

# PHOTOVOLTAIC AGRICULTURE

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## INTRODUCTION

Photovoltaic agriculture is an efficient system that supports the enhanced production of electricity and crop with in the same land. Here, it is not only focused on power generation but also on getting quality yield from the agricultural components of the system. The components may range from shade tolerant crops to livestock under a roof fitted with solar modules.

Starting from Albert Einstein's theory of photoelectric effect, which led to the discovery of solar cells there have been many scientists, developed the idea and experimented with the applications and development of photoelectric effect. Though there were many pioneers in the field of photovoltaic, it was Adolf Goetzberger, German physicist with Armin Zastrow in 1981 expanded its application in the field of agriculture. Dating back from 19th century it took more than two decades for the theory to be adopted in a large scale out of experiment fields, in Japan by Nagashima in 2004. After which it started growing exponentially around the globe.

## Why to shift from the conventionals?

This is the question that arises when the conventional practice is comfortable but we have evidently created a global discomfort in

the form of climate change by burning fossil fuels over the limit resulting in increased average global temperature. This leading to glacier melts and sinking of small islands due to rise in sea level. Lose of biodiversity from coral reefs to all the life forms under and above water. The bigger picture is definitely the concern that is accumulated by individual domestic house holds. One of the major concerns of small and medium farmers is the cost spent on fossil fuel that can be saved by altering to the renewable source. It is a good source of power generation that also reduces the noise and air pollution from the diesel motors and fumes of generators in the field. Spill contaminations in the field is polluting the horizons during the transportation of fuel can be deteriorating the humus and below. With ever increasing fuel cost and electricity bill the remedy is the need of the hour.

## Applications of photovoltaic in agriculture

The array of solar panel with well planned arrangements can be very effective for achieving the goal. These arrangements and installations vary depending on the need and application. Photovoltaic agricultural greenhouse is one of the main applications where the roof of the green house is either substituted with solar

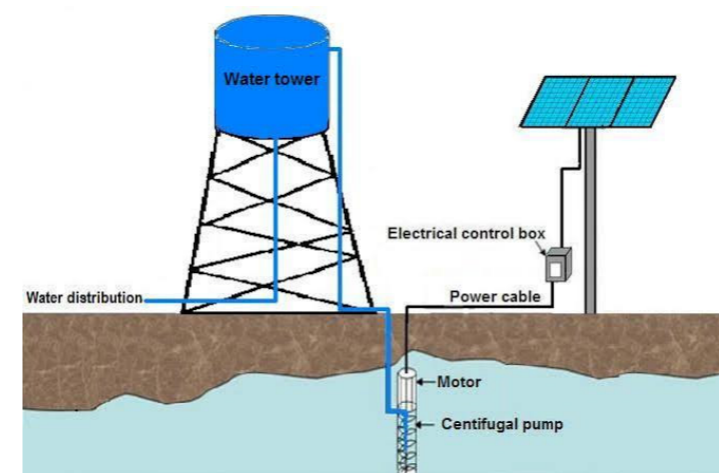
modules or solar modules are fitted over the roof leaving a gap on a mount. The solar modules if replaced with the conventional green house roofs one has the options to choose among the transparent one and the opaque one based on the crops to be grown under the roof.

Photovoltaic livestock are those that get benefitted from both the power generated and the shade the panels provide. Mostly these panels are mounted on concrete pillars that occupy the least area. Pasture lands of sheep and even over the ponds of fishery. The microclimate created by these structures is favorable as the air is cooler during day and warmer during the nights.

Photovoltaic wastewater treatment involves treatment of HF removal, pH neutralization and the discharge containing propanol (for the production of cells based on mono-crystalline silicon. This is an effective method is removing undesirable substances from the waste water.

Photovoltaic pumping is again a simple and effective application where the water is drawn up to the water reservoir with the power generated from the solar radiation and once the water reaches an elevation good enough to distribute to cover the entire system, irrigation is achieved.

The one main concern with the unpredictable weather conditions can be mitigated to an extent with batteries of capacities to sustain the period of solar absence.



# TYPES OF ARRANGEMENTS OF SOLAR PANELS

1. Roof top solar arrays that is being installed over the green house.
2. Solar array that is installed in an allotted portion of the farm which may either serve the purpose as wind shield or simply for harnessing the maximum solar radiation.
3. On field solar arrays :-In between the crops or even above the shade tolerant ones and those that grow under a green house. These structures can even be installed in such a way that it covers the irrigation channel without competing with the crops for light and space. This has the added advantage of reducing the evaporative losses of irrigation. The one vital factor considered in installation is the orientation of the arrangements. These panels mounted should be maintained with the required distant so that its shade doesn't fall on the one next to it at any time. South to north is the most preferred direction for installation.

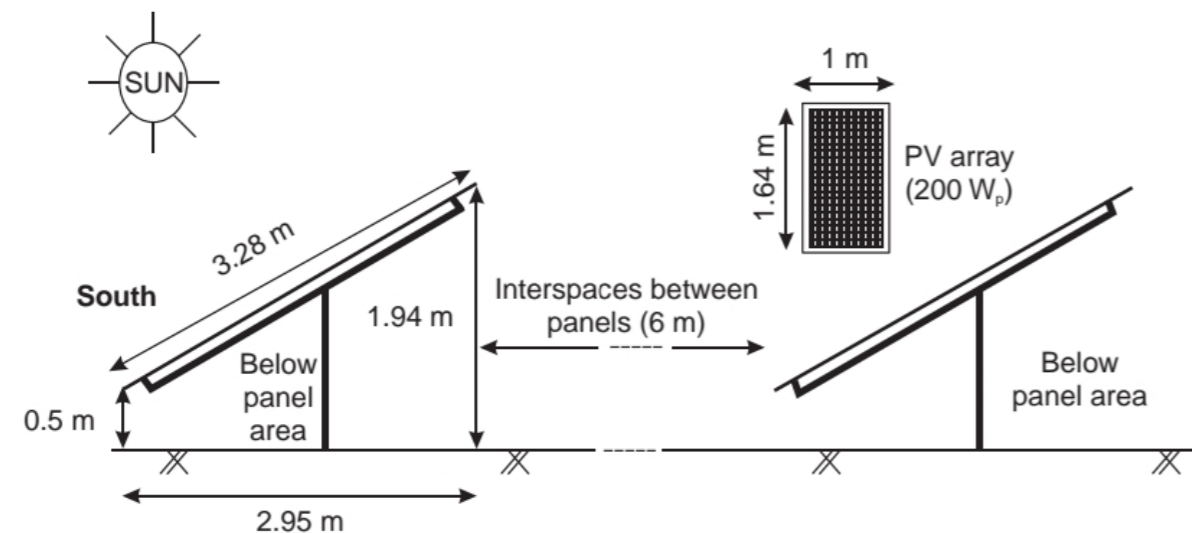


Fig. 2. Design of typical agri-voltaic system.

Some of the crops that can be grown in between and under these structure include *Vigna radiata*, *Vigna aconitifolia*, *Cicer arietinum*, *Capsicum annum*, *Brassica oleracea*, *Allium cepa* and *Allium sativum*.

## GLOBAL INITIATIVE

The international Solar Alliance (ISA) is an initiative launched by India in the year 2015 for the promotion of solar energy utilization, under United Nations Conference on Climate Change in Paris. After the virtual meetings held in the month of February, 2021 there are talks of solar bank. The Solar bank will be a financial agency that pools resources from around the globe to finance the member countries in building solar grids. So far there are 121 ratified members, who are all expected to join the OSOWOG (one sun, one world and one grid) to make it into a successful change.

## CONCLUSION

Photovoltaic agriculture is a mutualistic relationship between man and machine as these modules are sensitive to temperature they tend to have PID losses (Potentially Induced Degradation) when reaches its temperature coefficient and remains there for a prolonged period. To avoid this they should be kept among or near vegetation to have the required moisture to prevent itself from completely drying out. India being in the solar rich belt and the current president of ISA, as a citizen it is our duty to take part in the initiative. So far India has achieved building solar structures with a capacity of 32GW. With feed in tariff systems each individual can generate and contribute to the national and the global grid.

