SOLAR OPERATED COOLING SYSTEM FOR POULTRY SHED

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ABSTRACT

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. Apart from this, poultry sheds are generally located in rural areas where schedule power cuts are normal affair. The operation cost of cooling & ventilation 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 on solar operated Low-Cost Cooling System for Poultry Shed. It incorporates use of different temperature & humidity control techniques, battery storage system, solar PV system, structure and exhaust air 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.

Keyword : - *Heat stress, poultry, ventilation, solar poultry ventilation system, automatic temperature control.*

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.

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. Improper ventilation will increase humidity and build up carbon dioxide and odour. 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 (Fan, 2014). The energy scenario in relation to irradiance and global irradiance at the experimental area is presented in Table 3. It is not possible to harvest available solar irradiation due to the reflection of radiation. Poultry production is a very versatile agrobusiness, because of its high feed efficiency (high feed conversion ratio). 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.

1.1 Problem Definition

i. The poultry birds require an optimum temperature and relative humidity conditions for healthy growth. Hence, seasonal variation in weather demands the need for AC. The thermo neutral zones for poultry bird and represent the physical effect of heat stress on the poultry (broiler) birds. Optimum physiological growth in the birds increases with the optimum range of temperature and humidity inside the poultry house.

ii. It is found that the seasonal CO_2 emissions tended to be stable within small variations of 3% and 9% from the averages for the broiler barn and the layer barn, respectively. The health environment of chicken in poultry houses is significantly based on the indoor temperature. In the heating season, low ambient temperatures require heating chicken houses as desirable temperatures between 21°C and 32°C for poultry houses.

iii. Problem of heat stress, though being seasonal and of variable duration, its effects can be economically significant. As birds body temperature rises, feed consumption, growth rate, feed efficiency, egg shell quality and survivability decline. Heat stress not only causes suffering and death in the birds, but also results in reduced or lost production that adversely affects the profit of the enterprise.

iv. The optimum poultry housing temperature for mature birds are generally accepted to vary between (15°C - 25°C), a range known as a thermal comfort zone. However, within this range of environmental temperature animal tends to eat more food to generate enough metabolic heat to compensate for its increased heat dissipation. In the environmental temperature range of (25°C -30°C) the consumption of food decreases.

1.2 Objectives of the Present Study

The following are the objectives of this project work:

1) The project deals with the study, design & fabrication of a solar power poultry shed ventilation system.

2) The objective of this project is to enhance the use of non-conventional energy & solar panel for poultry shed ventilation system.

3) Global energy crisis is getting severe day by day along with pollution problem using fuel. This objective is situation use of solar energy for the survival and development of humans.

4) To make solar power poultry shed ventilation system which mainly focuses on the basic problem of electrical load sheading faced by the farmer.

5) To make solar power poultry shed ventilation system which will use nonconventional solar energy.

6) To make this project as revolution in small farm in India, which is most uncovered area in this sector, is low cost and more energy efficient way to make solar power poultry shed ventilation system.

1.3 Proposed Methodology of Solving Identified Problem

1. Proposed Methodology 1 – Basic Information & Literature survey about Poultry Shed
2. Proposed Methodology 2 – Selection of Components for Poultry shed
3. Proposed Methodology 3 – Design of Solar Power Poultry shed ventilation system
4. Proposed Methodology 4 – CAD modelling & Fabrication of Solar Power Poultry shed ventilation system
5. Proposed Methodology 5 – Assembly & Testing of Solar Power Poultry shed ventilation system

2. LITERATURE REVIEW

2.1 Literature Survey 1:

Due to the shortage of electricity in Bangladesh, there should be an alternative energy sources for providing continuous lighting and ventilation in the poultry house. In the study, solar energy-based system is proposed for the mentioned purposes. Solar panel using in the experiment produced a power of 26.73 W/m2 when solar irradiance was 848 W/m2 in study area. Maximum solar power was received from solar panel during 12~13 pm when panel was placed in south face at 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 9 m2 area. In cloudy day, a 12V 100 Ah battery is able to provide 38 hrs. back up time for 9 m2 area. Rural farmers may use the solar based energy for dual purposes in their living and poultry houses. So, solar energy-based system may be considered for rural farmers in Bangladesh.

2.2 Literature Survey 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 humility 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 oC) 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 which are widely used in poultry production in the Sudan. This is especially important for the rural areas where electric power is not available. Solar energy may also be utilized to power the pump required for pads wetting.

2.3 Literature Survey 3:

Poultry farming is one of energy intensive industries that consume large amount of energy to provide the suitable indoor environment for chicken health and production like meat and eggs. Currently, there are extensive researches and practices of applying renewable and sustainable energy technologies to poultry farming to achieve energy saving and carbon dioxide emission reduction. Therefore, it is worth to retrospect the state-of-the-art development and summarize the key features in this field. The main technologies include photovoltaic (PV), solar collector, hybrid PV/Thermal, thermal energy storage, ground/water/air sources heat pumps, lighting and radiant heating. It is found that up to 85% energy saving can be achieved by using these advanced technologies in comparison to the traditional poultry houses with a payback time of 3–8 years.

3. CONSTRUCTION & WORKING

Various resources and factors were considered for getting the information on the project: First, the requirement of the poultry shed is to identify. The specification of the material is thought according to the need. Then, the allocation of budget by the poultry farmer is taken into consideration. Different research papers were read, we visited many farmers. Guidance was taken from college staff regarding the initial research of project. The Resources/Consumable required are: The main components of agricultural multipurpose machine are as follows:

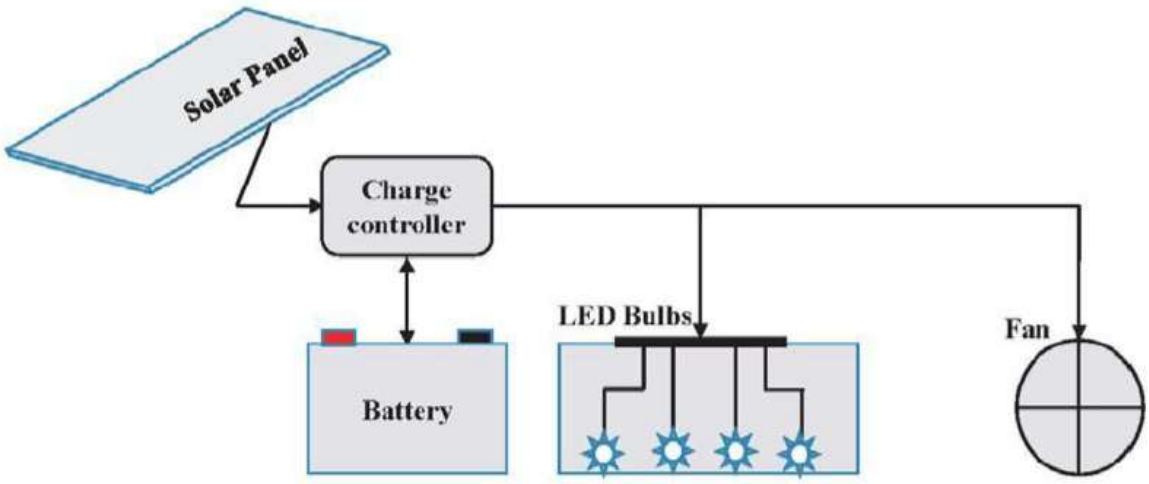

Fig. 3.1: Resources Required for Solar Operated Cooling System for Poultry Shed

Fig. 3.2: Battery

Fig. 3.3: Solar Panel

Fig.3.4: Temperature Controller

Fig. 3.5: DC Exhaust Fan

Fig.3.6: Washer

Fig.3.7: Nut &Bolt

Installation of Solar Panel on Roof

A well-designed solar electric system should be placed in clear and unobstructed place for continuous access to the sun in most of the day throughout the year. Setting a solar panel with a system precisely is a critical and important issue in order to achieve maximum power production.

Experimental Setup

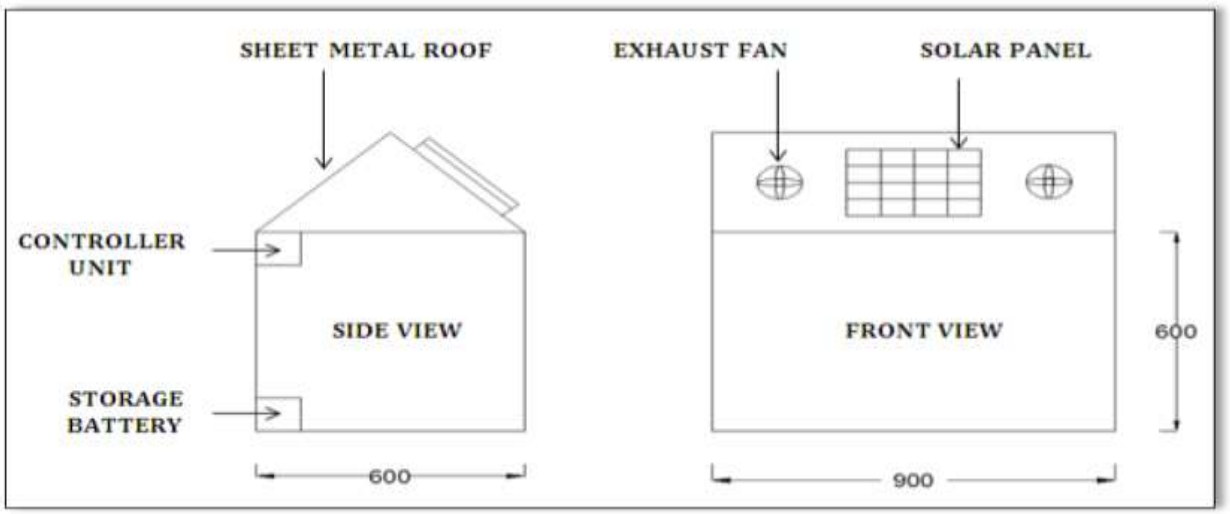

Fig.3.8: 2D Concept of Solar Power Poultry shed ventilation system

Photograph

Fig. 3.9: Solar Operated Cooling System for Poultry Shed (Actual Model)

4. SPECIFICATIONS

A. Part name: sheet metal poultry frame.

Part weight – 8 kg

Part material – M. S. Sheet

Part quantity – 1

Part size – 900 mm x 450mm x 450mm.

B. Part name: sheet metal poultry roof.

Part weight – 2 kg

Part material – S. S. Sheet

Part quantity – 1

Part size – 900mm x 450mm x 150mm

C. Battery:

Battery type – lead *acid* battery 12V 2.5Ahr.

Charging time - 1 to 1.5 hours

5. RESULT TABLE

Serial No	Time	Temp.
Outside temp. Inside temp.	11 Am	30 36
Outside temp. Inside temp.	12 pm	32 36
Outside temp. Inside temp.	1 pm	32 37
Outside temp. Inside temp.	2 pm	34 42
Outside temp. Inside temp.	3 pm	34 40

6. ADVANTAGES

i. Cost of system modification of poultry shed ventilation system is low & No need to purchase heavy components.

ii. Working principle of poultry shed ventilation system is quiet easy & manual assistance is not required.

iii. Portable. Autonomous self-cleaning & cooling mechanism that can be attached to solar panels and operated without fuel consumption.

iv. Poultry shed ventilation system is easy to construct, low cost and low maintenance.

v. The surface of PV panel remains clean regularly to gives better efficiency of PV system.

vi. By using adjustable timer, user can cool the car cabin as per convenience changes.

vii. No manpower is required for cleaning assistance fully automatic.

7. CONCLUSION

This project is an effort to bring down this heat by providing proper poultry shed ventilation. A smart system to ventilate the poultry shed is designed and relevant prototype is implemented. This system consists of a ventilator fan placed at optimum positions and run with optimum power which depends on the temperature using solar panel. In this project we done the experiment on afternoon 1PM to 5PM. The following results are got. Also, we have found amount of heat generated inside the cabin. The sunlight is diminished after 5PM at that time battery are used for running the fans. We have tested the battery for the time it has worked. It worked for 8 hours after sunlight are diminished. From the above- mentioned experimental investigation, it was evident that the solar PV powered ventilation system was successfully performed when tested for its intended application. In this the results of test show that the rise poultry shed temperature with ventilation system was lower compared to that without ventilation system. In this project we reduced temperature 4 to 8 degrees in peak time. Also, we control the temperature in the evening time by using battery power. By using this equipment, we can control the

temperature in small segment poultry shed model successfully. This system can work using solar power hence by using this system we can save electricity. The following result shows the average performance of the system, it shows that solar powered ventilation system is beneficial to reduce temperature of poultry shed $4^{o}C$ to $8^{o}C$ in peak time.

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