establishment of newly planted vegetation on man-made slopes and for keeping vegetated man made slopes green dry seasons. It is best to irrigate your garden at night during the summer so that the plants have time to absorb the water before it evaporate. With all these great advantage it is easily understandable why solar irrigation is becoming so popular for watering needs for both gardens and plantations.

### 4.2 SOLAR DRIP IRRIGATION

The latest system aims at applying the water directly to the root zone of the crops in the form of drops. The system consists in conveying water through a flexible pipe line arrangement operating under low pressure and applying water to the root zone pipe line arrangement operating under low pressure and applying water to the root zone of the plants

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through drip nozzles. The system thus reduces the loss of valuable water by evaporation and percolation. The system enables to maintain just desired amount of moisture in the root zone of the soil required for consumptive use of the plant growth. It is a sub irrigation or sub surface irrigation systems in which water is applied below the ground surface directly to the zone of the crops.

Drip irrigation can reduce the water requirement by as much as 25 to 50 % compared to conventional irrigation system. The main advantages of drip irrigation system are that soil moisture remains relatively constant, and air is always available to the roots. In other watering method there is an extreme fluctuation in water content, temperature and aeration of the soil. With drip irrigation the water soaks in immediately when the flow is adjusted correctly. There is neither running nor runoff, so water is not wasted. All of the water is accessible to the roots as it applied near the root zone. Water lost to evaporation is negligible and interference by wind is minimal.

## 5 COMPONENTS REQUIRED FOR DRIP IRRIGATION

Careful choice of the components means half battle is won. Therefore, the following points should be taken into account when selecting a drip system.

1. Ease of installation
2. Ease cleaning the emitters
3. Durability
4. Types of filters
5. Possibility of flow control

The components of drip irrigation are

### 1. TANK

Material –stainless steel

Dimension-50×37×15 cm<sup>3</sup>

*IN LARGE SCALE*

Gross commanded area (GCA): 1 Acre = 4047 m<sup>2</sup> (approximate)

Cultivation commanded area (CCA); 75% of GCA = 3035.25 m<sup>2</sup>

### 2. SUBMERSIBLE PUMP

Type : Open Well Submersible Pump

Power : 0.5 Hp

Voltage : 8V-24V DC (Standard: 12V DC)

Max flow rate : 2 liter/min

Brass ½ BSP/NPT main Inlet/outlet

Max working Pressure : 10 Bar

Max working temperature: 110°C (230°F)

Min start-up power consumption less than 2 watt

Assume, efficiency: 70%

### 3. STAINLESS STEEL

Stainless steel net is used to providing the base and percolate the water from model prepared ground level to the tank.

Stainless steel net is supported by hard wood. The hard wood stretch it and keep it in its position.

### 4. WATER PIPE LINE

IN MODEL:

Plastic pipes were used of length 45cm that is 18.75 inch and diameter of 0.7cm.

IN MAIN FIELD

Buried PVC pipes were used for the main lines (10-inch diameter), sub mains (4-inch diameter), and flush manifolds (3-inch diameter). The main lines were designed for future expansion to 200 acres.

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## 6 SOLAR PANEL OF 10 WATT AND 16 VOLT.

SCHOTT MONO190 convinces with its mono-crystalline high performance cells. The particularly high degree of cell efficiency ensures a high module performance .

Following feature characterize the high yield solar module:

Mono crystalline high performance cells with efficiency factor of over 17.5% for excellent module efficiency factors provide optimum results on small roof surface more output per module generates high yields.

The positive tolerance of the nominal power rating provides a stable high energy output. Black cells in combination with black frames warrants high twist resistance.

Double internal quality standards in comparison with the IEC- standard ensure a safe investment SCHOTT Solar provides a 25 –year linear performance guarantee for these glass-foil modules which guarantees high yields.

### 4.2.2 OPERATION

The operation would be done for rabbi and summer season, when the requirement of water is high. This project is has been carried out for the purpose of vegetable irrigation. A 37×32 cm<sup>2</sup>, Solar panel is used in the process.

1. The solar panel is kept in such a way that sun rays falls on it uninterrupted (without any obstruction). The power generated by the panel is rated to be 40watts, Which is stored in the battery.
2. The pump utilizes this power to do the mechanical work of distributing water irrigation area.
3. The pump lifts water from the tanks of the cross-sectional area cm<sup>2</sup> and depth 20cm.
4. The water lifted by the pump is then horizontally distributed with low pressure.

## V. OBSERVATION / RESULT & DISSCUSION

### 5.1Formulas

#### 6.1.1 PUMP MOTOR

The pump is driven by ac motor whose optimal value can be computed by the following expression

$$\text{Motor Power} = \frac{HP}{\eta}$$

Where, HP = Hydraulic power of pump [W]

$\eta$  = Efficiency of pump

The hydraulic power HP can be computed by the following expression

#### 6.1.2 HYDRAULIC POWER

$$HP = Q \rho g H / 3.6 \times 10^3 \times 2$$

Where , Q=discharge rate m<sup>3</sup>/sec

$\rho$  =density of water 1000 kg/m<sup>3</sup>

g= acceleration due to gravity 9.81 m/sec

h= dynamic head (m)

### 6.2 CALCULATION

VOLUME	TIME (sec)	DISCHARGE (m <sup>3</sup> /s)
1 litre	10.6	0.0943×10 <sup>-3</sup>
1 litre	10.58	0.0943×10 <sup>-3</sup>
1 litre	11.72	0.0943×10 <sup>-3</sup>

Hence,

$$Q = \text{Mean Discharge Rate} = \text{flow density} = 0.09137 \times 10^{-3}$$

Pf $\eta$  = hydraulic power (kW)

T = Mean Timing = 10.97 sec

p $\eta$  = motor power

Dynamic head = (40+5) Feet above the ground surface

= 45 feet

= 15 m

Therefore , hydraulic Power =  $Q \rho g H / 3.6 \times 10^3 \times 2$

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$$= (.09137 \times 10^{-3} \times 1000 \times 9.81 \times 15) / 3.6 \times 10^{3 \times 2}$$

$$= .00000373474 \text{ kW}$$

$$\text{Hp} = 3.73 \times 10^{-3} \text{ watt}$$

Assumed ,efficiency of a pump = 0.60

Then Motor power = HP/Efficiency

$$P_m = P_h / \eta$$

$$= 3.73 \times 10^{-3} / 0.60$$

$$= 6.2167 \times 10^{-3} \text{ Watt}$$

$$\text{Motor power} = 6.2167 \times 10^{-3} \text{ Watt}$$

IN LARGE SCALE CALCULATION

Since , in 1sec discharge is  $0.09137 \times 10^{-3} \text{ m}^3/\text{sec}$

Therefore , in 1 hr discharge is 0.3289 cumecs

Pumps run for sucking the water for 4 hr

Hence, discharge in 4 hr is 1.316 cumecs

Hydraulic power required in 4 hr 0.05379 kW that is 53.79 Watt for irrigate 75% of lacer i.e. 3035.25m<sup>2</sup>.

It required 2 **NUMBER** of U5-40 Solar panel

Feature of BP 340J Solar panel

FEATURES	VALUE/TYPES
Rated Power(Watt)	40
Voltage at maximum power(V)	17.5
Current at maximum power(Amp)	2.28
Cell Type	Monocrystalline
Cell Temperature at which max power tested	20°C
Construction	Glass/Tedler
Size(mm)	(0.635x0.550x.035) m <sup>3</sup>
Cost per unit watt (Rs/-)	489.5/-

Hence, Total size of Panel required  $1.31 \times 1.07 \times 0.050 \text{ m}^3$

2 Nos. of U5-40 generate 80 Watt at 25°C temperature

### 6.3 INSTALLATION COST OF SOLAR IRRIGATION SYSTEM

MATERIAL	COST(Rs/-)
2Nos. PV Panel 40W, 17.3V	39160/-
Battery 150AH/ 12V (3 yrs. service life)	10000/-
Submersible Pump	3500/-
Maintenance	1000/-
<b>Total</b>	<b>53660/-</b>

### 6.4 COST ANALYSIS

The subsidiary cost given by Central government to the farmer = Rs 80/watt

Similarly, the subsidiary cost provided by state government to the farmer = Rs 50 watt

Hence, total Subsidiary Cost = Rs 130 Watt

$$\text{Therefore , Cost of the 2nos. Panel 40W, 17.3V} = \text{Rs.}(489.5 - 130) \times 40 \times 2$$

$$= 28760/-$$

$$\text{Hence Total cost after subsidiary} = \text{Rs} (28700+10000+3500+1000)$$

$$= 43260/-$$

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If any provision of battery is given for storage then its calculation will be done. The maintenance cost is computed from the erecting of solar Panels.

## VI. CONCLUSION

In present days the available sources of fossil fuel gradually decreasing resulting, the increase in their cost. The electricity is being generated by thermal power plants using coal.

The cost of commercial electricity is very high in these days, resulting unaffordable cost of electricity for a poor farmer, while solar energy is natural source power generation. It is more reliable and also conservative in nature and easily available free of cost.

Introducing Drip irrigation system with solar energy, it shows efficient work and reduced losses of water and cost of commercial energy about 90%.

The solar energy is renewable source of energy. Hence it requires only 2nos. of solar panel to irrigate 1 acre of land. The cost of the solar panel which we calculated was 39160/- as installation cost and 1000/- maintenance cost. It will be sufficient for cultivation area of 1 acre at 53.79 Watt.

The Battery with the solar panel gives a backup of 2-4 days, therefore when its winter or rainy season when sun hides, it would be good enough to get through the day till the next day or else will use regular power as a backup.

Drip irrigation can help you to use water efficiently. The immediate benefits of drip irrigation are reduced water use by 30-40% as compare with Furrow Irrigation and 50-60% as compare with Flood Irrigation system, and gives opportunities for maximizing the production while minimizing the cost. The maintenance cost of Drip irrigation system is low and is reliable for 4-5 year.

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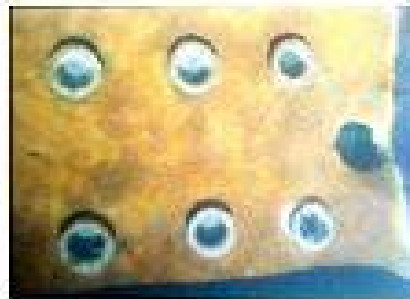
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## APPENDIX PHOTOGRAPHS MODEL PARTS

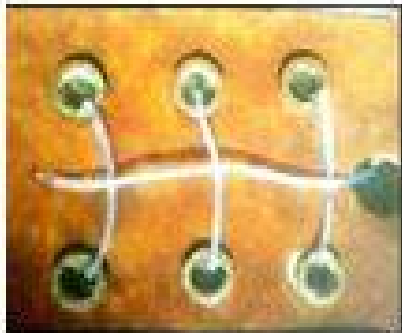
1. TANK



2. FIELD FOR CULTIVATION OF VEGETABLE



3. WATER DISTRIBUTION BY PIPE



4. OUTLET OF PIPES





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### 5. SUBMERSIBLE PUMP (Open Well)



### 6. IRRIGATION OF FIELD

