9 Raising healthier poultry: Nigeria

General information

- **Implementing institution**
  National Centre for Energy Research and Development (NCERD), University of Nigeria, Nsukka

- **Head**
  C.E. Okeke

- **Details of institution**
  Address: National Centre for Energy Research and Development, University of Nigeria, Nsukka, Nigeria

  Tel.: (+234) 042 771853

  Fax: (+234) 042 771855

  E-mail: misunn@aol.com

- **Implementation period**
  1993 to 2000.

- **Costs**
  US$10,000 from UNISPAR/UNESCO-sponsored project to implement 10 medium-scale solar energy brooding systems in 1999.

Summary

In 1980, the Government of Nigeria established the National Centre for Energy Research and Development (NCERD) at the University of Nigeria, Nsukka, in the eastern part of the country. The NCERD mandate is to carry out research and development on solar and other renewable energy technologies and to disseminate the results. Activities of the Centre include the training of personnel (engineers, scientists, technicians, artisans, etc.) in a wide range of technologies.

More specifically, NCERD conducts research and systems development in photovoltaic (PV) solar energy, solar thermal energy (for drying, heating and cooking, and poultry production), biomass and biogas, coal briquette technologies and systems for using energy efficiently. The present case study focuses on an NCERD project to use solar energy to make poultry brooding systems in Nigeria more efficient and profitable.

Farmers often lose a sizable proportion of their day-old chicks during the brooding period as a result of inadequate or non-existent power supplies. The project pioneered research on the socio-economic impact of using solar energy in poultry brooding technology in rural areas.

The special features of the innovative poultry brooding technology of the project are that it harnesses solar energy and uses locally available materials; it can be adapted to both rural and urban poultry production; and it incorporates a waste conveyor, which aids the removal of poultry waste. Use of this technology has led to:

- a pollution-free environment for poultry breeding;
- chicks of improved feed conversion ratios and lower mortality rates;
- systems that are free from fire hazards and allow higher profit margins than conventional brooders;
- development of small and medium-sized poultry brooding systems.

The case study shows how solar energy can help to solve the problem of heating for the poultry industry. Project findings also could prove useful in devising policies to reduce the risk of power failure or unavailability of power for poultry farmers. This experience involved design, development and technology transfer while its major objective (and challenge) was to popularize and disseminate a new technology.

Background and justification

Almost eight out of every 10 Nigerians are involved in agriculture and about 10 per cent of the population are engaged in poultry production, mostly on subsistence small or medium-sized farms.

Typically, Nigerian poultry farmers use combinations of kerosene bush lamps and stoves to heat hatcheries and box nurseries for brooding day-old chicks. Because kerosene is an expensive fuel, many farmers cannot afford either to start raising poultry or to expand their existing poultry production. For example, a farm with a capacity of 1,000 birds requires 14,400 litres of kerosene a year, costing about US$3,150. In addition, those few (mainly large-scale) farmers who use electricity from the national grid to power their brooding facilities often suffer power interruptions, resulting in the loss of young chicks.

The mortality rates of chicks brooded in kerosene- and grid-based systems are 7 and 10 per cent, respectively. Most chick deaths are caused by carbon dioxide or carbon monoxide gas emissions or by outbreaks of fire. The traditional method of leaving chicks to be brooded by their mothers for their first few days of life results in mortality rates of 60 to 70 per cent. These factors lead to low net incomes for chicken farmers — a farm of 1,000 birds earns about US$4,000 per annum, for example — that have discouraged poultry farming in Nigeria.

Until the NCERD project, there had been no experimentation with modern technologies and practices in the Nigerian poultry-production sector. Solar energy would be an excellent source of sustainable power for poultry farmers. Solar radiation is available all year round in Nigeria, which receives about 4.85 x 10^{12} kilowatts of energy from the sun every day, equivalent to about 1,082 million tonnes of oil a day.

Assessments found that the initial costs of installing a solar PV system for poultry brooding can be recuperated within two years by energy savings. The technology is environmentally sound because it is does not pollute the atmosphere and it also drastically reduces the risk of fires. Solar energy poultry brooding is highly reliable, inexpensive to maintain and of great economic benefit to both rural and urban poultry production.

Description

Three different models of the technology were designed: for small-scale (up to 50 chicks), medium-scale (between 50 and 100 chicks) and large-scale (up to 2,000 chicks) production. Solar-powered poultry brooders have the following characteristics:

- They are economically viable.
- They use equipment that is relatively easy to produce and operate.
- They produce cost-free energy.
- They improve the quality of the chicks produced.
- They are relatively inexpensive to maintain.
- They rely on construction materials that are available locally.

The systems' solar energy storage device and handling system for poultry waste (via a conveyor belt) are major innovations. Small and medium-sized systems were field-tested by 10 Nigerian farmers under projects of the University-Industry-Science Partnership (UNISPAR) programme of the United Nations Educational, Scientific and Cultural Organization (UNESCO). Large systems were tested at three farms. Workshops were held to inform existing and potential users about the new technology. Indeed, encouraging farmers to accept and adopt the new technology proved to be one of the biggest challenges faced by project organizers.

Trials demonstrated that when outdoor temperatures are between 21° and 33°C and humidity is between 45 and 90 per cent, solar-powered brooding systems operate at a steady temperature of about 35°C and a humidity of 50 to 80 per cent. The ability of the systems to maintain these conditions even at night or on cloudy days is a major advantage. The table shows how well solar energy brooding performs in comparison with kerosene or grid electricity.

Patenting and commercialization

The innovative chick brooding technology still has to be registered and patented. Ten of the medium-scale systems have been produced and commercially distributed in Enugu State.

Partnerships

Although no formal national or international partnerships have been established, project success depends on poultry farmers' acceptance of the new technology and on government support

Table | Performance of broiler chicks under three brooding systems

Chick parameters	Kerosene	Grid electricity	Solar energy
Initial body weight *(g)*	49.84	49.91	49.91
Final weight *(g)*	452.16	400.01	562.74
Feed intake *(g)*	39.30	37.20	38.37
Weight gain *(g/day)*	14.39	12.50	18.31
Feed conversion ratio	2.73	2.89	1.9
Mortality rate *(%)*	7	10	3

for the project activities. It is particularly useful to involve government officials in a project, because they are then more likely to use government networks to help to promote and popularize new technologies that improve environmental conditions and people's living standards.

Replicability

Poultry breeding is culturally acceptable to people all over the world and provides an excellent source of protein for poor communities because it requires little capital, labour or land. However, the high cost or unavailability of heating for chick brooding hampers the establishment of small-, medium- or large-scale poultry production systems in many developing countries. Sustainable sources of energy, such as solar power, could therefore have an important impact on poultry production in many other developing countries, especially in tropical regions where the development of sustainable forms of energy for agricultural production is still in its early stages.

Lessons learned

The project faced a number of challenges during its implementation. Foremost among these was trying to change the deep-rooted, conventional methods of poultry production. Initially, local farmers were skeptical about adopting the innovative chick brooding technolgy and feared that the safety of chicks would be threatened by the effects of radiation. Furthermore, most poultry farmers have low incomes (as a result of the poor state of the local economy) and are reluctant to risk spending on new, unfamiliar technologies. Systems must also have adequate energy storage devices so that power supplies are not interrupted by sudden drops in solar radiation owing to cloud cover. The lack of national energy conservation and environmental protection policies also made it more difficult to transfer the renewable energy technology.

Awareness-raising is one of the most important early steps in technology transfer. In this project, farmers' initial wariness was overcome by the first workshop organized in 2000, which generated considerable interest from both individuals and government officials. New methods of gaining end-user confidence were found, and the demand for the new technology has increased steadily ever since. The potential of the project to reduce poverty was realized through efforts to involve women and young people in poultry production. Integration of the new technology into the Nigerian poultry production sector has made an important contribution to eradicating poverty and improving the socio-economic conditions of poultry farmers and the population at large.

IMPACT

When compared to high-cost heating fuels and the unreliable energy supply that they provide, solar power seems the best and most sustainable energy option for poultry brooding facilities in Nigeria. Solar energy is in endless supply, it is environmentally friendly and the technology to harness it is simple and easy to adapt. The main areas of impact of the project are:

- socio-economic improvements and poverty reduction because of a short (two-year) pay-back period for the solar systems;
- improved chick performance due to efficient feed conversion and lower mortality rates; and
- potential conventional energy savings of 60 per cent, which would alleviate the pressure on fossil fuels and grid electricity, reduce pollution and create tangible economic benefits.

FUTURE PLANS

Farmers will be more likely to adopt the new technology if they can appreciate the benefits of doing so in terms of both increasing their own socio-economic well-being and preserving the environment. A reliable energy supply is absolutely essential for poultry brooding. Conventional energy sources fail to offer such reliability because of frequent disruptions to the power supply. Moreover, the nation's poorest farmers often do not even have access to conventional sources of electricity.

At present, many Nigerian poultry farmers remain unaware of solar brooding technology. As a result, its use is not widespread. To overcome this problem, the Government Poverty Eradication Programme is considering the development of 1,000 medium-sized brooding-system units for up to 100 chicks each. Plans are also under way to install large-scale systems on a number of farms.

An action plan has been initiated for the design and development of an integrated solar energy-powered poultry production system comprising a solar egg incubator, solar brooder and solar manure dryer, and attempts are under way to patent the innovative technology. NCERD also plans to collaborate with interested organizations and countries by sharing its experiences and expertise in solar-powered poultry brooding systems.

PUBLICATIONS

Okonkwo, W.I. (1998). Solar energy chick brooding. In Energy Commission of Nigeria. *Rural renewable energy needs and five supply technology,* pp. 58-71.

Okonkwo, W.I. and Agunwamba, J.C. (1997). Socio-economic impact of solar energy brooding systems. *Proceedings of the Third International Conference on Power Systems, Operation and Planning,* pp. 276-280. Abidjan, Côte d'Ivoire, 13-17 Jan. 1997.

Okonkwo, W.I. and Akubuo, C.O. (2001). Thermal analysis and evaluation of heat requirement of a passive solar energy poultry chick brooder. *Nigerian Journal of Renewable Energy,* 9(1): 73-78.

Okonkwo, W.I., Anazodo, U.G.N., Echiegu, E.A., Hoeje, O.C. and Akubuo, C.O. (1992). The passive solar energy poultry chick brooder: further improvement and preliminary testing. *Nigerian Journal of Solar Energy,* 11: 32-40.

Okonkwo, W.I., Hoeje, O.C., Echiegu, E.A. and Akubuo, C.O. (1993). Performance evaluation of medium-scale passive solar energy-heated chick brooder. *Nigerian Journal of Solar Energy,* 12: 51-60.

Okonkwo, W.I. and Ukachwu, S.N. (forthcoming). *Comparative effects of passive solar, electric and kerosene brooding systems on the performance of broiler chicks.*