



Socio Economic Impact of Solar Energy Resources in Agriculture Sector: An Analytical Study

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Abstract:

India is the fifth economic power in the world, and 20% of its GDP is contributed by the agriculture and allied sector. The agriculture sector entails various activities involving land preparation, irrigation, crop growth, harvesting, food processing, etc. for meeting the current agricultural energy demand in India. Renewable solar energy has come up as a prime energy source that can reduce the farmers dependency on the use of conventional energy sources. The economics of solar energy in agriculture are highly favorable reducing farmers energy costs (especially for irrigation) by replacing expensive diesel/ grid power cutting operational expenses with low maintenance and offering long term savings with panel lifespans of 25-30 years, while agrovoltatics combing solar with farming further boosts income by reducing water use, protecting crops, creating new revenue streams, and enhancing overall rural economic growth and sustainability.

Keywords: Solar Energy, Agriculture Sector, Irrigation, Renewable Energy

Introduction:

In todays modern era, the progress of any country depends on its basic infrastructure. In india, under the concept of welfare state, providing high quality infrastructure promptly and at minimal cost to consumers and institutions is the ultimate goal of infrastructure policies. The foundation of the of the economy depend upon infrastructure policies needsto be measured on three factors compared to international standard; the quality, quantity and price charged for the infrastructure services provided to consumers. The demand for energy has increased significantly in the domestic, agricultural, trade, industry and service sectors. Economics of solar energy in agriculture involves significant initial costs but offers long term savings through reduced electricity bills, lower

operational expenses, and enhanced productivity (irrigation, processing), leading to energy independence and sustainability.

What is solar energy?

Solar energy is the power obtained by harnessing the energy of the sun's rays .It's an abundant. The energy is captured primarily through photovoltaic cells, commonly known as solar panel. these solar panels sustainability is evident as they convert sunlight directly into electricity with minimal environmental degradation. solar energy reduces dependence on non-renewable resources, diminishes greenhouse gas emissions, and allows for decentralized power generation

Objectives:

1. To study the relevance of the government energy policies.
2. To know how much energy availability there.
3. To study the level of energy awareness of farmers.
4. To conduct a comparative study of renewable and non renewable energy use in agriculture sector.
5. To suggest measures to promote the use of non renewable energy resources

Assumptions:

1. There is conventional energy conservation policies.
2. The use of non-conventional energy is statistically less than that of conventional energy
3. There is a lack of energy literacy among farmers.

Research Methodology:**Nature of Research:**

The present study based on qualitative and analytical research approach. It aims to conduct in depth analysis of solarization in agriculture sector and the implementation of solar panels in agriculture sector.

Sources of Data Collection:

Academic journals (google scholar, scopus, ERIC) International reports Government policy documents

Limitations of the Study:

The study is based on solely on secondary data Findings are theoretical and analytical in nature.

Role of Renewable Energy in Agriculture:

The cost of implementing and managing solar energy setup has decreased due to advancements in the industry, enabling more

installations across different applications in the agricultural sector. Some of them include -

Solar Energy-Powered Water Pumps:

In many places where electric supply might be limited or not available, solar water pumps are lifesavers. Solar pumps use solar energy and pump water from reservoirs, and canals to the farms which would save hours of time for farmers.



Fig.1

Here solar panels are employed to harness the solar energy and using inverters, DC power is supplied to the power grid or stored in batteries. This power will be used efficiently to run the pumps to supply water.

Water and Space Heating:

Livestock and dairy operations have specific space and water heating requirements around the year at different seasons. Since, in most cases, cattle farming is done in closed structures, the temperature and air quality are vital for operations. Solar power is used to manage this around the year. By employing a solar-powered heating system, farmers can easily save costs incurred on electricity bills. These systems use solar panels that effectively power the temperature control systems as required.

Crop and Grain Drying:

Using sunlight to dry crops and grains is one of the oldest applications of solar energy used by farmers. While this is a completely free, viable method that can easily be employed, it has a risk of exposing the crops to the wind, rodents, impurities, etc. contaminating them. With advancements in technology today, there are solar dryers that can help in harnessing maximum solar energy and concentrating it in a closed container where trays are used to dry the produce. These systems will also help in accelerating the process and reducing the time required.

Green House Heating:

Greenhouse heating is essential for the proper growth of certain crops and plants. Commercial greenhouses use sunlight for lighting and not for heating. Mostly, they depend on oil and gases for maintaining the required temperatures. Solar green housing heating systems are used to feature both the lighting and heating that is required. A solar greenhouse has a solar panel to collect the energy and batteries to store the energy. It also has insulation that will help in retaining heat during cold days and nights.

Remote Supply of Electricity:

Farms might be located in remote areas where the electricity supply is limited and farmers may constantly face issues related to power outages and shortages for running their equipment, and tools on the farms. Solar PV systems are employed in the farms to produce the required electricity that is stored in the batteries and used when required. This not only helps in reducing the power consumption from the electricity supply but also saves money for farmers in the long run.

Solar-powered Cooling Systems:

In many cases, farmers face huge losses due to the lack of availability of proper

refrigeration and cooling systems in their farms. Even if they have a refrigeration system, it becomes very difficult to power them all day with constant power cuts and outages. Solar-powered cooling systems will help in tackling this problem. The refrigeration systems used will have a continuous supply of power from the batteries hooked to the solar panels where the power is supplied directly in the morning and the backup power stored is supplied during the night.

The Advantage of Solar Power for Agriculture sector:

The economics of solar energy in agriculture involves significant long-term cost savings (no fuel/electricity bills for irrigation, processing), increased productivity, and income diversification, though high upfront capital investment is a barrier, offset by government schemes like PM KUSUM Scheme (India). Applications like solar pumps, dryers, and agrivoltaics (panels solar + farming) reduce energy dependence and operational costs, while creating revenue streams and supporting sustainable development goals (SDGs) by saving water and enhancing energy security. Using solar on agricultural land known as agrivoltaics, combines farming with solar power generation, creating dual land efficiency, offers farmers extra income, conserve water via shading, improves microclimate for crops, and reduces reliance on grid electricity, making farming more sustainable and profitable by generating power.

Reduced Operational Costs: Eliminates or drastically cuts expenses on diesel or grid electricity for irrigation, processing, and other farm needs.

- **Increased Income:** Value addition through solar drying, reduced post-harvest losses, and potential for selling excess power.
- **Energy Independence:** Provides reliable power, especially in remote areas,

reducing vulnerability to grid failures or fuel price hikes.

- **Productivity Gains:** Enables efficient irrigation and mechanization, leading to higher yields and better crop quality.

Key Applications:

- **Solar Irrigation Pumps:** Replaces costly diesel pumps, offering lower running costs and less maintenance.
- **Solar Crop Dryers:** Reduces spoilage, improves marketability, and adds value to crops.
- **Agrivoltaics (Solar-Agriculture):** Combines solar panels with farming, shading crops, reducing water evaporation, and generating electricity on the same land.
- **Solar Processing Units:** Powers post-harvest processing, creating rural employment

Economic Considerations & Challenges:

- **Policy** **SupHigh Initial Cost:** The primary hurdle is the upfront investment for solar systems.
- **port:** Subsidies and schemes (like PM KUSUM Scheme) are crucial for adoption.
- **Land Use:** Integrating solar with farming (agrivoltaics) optimizes land use, but careful planning is needed to balance food and energy production.

Conclusion:

Demand for electricity in agriculture is one of the largest asks for India's power sector as irrigation systems, motors, and temperature control systems are largely undeveloped.

Farmers are dependent on electricity to power their pumps and other equipment. With the increasing demand and the expensive ordeal involved in producing electricity using conventional methods, it would be very difficult for both the energy sector and small-time farmers to sustain themselves in the long run. Solar power

can be an optimal option to meet this demand and generate the power at the source to run multiple applications that are dependent on electric supply from the electricity board today.

With the right implementation, a solar energy setup can be very rewarding in the long run. Renewable energy and the agriculture sector can be a winning combination that can solve many problems that we face today. It can also be a new channel that can help in improving the quality of agricultural yields, cutting overhead costs and improving the efficiency of agricultural processes.

Recommendation:

Enhancing financial viability through tariff adjustment and viability gap funding under PM KUSUM. Utilizing Krishi Vigyan kendras for agrivoltaics education and training for farmers. Providing subsidies for solar power irrigation pump.

References:

1. Gupta, M., & Goyal, H. B. (2021). "Solar energy for agriculture : An overview off applications and benefits. Energy Reports 7, 1339-1365. Doi:10.1016/j.egy.2021.04.03.
2. Kumar A. & Sah B. P. (2019). Solar energy for sustainable agriculture in india: Challenges and opportunities. Renewable and sustainable energy reviews, 103, 163,176.doi: 10.1016, 2018.12.25.
3. Economic survey of Maharashtra, 2018-19, page155.
4. Mnre.gov.in/www.beeindia.gov.in 22 Mar 2021.
5. Das S. R., Energy conservation, need, problem and prospects in india, Economic times, Bombay, Nov. 10, 1983.