

Dual Use of Land for Farmers using a Combination of Solar Photovoltaic Panels and Agriculture: Agrivoltaics

Dr. V. K. Jain

**Amity Institute for Advanced Research and Studies
(Materials and Devices)
Amity University, Noida**

Team Members:

Dr. Suman, Dr. Abhishek Verma, Amity Institute for Advanced Research and Studies (M & D)

Dr. Naleeni Ramawat

Amity Institute of Organic Agriculture

Agri - Voltaics: For Farmers

Agri-voltaics: A new concept for

- i. 'farmers for Cultivation' and
- ii. 'Photovoltaic for Power generation', *together*.

❖ Farmers in India are many times facing the problems due to ***heavy rains, floods, hailstorms or due to drought and many others reasons.***

(*can provide a good support to the farmers during these extreme conditions*)

❖ Also a new concept for getting ***the maximum efficiency*** of the solar panels. It can ***provide the solution of loss in efficiency*** due to ***increase of temperature*** and ***deposition of dust*** on these panels.

Agri – Voltaics Working Model in Amity University, Noida

- ❖ To show the feasibility of this model, we at *Amity University has set up a working model of 10KW electricity generation as well as grown the food crops in the same field.*
- ❖ *2KW solar panels have also been installed to supply the electricity for solar water pumps and farmer's house, etc.*
- ❖ The total agriculture land area of *35 x 18 meter* has been used as the proof of the concept, to install the *solar panels with a particular optimized design.*
- ❖ Complete software modeling has been performed to keep the particular distance in each panel and the height of the solar panel to get the maximum outcome with minimum shadow effect on the crops.







Agri – Voltaics Working Model in Amity University, Noida

Effect of shadow of solar panels on the crops

- ❖ The shadows of solar panels will fall on the crops. The shadow is not constant but moving as the sun is moving. ***Due to this effect, the shadow on crops will be very less or no effect.***
- ❖ studied the shadow effect on different crops by measuring the intensity of the sun radiations in the shadow area and making a comparison of the growth of the crops by having a control in non-shadow areas.

Solar panels in Agivoltaic

- ***Solar Panel's Temperature***

- The temperature of the solar panels increases to very high of the order of **60-80°C**. At these temperatures the efficiency of these cells goes down by **4-5% down**

Agrivoltaics will automatically cool solar panels by evaporation of water (transpiration) due to the crops below the panels.

This will be an extra advantage in comparison to having the solar panels in the barren lands.

- ***Accumulation of Dust on top of Solar Panel***

- ***Here a special design has been made to clean the dust from the solar panels using water from the solar water pump.***

Advantages of Agri - Voltaics

These are **several gains to the farmers** after adapting Agri-Voltaics concept:

- ❖ The farmers **can grow any crop** and **earn money as usual**.
- ❖ However, by **using this type of double structure**, they can **earn extra money by selling the electricity** to Government and **increase income** for their families. .
- ❖ They can **even use some part of this electricity for their house** (as they are generally living near their farmland) and can **improve their living conditions**.
- ❖ They can also **utilize some power generated to run the solar water pump for irrigation** and should not wait for the electric supply from the Government. It will make them **more independent**. This will also **remove the dependency on the diesel generators**, which tremendous lot of pollutions.

Photographs of the installed Agrivoltaics Model on the Agricultural Land



Installed 10 KW Solar Power Plant on the Agricultural Land

Photographs of the installed Agrivoltaics Model on the Agricultural Land



Dust Cleaning on Solar Panels using water from Solar Water Pump



Shot on OnePlus
Powered by Dual Camera



Connecting Agri-voltaics to Government's Swachh Bharat Abhiyan (Clean India Movement).

- ❖ Recently a large number of toilets have been made in remote areas, but a large number is not in proper use due to the non-availability of running water.
- ❖ This difficulty can be overcome by using the solar water pump in remote areas and has been shown in our model.
- ❖ Here, we have assumed that if a farmer is living in his house which is at a remote area nearby his farm field, he can easily access the water from same solar water pump for their toilets and can also supply water to nearby many toilets.
- ❖ Another advantage is availability of clean drinking water using the R.O. (as the electricity is available) at the remote place even.
- ❖ Farmer can also utilize the partial generated off-grid solar power for his lights, fans and plus even for TV, mobile charger, R.O system to have the clean drinking water, etc. This model has also been successfully installed in Amity University, Noida near the agriculture land.

Photographs of the installed Agrivoltaics Model on the Agricultural Land



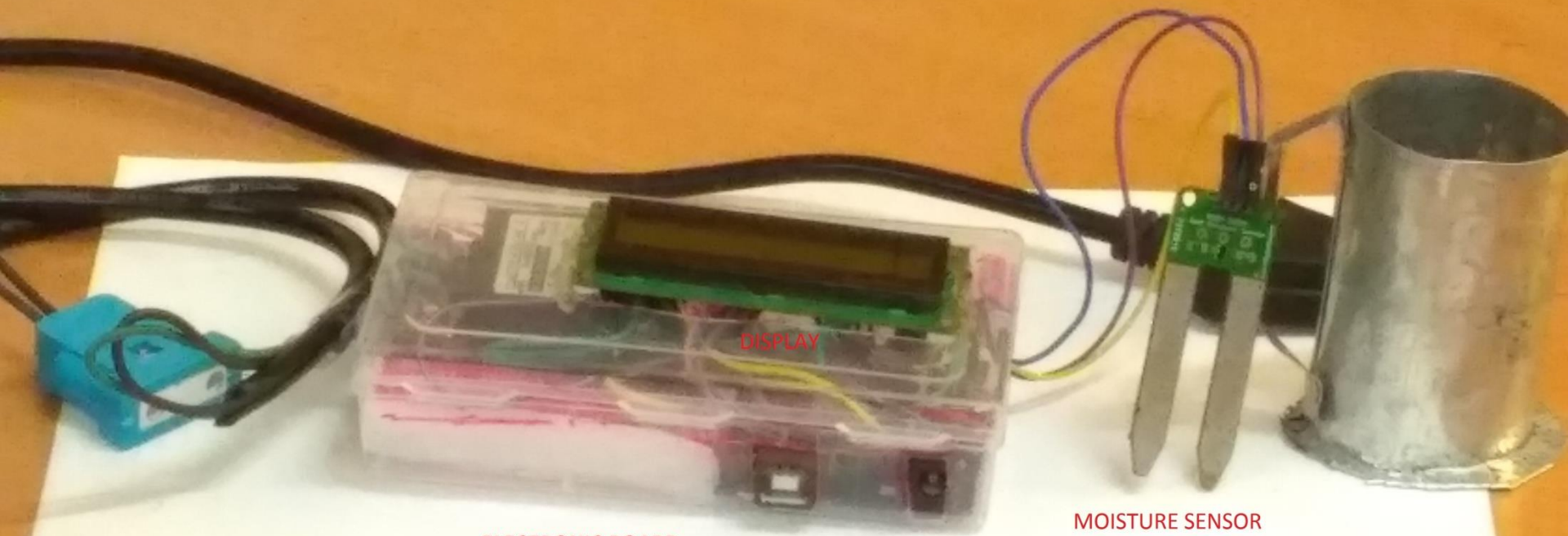
Farmer's house nearby Agricultural Field with modern utilities running on the partial solar power energy generated using Agrivoltaics Concept

Farmer's house nearby Agricultural Field with modern utilities running on the partial solar power energy generated using Agrivoltaics Concept









ELECTRONIC BOARD

MOISTURE SENSOR

Effect of Agri-photovoltaic on growth and development of Crops:

Maize

Date of sowing: 08 June 2017

Date of germination: 16 June 2017

Types	Plant height (cm)	No of leaves	No of Cobs per
Treatment	185	11	1
Control	180	12	1

Brinjal

Date of Transplanting of Brinjal: 12 July 2017

Types	Plant height (cm)	No of leaves	No of Cobs per
Treatment	32	20	8
Control	30	20	8

Note: The data presented is mean value of five plants replicated thrice

Financial Example for Agrivoltaics Concept

Agrivoltaics would help to add to the economic viability of these.

Will get gain from crops

From Solar panels for example

Panel	Space required	Cost	units generated	sale Rs.7/unit
10kw	1000sq.feet	app.Rs. 7 lakhs	50 units (if sun is for 5hrs) 100units/day (if sun is 10hrs)	cost Rs. 350/day cost Rs.700/day

If he is using maximum 20 units/day for irrigation and his house, he can save about 80 units

80X7=Rs.560/day means more than Rs. 10000/ month approximately can be earned.

How can this model be implemented

Following ways are suggested to do so.

- ❖ One way is that Govt. can provide 50% of subsidy or more to farmers.
- ❖ Another way is that Govt. can give soft loans with minimum interest and can have a collection of minimum of Rs. 2000/ month.
- ❖ Yet another formula can be some private person, who can install the total plant costing Rs. 6 lakhs and can share 50% of the earning per month with the farmer.

Thanks