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Development of Poultry Shed Ventilation System: A Prototype Approach

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Abstract: *The current study is on poultry shed prototype ventilation system model. 60% of India's population eats meat and this is growing. The poultry business grows 8-10% a year. Ambient conditions, notably high temperature and relative humidity in poultry sheds, cause heat stress in chickens, reducing production and increased mortality. India is mostly tropical, therefore summer midday temperatures approach 45°C in several regions. The capital and operating costs of traditional evaporative air-cooling systems are considerable compared to Indian poultry management investment norms. Poultry barns are usually in rural locations where power outages are common. Generator-powered cooling & ventilation costs 3 to 5 times more. The majority of poultry businesses don't employ suitable cooling systems, which affects production costs and earnings. The current study develops a low-cost cooling effect by operating a solar-powered Low-Cost Cooling System for Poultry Shed. It uses temperature & humidity control methods, battery storage systems, solar PV systems, structure, and exhaust air management to reduce heat stress in poultry birds. This technique minimizes mortality, enhances productivity, and boosts agricultural profits.*

Keywords: Heat Stress, Poultry, Heating, Ventilation, Solar PV System, Automatic Temperature Control

I. INTRODUCTION

Cooling poultry barns using fans and coolers have been studied to protect poultry from high ambient temperatures. The implementation of such management approaches remained uncertain owing to ineffective temperature maintenance and high costs. During monsoon season, when temperature and humidity are high, these cooling systems are unworkable. Environmentally managed chicken coops are rare in India, which may raise production costs. This makes poultry production unprofitable. Big players and integrators employ ecologically cooled closed chicken buildings, but medium and small farmers can't afford them. Poultry barns are usually in rural locations with regular power outages. A generator-powered cooling system costs 3 to 5 times more. Most poultry businesses don't employ suitable cooling systems, which affects production costs and earnings. A layer farm owner from Pune, Maharashtra, addressed the authors about bird heat discomfort throughout the summer. Extreme temperatures increase heat stress losses every year. This paper studies the topic from a thermal engineer's perspective to identify an easy-to-implement, economical solution for medium to small farm owners. Poultry housing is the most important factor for chicken farming. When planning poultry housing, it is necessary to keep in mind proper ventilation and controlling indoor temperature. The chicken house should be made based on the local climate to control the 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 supply fresh, oxygen-rich air for chicks, keeping them healthy. Inadequate ventilation increases humidity, CO2, and odor. Average voltage loss and fan current are shown. 12–13 pm was peak solar power. Solar energy powers DC fans. The airflow rate depends on a chicken house's size and environment. The DC ventilation fan's airflow rate is shown based on daily power usage. Climate, geography, and weather affect a solar panel's output. Only a tiny amount of solar energy is converted into useable energy. Solar cells can catch incoming photons, a critical property (Fan, 2014). Table 3 shows the experimental area's energy scenario based on irradiance and global irradiance. Reflection prevents solar energy harvesting. High feed efficiency makes poultry raising a diverse enterprise (high feed conversion ratio). It's adaptable to numerous environments, provides many jobs, and has a rapid ROI. Poultry farming also provides protein for human diets. Egg production, broiler production, feed manufacturing, equipment manufacturing, etc. contribute to poultry farming's significance to the national economy.

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II. Literature Survey

M.R. Ali, B. Das, et al. (2016) [1] concluded that due to the shortage of electricity in Bangladesh, there should be alternative energy sources for providing continuous lighting and ventilation in the poultry house. In their study, a solar energy-based system is proposed for the mentioned purposes. The solar panel used in the experiment produced a power of 26.73 W/m2 when solar irradiance was 848 W/m2 in the study area. Maximum solar power was received from the solar panel during 12~13 pm when the panel was placed on the south face at a 30° angle. A total of 9 m2 area was considered to conduct the experiment. According to the experiment, 31.5 W power was required for lighting and ventilation purposes for 108 chicks in a 9 m2 area. On a cloudy day, a 12V 100 Ah battery is able to provide 38 hrs backup time for a 9 m2 area. Rural farmers may use solar-based energy for dual purposes in their living and poultry houses. So, a solar energy-based system may be considered for rural farmers in Bangladesh.

Hafiz M. U. Raza, Hadeed Ashraf, et al. (2020) [2] explored a low-cost air-conditioning (AC) option from the viewpoint of heat stress in poultry birds. In this regard, the study investigates the applicability of three evaporative cooling (EC) options, i.e., direct EC (DEC), indirect EC (IEC), and Maisotsenko-cycle EC (MEC). Performance of the EC systems is investigated using wet-bulb effectiveness (WBE) for the climatic conditions of Multan. Heat stress is investigated as a function of poultry weight. The thermal comfort of the poultry birds is calculated in terms of the temperature-humidity index (THI) corresponding to the ambient and output conditions. The heat production from the poultry birds is calculated using the Pederson model (available in the literature) at various temperatures. The results indicate a maximum temperature gradient of 10.2 _C (MEC system), 9 _C (DEC system), and 6.5 _C (IEC systems) is achieved. However, in the monsoon/rainfall season, the performance of the EC systems is significantly reduced due to higher relative humidity in ambient air.

Ralebhat Rahul, Kothmire Pramod, et al. (2016) [4] concluded that the majority of the poultry operators do not use proper cooling systems which makes them susceptible to the adverse effects of temperature on production cost and hence profits. The present work is directed toward developing a low-cost cooling effect through operational interventions. It incorporates the use of different techniques and management practices to eliminate the effect of heat stress in poultry birds. The system reduces mortality, improves productivity, and thereby increases profit for the farm owner.

III. Problem Statement, Scope, Objective

3.1 Problem Statement

Human and non-human thermal comfort requires temperature and humidity regulation. Healthy chickens also need the right temperature and humidity. Changing seasons needs AC. The thermoneutral zones for poultry (broiler) birds signify heat stress. Thermoneutral, higher, and lower critical temperatures are described. Temperature and humidity in the poultry house affect birds' physiological development. In a heat-stressed environment, poultry fowl lack sweat glands like humans.

3.2 Scope

The poultry shed ventilation for the project consisted of relatively basic kinds of elements and required far fewer components than the natural poultry shed ventilation that is often used. Due to the fact that the work done in researching and finishing the outcomes of this system with addressing other kinds of traditional poultry shed ventilation available system difficulties may be adopted from higher to lower unit costs, it was successful. The fact that it has such a minimal maintenance demand is another factor that may help bring down overall expenditures. During the functioning of the ventilation system in the poultry shed, this system consumes less power. This little percentage of rows out of a very high total number is able to project this system over the investment. As far as the average Indian farmer is concerned, this technology would be quite useful for a low-capital investment chicken shed ventilation system that was previously on the market. In the future, this machine may serve as a straightforward alternative method of addressing the ventilation needs of chicken sheds.

3.3 Objective of the Study

The basic objectives of the present study are as follows:

- To study, design & fabrication of solar power poultry shed heating & ventilation system.
- To enhance the use of non-conventional energy & solar panel for poultry shed heating & ventilation systems.
- To make solar power poultry shed heating & ventilation system which will use non-conventional solar energy.

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- To make solar power poultry shed heating & ventilation system, which mainly focuses on the basic problem of electrical load shedding faced by the farmer.

IV. METHODOLOGY

The following steps are implemented during project execution:

- Step 1: Basic Information & Literature survey about Poultry shed.
- Step 2: Selection of Components for Poultry shed
- Step 3: Design of Solar Power Poultry shed ventilation system.
- Step 4: CAD modeling & Fabrication of Solar Power Poultry kished ventilation system.
- Step 5: Final Dimensions and Final Design in Software with Analysis.
- Step 6: Assembly & Testing of Solar Power Poultry shed ventilation system.

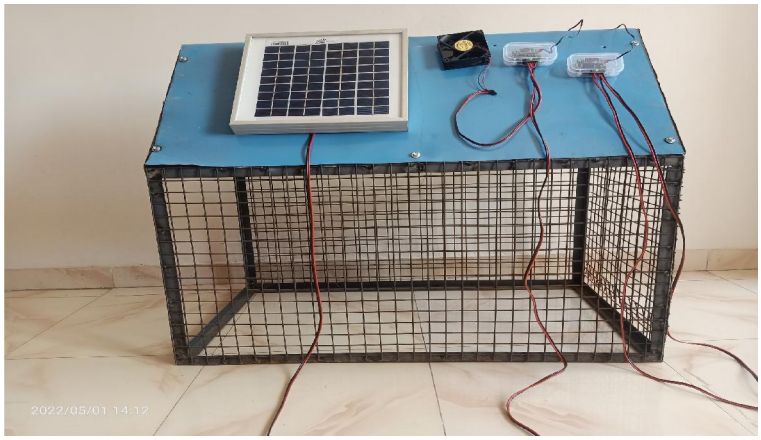

Figure 1: Poultry Shed Ventilation System Prototype Model

Figure 1 shows the Poultry Shed Ventilation System Prototype Model. The solar panel converts solar energy to electrical energy. Electricity conveys from the solar panel to the charge controller by a high-quality electrical cable. The charge controller is used to protect the battery from overcharge. Inthis experiment, LED bulbs were used for lighting and a DC fan was used for ventilation. Loads such as bulb and fan were connected to the battery in parallel. A DC ventilation fan was connected with a solar panel via battery forcirculating and flowing fresh air in the poultry house. same as that of the LED bulb due to the parallel connection. In the experiment, several accessories were used to measure various parameters and to conduct experiments for lighting and ventilation purposes. All required accessories and measuring instruments for the experiment.

V. CONCLUSION

Finally, we make a ventilation system for providing fresh oxygen-rich air for chicks, which maintains a friendly environment for chickens for better growth & reduces thermal stresses in the shed.

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