



Solar Energy for Future Agricultural Operation

(*Yash Narayan Sharma, Pinky Yadav, Gaurav Prakash and Hemraj Nagar)

Agriculture University, Kota (Rajasthan) 324001

* ynsharma1997@gmail.com

The world's energy demand is rapidly increasing because of population growth and advancements in technologies. There are two types of energy sources such as renewable source and non-renewable source. Any natural resources that can be replaced rapidly are considered as renewable energy sources. These energy sources are abundant, renewable, naturally replenished and environmentally friendly. It includes solar energy from the sun, wind energy, geothermal energy from the heat inside the earth, hydropower from running water, ocean energy in the form of waves and biomass from plants. A non-renewable resource is a resource that cannot be replaced once it has been consumed. It includes petroleum, hydrocarbon gas and liquids, natural gas, coal and nuclear energy. Both energy sources have advantages and disadvantages based on different technologies that are used in our current energy system. There is a growing trend in using renewable energy sources and creating technology to improve their efficiency because of the limited amount of fossil fuels available and their environmental effects. Solar energy is one among renewable energy sources with a high potential to effective agricultural applications in a sustainable manner. However, the fundamental aspects of such concept is still not displayed properly among agricultural communities all over the world. This critical note therefore tends to display a cutting-edge view of potential solar energy applications among readers of this magazine.

Solar Energy

Solar power is an unlimited source of energy on the earth. Moreover, every day the sun produces significantly more energy than human requirements to power everything on the entire globe. However, most of the useful fraction of the solar energy is still wasted without productive outcomes. Therefore, it is important to promote the applications of solar energy in agriculture for the better environmental sustainability. The following sections have therefore been filtered from the vast array of literature in order to provide innovative views to the readers so as to increase the use of solar energy for various agricultural applications. Important facts regarding solar energy to be emphasized for a better expansion in future.

- **Renewable:** Solar panels generate electricity by converting the sun's constant flow of energy into electricity. It can be used for various agricultural applications including automated dryers and greenhouses.
- **Free of CO₂ emissions:** When solar panels generate power, no hazardous emissions are emitted into the atmosphere. It is widely accepted that the emission potential of solar systems is negligible, and it is badly needed to help minimize the emission of greenhouse gases by the burning of fossil fuel resources.

- **Low operating cost:** The photovoltaic process does not contain fuel and other variable costs. However, users of the solar energy do not understand it clearly. It is important to make it clear among the various users of solar energy.

Solar Energy Technologies

In one hour, the sun produces energy to the earth higher than the entire global energy need per year. Sunlight is converted into usable energy sources using a variety of technologies. There are two ways to obtain solar energy from sunlight such as energy from heating systems and electricity from photovoltaic technology (PV). Solar thermal and photovoltaic technologies are two types of solar energy technologies. Solar thermal technology converts the energy of solar radiation into heat using flat-plate and concentrating solar collectors. It can then be stored and used in a variety of household, residential and industrial applications. PV systems are able to convert sunlight directly into electricity because they use semiconductors. In agriculture, both thermal and PV applications try to enhance profitability by improving yields, minimizing losses and speeding up production. There are various ways of applications of solar energy in the agriculture sector. The following said windows of solar energy applications in agriculture can be upgraded using innovative technologies.

- Solar dryers
- Solar greenhouses
- Irrigation for agricultural crop

Solar Dryers

The presence of moisture in agricultural commodities causes microbial deterioration of such products. Therefore, it is essential to remove free water present in such products in order to avoid spoilage of organisms' activity. Food preservation through drying is one of the earliest and most widely utilized strategies for enhancing the nutritional value of food. Food is dried to remove moisture so that it can be stored for a long period and be protected against contamination. Furthermore, reducing the weight and volume of materials helps to make easy transportation and storage of agricultural commodities. However, the efficiency of solar drying systems can be improved further by the incorporation of hybrid systems as clearly explained in the Figure 1.

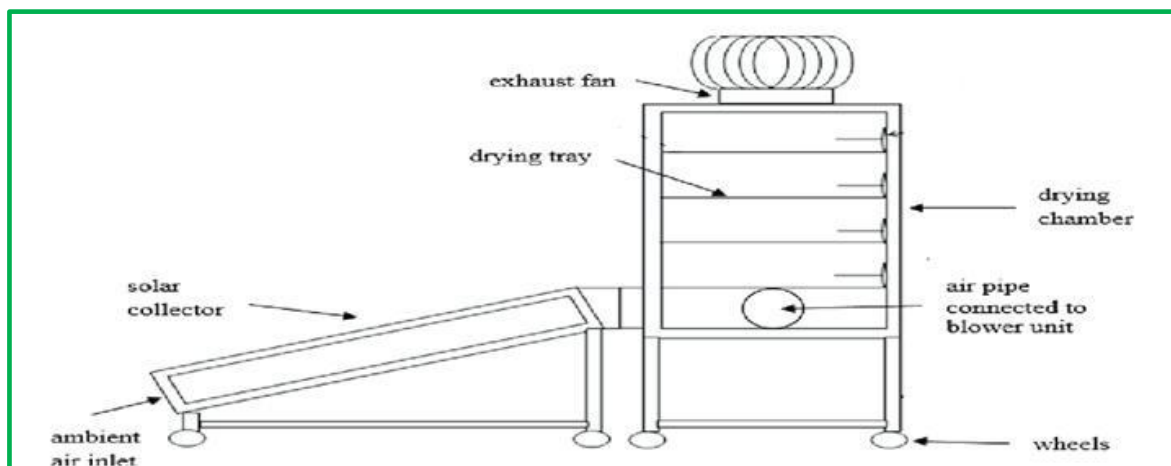


Figure 1: Hybrid solar dryer with solar tracking system (dual axis solar tracker)

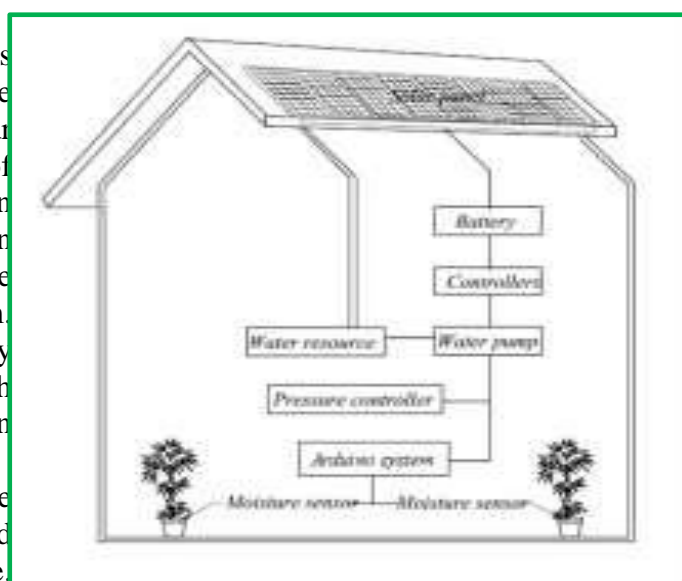
A new concept has been proposed with tracking system for the improvements in solar drying of agricultural produces as shown in the Figure 1. Therefore, the efficiency of solar absorption would be higher than normal hybrid solar dryer, if the proposed concept is validated scientifically. It then leads to effective utilization of solar energy for drying of agricultural produces. This cutting-edge concept can be utilized by researchers of various

sectors for the development highly effective solar drying systems with reasonable level of energy.

Automated Solar Greenhouses

The greenhouse is a structure that is now commonly used in agriculture to cultivate high quality plants. Solar energy has recently been used to heat greenhouses called as solar greenhouses. Solar greenhouses are intended to collect solar energy not only during sunny days but also to store heat for use at night or during cloudy periods. Solar panel can be a wall mounted or attached to houses or barns. Solar energy can also be used to provide light to the greenhouse. Solar powered agricultural greenhouses are categorized into two types such as passive and active solar greenhouses. Active solar greenhouses (ASGs) are combined with solar systems such as photovoltaic (PV), photovoltaic thermal (PVT) or solar thermal collectors to accelerate the collection of solar energy, whereas passive solar greenhouses (PSGs) are designed to obtain as much of solar energy as possible. A new concept has been proposed to design automated greenhouses for various plants. The below Figure 2 is the conceptualized

helping researchers develop effective greenhouses. Solar several regions of agricultural crops in no access to an Figure 2 shows the irrigation system can be operated by energy system with operate irrigation Automated controlled with the system and the greenhouse



framework for and others to automated energy is used in the world to irrigate areas where there is electrical grid. The automated solar An electrical motor a controlled solar stored energy to systems. irrigation is help of Arduino moisture sensors in Moreover, solar electric (photovoltaic) greenhouses are not cost effective unless you are growing high value crops. Furthermore, studies on automated greenhouses are very limited. Hence, there is need to perform comprehensive scientific evaluations into the automated greenhouses for the better utilization of these structures at the commercial level.

Conclusion

Agricultural technology is rapidly growing. Farm machinery, farm structures and production facilities are all being updated on a regular basis. This critical note is a summary of the newly conceptualized windows of solar energy applications for the better agricultural outcomes in future. Moreover, this piece of the discussion is considered important for various researchers all over the world to significantly expand effective use of solar energy in agricultural applications. It will help improve environmental sustainability for future generations