Vol 7 No 4, Desember 2023
ABDI DOSEN
Jurnal Pengabdian Pada Masyarakat
pISSN: 2614-6509
eISSN: 2620-5156

INSTALLATION OF SOLAR-POWERED ELECTRIC WARMERS FOR DOC-BROODING IN BLITAR CHICKEN FARMERS

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Abstract

Community Service (PPM) is held in Sumberejo Village, Sanankulon District, Blitar Regency. Chicken farmers face several challenges related to heating their chicken coops, including restrictions on using subsidized fuel or LPG, which force them to seek other heating alternatives. Leaks in heating systems that use LPG, which pose a fire hazard. Poor air quality and low oxygen levels in coops that use conventional heating methods (firewood and LPG). These challenges can contribute to the decline in the quality of Day-Old Chicks (DOC). This activity aims to install an electric warmer system that produces a safe and comfortable temperature for Day-Old Chicks (DOC) and is easy to use for breeders. In addition, build an independent energy source to run the heat treatment system equipment in the DOC-Brooding area with a solar panel installation. The installed 600 Wp PLTS system consists of 4 solar panels with a capacity of 150 Wp each, an 850 VA hybrid inverter and 100 Ah VRLA battery. Electrical energy from PLTS can power a 200 W electric warmer. The solar panel installations can produce an average of 3.6 kWh of electrical energy/day. So that the electricity savings from PLN can reach IDR. 162000 per month.

Keywords: Solar Panel, DOC, Brooding, Chicken Farmer, Electric Warmer

INTRODUCTION

Sumberjo Village, located 10 kilometers Southeast of Blitar Regency capitals, has promising potential in terms of both natural and human resources. This community service activity targets a group of poultry farmers/chicken breeders in the Blitar area. A location survey and interviews revealed several problems that need to be addressed and solutions that can be implemented. However, the problems and challenges faced by farmers are complex, so this activity focuses on the problem of coop heating equipment (chick brooding process) for newly hatched chicks, known as Day-Old Chicks (DOC).

DOC, or day-old chick, is a newly hatched chick that is only one day old and has a blood content of approximately 5% (Indo Agropodia, 2018). The initial period of raising and caring for DOCs is critical and essential for success in broiler chicken production. Brooding is the period of mothering chicks, during which they require artificial heating until they reach a certain age or can adjust to their environmental temperature. Therefore, the artificial heating

Submitted: October-2023 Received: November-2023 Available Online: December-2023

system is a crucial brooding component that significantly impacts DOC growth and development.

Heaters are typically used for the first two weeks of a chick's life, but this can vary depending on the weather conditions in the coop. A comfortable temperature DOC-brooding can be achieved by using a heater/warmer. The heating function for DOC is very important because it is not only a heater, but the heat produced also functions to stimulate various organ functions, including organs that regulate body temperature (Tamzil, 2014). Meanwhile, according to Rusydy et al (2022), an inappropriate heating temperature will increase *Adrenocorticotropic Hormone* (ACTH) levels, which is an indicator of stress in DOC.

The main problem so far is that the source of heat used is still oriented towards PLN electricity or the use of LPG and even firewood. This method turns out to still has many shortcomings and causes some problems. Based on a survey conducted at the location, the conventional chicken heating equipment was found to have shortcomings. Therefore, it is necessary to develop a chicken heating device that can address farmers' concerns. Chicken farmers' problems related to heating equipment that originates from electricity, LPG gas or firewood are explained as follows:

1) High electricity costs.

Incandescent lamps (bulbs) are the most common type of electric heater. They are simple, practical, affordable, and have a low risk of fire. However, incandescent lamps are only suitable for small-scale chicken farms, as the cost of electricity is too high for large-scale farms. Additionally, it is difficult to control the coop temperature with incandescent lamps, and continuous lighting can disrupt the chicks' diurnal rhythm and cause leg and bone abnormalities, making it difficult for broilers to move around to get food and water (Supriyanto et al, 2020). Meanwhile, electric heaters must work 24 hours a day. Apart from the problem of expensive electricity costs, there are often power outages for quite a long time, which causes the heater to unwork. This results in the death of chicks (DOC).

2) LPG heating systems can pose a fire hazard if not properly installed and maintained.

LPG heating systems can be dangerous if not properly installed and maintained. One common hazard is gas leaks, which can occur when the regulator is not installed correctly when changing a gas cylinder. If a leak occurs when a light stove, it can cause a large fire. Figure 1 shows a photograph of a conventional LPG heating device commonly used by farmers in Blitar.

Fig.1 Photograph of a conventional LPG heater commonly used in DOC coops

3) Restrictions on the use of subsidized fuel/LPG.

Subsidized fuel/LPG restrictions have forced chicken farmers to adopt alternative heating methods, such as wood-burning heaters. Unfortunately, wood-burning heaters produce too much heat, which is more than the chickens need, and thus less effective.

4) The conventional coops produce poor air quality and low oxygen levels.

The combustion process of a conventional heating system in a closed room consumes oxygen and produces carbon dioxide, which can negatively impact the health of chicks. Chickens need sufficient oxygen levels and temperature, and if the combustion heat is reduced to meet oxygen levels, the heating temperature required by the chicks will not be met. As a result, chicks may be susceptible to infectious bursal disease (gumboro) and their nutrition may be diverted from increasing body weight to growing feathers to maintain a stable body temperature.

Therefore, based on the problems mentioned above, community service solutions are offered, namely: (i) Installation of an electric heating system that can produce a safe and comfortable temperature for chicks and is easy for farmers to use. (ii) Build an independent energy source to run the heat treatment system equipment in the chicken coop by installing a solar rooftop. Solar rooftop systems, which are similar to home solar systems, can be used to power heating coops. Rooftop solar is often used in remote areas, such as pool locations, where grid electricity is unavailable or unreliable. While the upfront cost of rooftop solar is high, the long-term savings are significant. In the past five years, solar panel technology has advanced rapidly, making solar-powered equipment more accessible and affordable for society. Government policies supporting the development of new renewable energy, particularly solar energy, have also contributed to this progress. Solar panels can be used for a variety of purposes, including solar power plants (PLTS), street lighting, pest-repellent ultraviolet lamp technology, and electric vehicle charging stations. As a result, there has been a surge of research and development (R&D) on the application of solar panel technology to meet society's electrical energy needs in recent years.

The assembly and installation of a solar-based electric coil heating system is an application of research development carried out by the team. Community service (PPM) can provide a strengthening of science and technology as well as the use of renewable energy in the field of poultry farms, especially chickens. So that the results of the PPM program carried out can be a pioneer for chicken farmers in the region which will ultimately become a livestock industry that can be oriented towards national and even global markets.

IMPLEMENTATION METHOD

The community service program was carried out in Sumberjo Village, Sanankulon District, Blitar Regency, in August 2023. The successful implementation of community service requires appropriate, effective, and sustainable methods. The stages of implementing this community service program are:

1. Coordinate internal teams (lecturers, staff, and students) to strengthen the program structure and ensure that activities are organized and focused. This stage includes all technical, managerial, and scheduling matters.
2. Coordinate with partners (breeders) to develop plans for creating a brooder heating system and installing photovoltaic (PV) modules and equipment to supply electricity for heating.
3. Check the location of the coop to ensure a strategic location for placing the equipment to be installed.
4. Purchase tools and materials to manufacture a brooder heating device with a solar-based electric coil system. The main components include solar panels, a charge controller, a battery, a heating element, an infrared lamp, and other supporting materials.
5. Install the equipment, namely heating equipment and solar power generation systems.
6. Monitor and evaluate the implementation of activities.

The overall flow of community service implementation is shown in the flowchart in Figure 2.

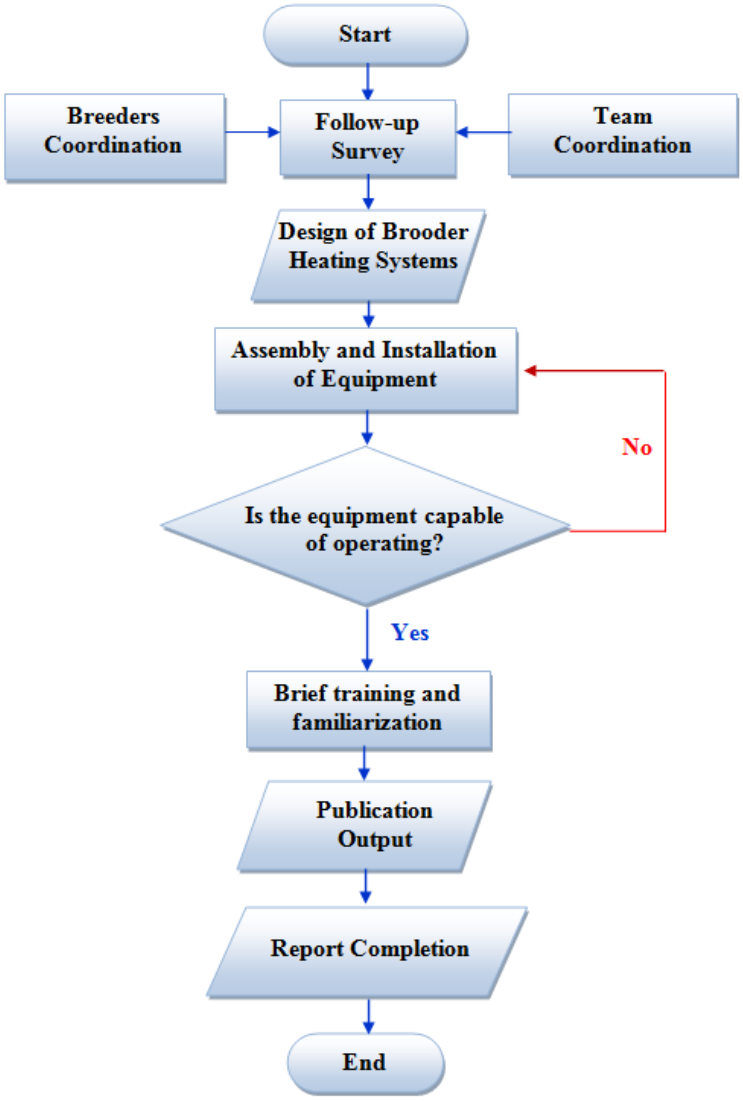

Fig.2 Flowchart for community service implementation

The implementation of this community service requires the installation of electric heaters in the DOC enclosure and a solar power system. This electric warmer/heater is based on previous research, particularly on heating coils (Asrori et al., 2023). The results of this research have been refined in terms of both design and feasibility for application. The DOC Electric Warmer is a space heating device for day-old chicks (DOCs). It is powered by electricity, so it must be connected to a solar power generation system to operate.

RESULTS AND DISCUSSION

The community service program achieved its initial goal of installing heating equipment and a solar panel-powered electricity source. The following section describes the results of these two activities in more detail.

A. The installation and testing of electric heater in DOC coops

The designed heating device features a thermocouple for temperature control at various

points in the room, a fan speed controller, and a timer. Its effectiveness factor should be considered to ensure consistent heat for the chicks, keeping them warm and comfortable, which is essential for their survival and growth. Chicken coop heaters are generally chosen based on their ability to produce a suitable, stable, and evenly distributed coop at room temperature without producing loud noises. To reduce heat loss in DOC coops, cover them with mulch plastic while ensuring adequate ventilation. Place the heater in a wind-free area, out of reach of the chicks (preferably by hanging it), as shown in Figure 3. Optimally, place the heater in the middle of the coop so that the DOC chicks have enough space to move freely and easily reach the heat source.

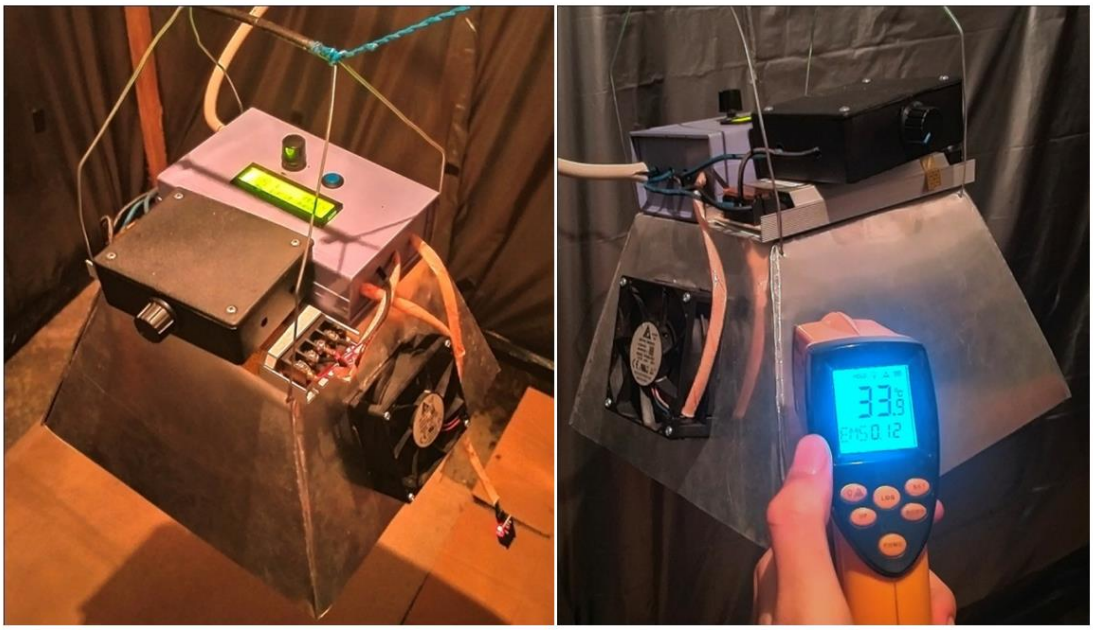

Fig.3 Positioning and testing the electric warmer in the DOC coop

The correct positioning and setting of the DOC electric heater will provide a warm and comfortable environment for the chicks. Modern commercial chickens are very sensitive to environmental temperature and cannot regulate their body temperature optimally until two weeks of age. Therefore, during the DOC period, it is necessary to regularly monitor the coop temperature to ensure that it remains at the desired level. The placement of the electric warmer affects its temperature output. Therefore, placing the heater in the middle of the coop produces an ambient temperature of 32.4 °C at a fan speed of 3500 rpm. This placement allows the heater to reach all points of the room more easily and evenly distribute the heat. Based on testing, the heater can produce a brooder temperature of 30-34 °C, which is suitable for DOC (Fatmaningsih et al., 2016).

The DOC coop has an area of around 15 m^2, with dimensions of 3 x 5 m. This area can accommodate around 500 chicks. Figure 4 shows the condition of the DOC coop before and after installing an electric warmer.

Fig.4 The DOC coop before and after the electric heater was installed

The installed DOC Electric Warmer requires an electricity source to operate, as it has a capacity of 200 W/AC. The use of electricity can be costly for farmers. Therefore, one of the technologies installed in this comunity service activity is a small-scale solar power plant with a capacity of 600 Wp to address this issue.

B. Solar power plant assembly

The DOC electric warmer's primary energy source is a 600 Wp solar panel. Solar panels convert sunlight into electrical energy, which is then channeled through the solar charge controller to the battery for storage. The solar charge controller also channels power from the battery to the inverter to convert it from DC to AC for the electric warmer. The installed solar power generation system has a capacity of 600 Wp, consisting of 4 units of solar panels with a capacity of 150 Wp. Solar panel energy production is influenced by location, weather conditions, environmental temperature, and shading factors. Therefore, it is important to consider these factors when installing solar panels. Figure 5 shows the process of installing solar panels on the roof of the coop.

Fig.5 The installation of solar panel on the coop roof

According to several studies, partial shading can reduce the output of solar panels by 10% to 14% (Giyantara et al., 2020; Rahmaniar et al., 2023). Therefore, solar panels should be placed in an open area free from the shading influence of trees or surrounding buildings, as shown in Figure 6.

Fig.6 The results of installing solar panels in an open area

Correctly installed solar panels are expected to produce the maximum daily average energy in kWh. In Indonesia, the sun hour value ranges from 3 to 5 hours, so let's assume a sun hour value of 4 hours. With an installed capacity of 600 Wp, the system is predicted to produce 2.4 kWh of energy per day.

Furthermore, the installation of the inverter, battery, and fuse equipment in a plastic box, as shown in Figure 7, manages the conversion of solar panel electrical energy. A hybrid-smart inverter is a device that combines a solar charger and an inverter. The Luminous Solar Hybrid Inverter 850VA/12V is a pure sine wave (PSW) inverter that can be connected to the PLN (On Grid) network. The PWM-type solar charger in this device can charge 12V/100 Ah batteries.

Fig.7 Smart inverter and battery installation in plastic box

C. The transfer of equipment to the DOC farmer

After testing and confirming the feasibility of the electric warmer design, it was installed in the DOC coops. The solar panel equipment and electric warmer were installed in August 2023, followed by familiarization and handover in September 2023. The farmer played a major role in this activity, especially in setting up the DOC coop. The following documentation shows the handover process, starting from the team's inspection of the coop to the familiarization process (Fig.8 & Fig.9). One of the important points of familiarization was to share the knowledge and technology applied in the community service with the DOC farmers so that they could maintain and make the most of the results of the community service activities carried out by the team from Politeknik Negeri Malang.

Fig.8 handover of equipment to community service partners

Fig.9 Community service team and DOC farmers in the site

Field evaluations have shown that the installation of solar panels has had a positive impact on DOC farmer partners. The installed solar panels have a capacity of 600 Wp (Watt peak), meaning that they can produce up to 600 Watts of power. Assuming a sun hour coefficient of 6 hours during the dry season, the installed solar panels can produce 6 x 600 = 3.6 kWh of electrical energy per day. This results in a monthly electricity cost savings of 3.6 kWh x Rp.1500 x 30 days = Rp. 162,000.-.

CONCLUSION

The Politeknik Negeri Malang Team's community service activities were successful and had a positive impact on the community, as evidenced by the following conclusions:

The 200 W DOC warmer is equipped with an adjustable booster fan to evenly distribute heat quickly. Additionally, the tool has an electronic control device to regulate the heating temperature and maintain a stable DOC Brooder temperature. The 600 Wp solar panel system installed in this community service consists of four 150 Wp monocrystal solar panels, an 850VA/12V hybrid solar inverter (pure sine wave frequency type), and a 12V/100 Ah VRLA battery. The installed solar panels can produce up to 3.6 kWh of electrical energy per day, providing an economic benefit of Rp. 162,000.- per month.

Acknowledgement

The community service is funded by SP Number DIPA-023.18.2.677606/2023 from Politeknik Negeri Malang.

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