



Applications of Solar Electricity in Crop Production and Protection

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Introduction

The sun light plays an important role in agriculture, starting from plant photosynthesis to drying of post harvest agro produces. In earlier days, solar energy was more effectively utilized in open yard sun drying for drying purposes. The sunlight is more abundantly available in tropical parts of the country, which will show more potential for harnessing and utilizing solar energy effectively in Indian agriculture. Presently, electricity is one of the energy sources used in agriculture, mainly used for operating the irrigation water pumps, electric fencing, stand alone agricultural machineries, light trap, bird scarer etc., However, the availability of electricity is limited to all the agricultural fields due to several factors. Solar photovoltaic (PV) technology is recently getting popular among the farming community due to simple operations, low maintenance, and highly reliable energy source. Solar PV technology utilizes solar radiation to generate electricity. Generally, heat and electrical energy can be obtained from solar radiation by using suitable devices. Solar thermal devices are used for tapping the heat energy from solar radiation. The solar PV devices are employed for converting the sunlight into electricity.

What is solar electricity?

The electricity production via solar PV devices is called solar electricity or green electricity. It is produced from sunlight using a solar cell. The solar energy conversion into electricity takes place in a semiconductor device is called a solar cell. Generally, the working principle of solar cell is based on the photovoltaic effect, i.e., generating a potential difference at the junction of two different materials in response to electromagnetic radiation. The solar radiation falls on the solar cells' surface can directly produce direct current (DC) electricity. In order to meet the desired electrical load, the solar cells can be connected in series or parallel to form solar panels. Further, the solar array can be formed by connecting the solar panels for producing large scale electricity. The electrical load can be connected directly to solar panels or through a battery. These cells are made up of semiconductor materials, and mostly silicon materials are used.

What are the components of a solar PV system?

Generally, the solar PV system is consists of solar panels, battery, charge controller, inverter, electrical cables, junction boxes, and a supporting structure. The solar panels are used to produce DC from sunlight. The battery is used to store the solar electricity produced by the solar panel. The charge controller monitors and controls the flow of current from the battery to the utility point and current supply from solar PV panels to the battery. If the

battery is fully charged by electricity from solar panels, it should not be recharged further, *i.e.*, overcharging. The charge controllers would prevent the battery from overcharging by disconnecting the power from panels to the battery. The purpose of the inverter in the solar PV system is to convert direct current into alternating current (AC). This component is an essential component of the solar PV system connected with AC machines. The cables are used for connecting the solar PV system's different components for electricity flow. The supporting structure can accommodate the different components of the solar PV system.

Benefits of solar PV power systems

- ✓ Solar energy is renewable, freely available, and also a pollution-free resource for solar electricity production.
- ✓ It has no mechanical moving parts, thus results in a low maintenance cost.
- ✓ This system can be more effective in remote and off-grid areas.
- ✓ A battery can be used to store solar electricity for further usage.
- ✓ Act as a power source for a variety of applications, starts from street light to satellites.

How can we effectively utilize solar electricity in agriculture?

Solar electricity can be used for different applications in agriculture. The solar PV devices available for different applications are presented in Table 1.

Table 1: List of solar PV powered devices used in agriculture

Sl. No	Name of PV devices	Nature of applications
1	Solar PV water pumping system	For irrigation purposes
2	Solar insect trap	To monitor and manage the harmful insects
3	Solar PV powered bird scarer	To protect the seeds, agro and horticultural produces from birds
4	Solar PV drones (with sensors)	To monitor the plant infesting insect pests, diseases and nutritional deficiencies
5	Solar PV powered weeders	For mechanical weeding operations
6	Solar-powered vehicles	Transport of agro produces
7	Solar PV supported automated irrigation system	For efficient use of water through drip irrigation by planning irrigation scheduling



8	Agrophotovoltaics system	Simultaneous production of food and electricity
9	Solar PV powered electric tractors	Different operations in agriculture such as sowing, ploughing, etc
10	Solar PV sprayer	Spraying of liquid chemicals
11	Solar PV duster	Application of powdered chemicals for managing the insect pest and diseases
12	Solar hybrid dryer (Solar PV and solar drying)	For the drying of different agricultural produces
13	Solar PV powered winnowers	For winnowing of grains to remove small insects, inert materials and also for grading
13	Solar PV desalination systems	To produce consumable plant water from saltwater
14	Solar PV powered solar greenhouses	To provide a better environment for plant growth with a protection from insect and vector transmitted diseases
15	Solar fencing	To protect the plants from wild animals

There is more potential for solar electricity to replace the conventional electricity used for different applications in agriculture in India. This step would help to develop energy, sustainable, and profitable agriculture. Among the several PV devices used in agriculture, solar fencing, solar PV water pumping system, and different models of solar insect traps have already reached commercialized scale production and reached huge numbers of them to help the farming community.



Fig. 1: Solar PV powered water pumping system



Fig. 2: Solar fencing



Fig. 3: Solar insect trap