

Design and Development of Solar Power Poultry Shed Ventilation System

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Abstract - Poultry farming requires proper ventilation to maintain optimal temperature, humidity, and air quality inside the poultry shed. In rural areas, unreliable electricity supply increases operational cost and affects bird health. This paper presents the design and development of a solar power poultry shed ventilation system that operates independently of grid electricity. The system uses solar panels, batteries, charge controllers, and DC exhaust fans. The proposed system is eco-friendly, energy-efficient, and cost-effective, making it suitable for small and medium-scale poultry farms. The environmentally cooled closed poultry houses are used by big players an integrator but these are not economically affordable to medium and small poultry farm owners. Apart from this, poultry sheds are generally located in rural areas where schedule power cuts are normal affair. The operation cost of cooling system on generator power is 3-5 times higher.

Keywords: Solar energy, Poultry ventilation, Renewable energy, Sustainable farming.

1. INTRODUCTION

There have been different studies conducted to safeguard the poultry birds from high ambient temperatures through cooling of poultry sheds using fans and coolers. But, due to inefficient temperature maintenance within desired range and large investment required, adaption of such management practices remained questionable. Further, use of these cooling systems becomes impractical during monsoon season, when both temperature and humidity remains high. Likewise, environmental controlled poultry houses are yet uncommon in India and such facilities may increase the cost of production. This will lead to uneconomical poultry production. The environmentally cooled closed poultry houses are used by big players an integrator but these are not economically affordable to medium and small poultry farm owners. Apart from this, poultry sheds are generally located in rural areas where schedule power cuts are normal affair. The operation cost

of cooling system on generator power is 3-5 times higher. Hence, majority of the poultry operators do not use proper cooling system which makes them susceptible to the adverse effects of temperature on production cost and hence profits. Moreover, the authors were approached by a layer farm owner from Pune district of Maharashtra, who is facing losses in productivity and profits due to heat stress in birds caused during summer months. With increasing instances of extreme temperature conditions, the losses due to heat stress are aggravating every year. This work is undertaken to study this problem from the point of view of thermal engineer and to find out engineering solution that is easy to implement and affordable to medium to small farm owners. Poultry housing is most important factor for chicken farming. When planning poultry housing, it is necessary to keep in mind about proper ventilation and controlling indoor temperature. The chicken house should be made based on the local climate to control indoor environment. Proper flow and circulation of fresh air and removing waste gases and warm air are essential elements in any poultry house. A ventilation system should provide fresh oxygen-rich air for chicks, which maintain friendly environment for chicken. Average values of voltage drop and current of the measured data for ventilation fan are presented. Maximum solar power was generated during 12~13 pm. Solar power supplied to DC fan will use solar power. Depending on volume of space in a poultry house and climate conditions, air flow rate is another key factor for proper ventilation. Air flow rate of DC ventilation fan on the basis of power consumption with time in a day is presented. Energy produced by a solar panel depends on many factors like climate, geographical conditions, and local weather. Solar panel converts only a small percentage of the energy that strikes it into usable energy. One of the key characteristics of a solar cell is an ability to capture incident photons. It can be adapted to widely varying conditions to provide many employment opportunities and has fast return on investment. Beside the economic returns poultry farming secures food

satisfaction for protein in human diet. The income received from poultry products, which spreads throughout the year from egg production, broiler production, feed manufacture, equipment manufacture etc., gives poultry farming more importance for the national economy.

2. METHODOLOGY

2.1 System Components

The system consists of a solar panel, charge controller, battery, DC exhaust fans, wiring, and mounting structure. The solar panel converts sunlight into electricity, which is regulated by the charge controller and stored in the battery. DC exhaust fans provide effective ventilation with low power consumption.

2.2 Working Principle

During daylight, the solar panel generates electricity and charges the battery through the charge controller. The stored energy powers DC exhaust fans that remove hot and polluted air from the shed, allowing fresh air to enter. This ensures a healthy environment for poultry birds.

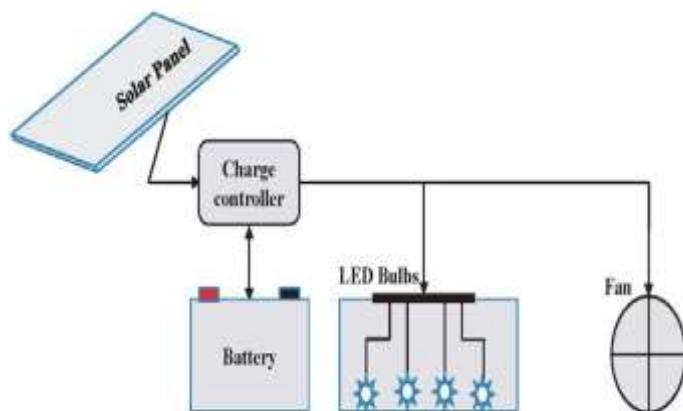


Fig. solar operated poultry shed cooling system.

2.3 OBJECTIVES

The objectives of this research are to design a solar-powered ventilation system, reduce dependency on grid electricity, improve air circulation, and promote renewable energy usage in poultry farming.

2.4 LITERATURE SURVEY:

1) India has a meat-eating population of about 60 percent and increasing. The poultry industry is a rapidly growing sector with annual growth rate of about 8-10 percent. Ambient conditions, especially high temperature in combination with high relative humidity in poultry shed leads to heat stress in poultry birds and in turn reduces their productivity and increases mortality significantly. India, being predominantly a tropical country, the day time temperatures during summer reaches as high as 45°C at many places. The capital and operational cost of conventional evaporative air-cooling system is very high as compared to the investment standards of poultry management in India. The operation cost of cooling system on generator power is 3-5 times higher. Hence, majority of the poultry operators do not use proper cooling system which makes them susceptible to the adverse effects of temperature on production cost and hence profits. The present work is directed towards developing low cost cooling effect through operational interventions. It incorporates use of different techniques and management practices to eliminate effect of heat stress in poultry birds. The system reduces mortality, improve productivity and thereby increase profit for the farm owner.

2) In this research a poultry housing model was developed to study the possibility of using solar and wind energy to cool air inside the house. In this model the roof was heated by solar energy, creating negative pressure in a well-insulated air cavity left under the roof. As a result, air convection from the air cavity generated suction force to pull air through evaporative cooling pads installed on the wind ward side. Direct wind force helped in enhancing cool air flow into the shed. An air cowl was installed at the outlet of roof cavity to assist in air suction from the shed. Daily readings of air temperature outside, inside the model and in roof air cavity were taken on hourly basis throughout the study period (October to December). Also, readings of relative humidity and air speed were taken. The results obtained showed that, the adiabatic efficiency of cooling pads varied between (0.64 and 0.73), the average cool air temperature varied between (20.3 to 26.9°C) during the peak thermal hours of the day. Cooling air velocity in the model varied between (0.23 to 1.21 m/s), while the air flow rates varied between (0.621 to 3.21 m³/s). All these values were found to be within the acceptable range for poultry rearing. These results indicated that, there is a practical

possibility for employing solar and wind power to cool air in the traditional poultry houses.

2.5 Advantages

- 1) Cost of system modification of poultry shed ventilation system is low & No need to purchase heavy components.
- 2) working principle of poultry shed ventilation system is quiet easy & manual assistance is not required Portable.
- 3) Autonomous self-cleaning & cooling mechanism that can be attached to solar panels and operated without fuel consumption.

2.6 Applications

This system work as an autonomous self- poultry shed ventilation mechanism that can be attached to solar panels and operated without human operation to use solar panel effectively to cool the poultry shed for comfort.

3. CONCLUSIONS

The solar power poultry shed ventilation system is a sustainable and practical solution for ventilation problems in poultry farming. It reduces dependency on conventional power sources and enhances bird health and farm profitability

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