Fuel Usage in Poultry Brooding: A Study of Ahiazu Mbaise Local Government Council of Imo State, Nigeria

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ABSTRACT

Brooding plays a vital role in chick survival and growth, requiring precise temperature regulation. However, increasing fuel costs and inefficiencies in conventional brooding systems pose serious challenges to poultry farmers, particularly in developing regions. This study examines fuel usage patterns, farmer characteristics, and key constraints affecting poultry brooding in Ahiazu Mbaise Local Government Area, Imo State, Nigeria. A purposive and multi-stage sampling technique was used to select 60 poultry farmers from 10 communities. Data were collected through structured questionnaires and interviews, and analyzed using descriptive statistics such as frequencies and percentages. The majority of farms (94%) operated 3–5 units, while 66.7% of farmers maintained stocking rates between 1 and 500 birds. Kerosene brooders were the predominant energy source (66.7%), followed by charcoal (25.0%) and gas brooders (8.3%), with no adoption of radiant tube heaters. Most respondents were male (62%) and aged between 20 and 40 years (72%). Key constraints identified included poor marketing infrastructure (40%), limited access to credit (32%), and low awareness of improved brooding technologies (18%). Poultry farmers largely depend on inefficient and costly fuel sources, underscoring the need for affordable, energy-efficient brooding alternatives to enhance productivity and sustainability.

Keywords: *Brooding, Poultry farming, Fuel usage, Temperature management, Small-scale farmers, Nigeria*

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INTRODUCTION

The period from hatching until the chickens no longer require supplementary heat is called the brooding period' and usually lasts for 3–6 weeks, depending on seasonal temperatures and the type of housing (Zhao *et al.,* 2007). Chickens need supplementary heat when they hatch, because they are unable to maintain their body temperatures. The heat can be supplied by a broody hen or by brooders fuelled by electricity, gas or oil. As the chicken grows, its downy coat is replaced by feathers, and the brooding temperature can be gradually reduced, until supplementary heat is discontinued at about 3–4 weeks (Zanatta *et al.,* 2008). During the brooding period, the chickens need warmth, shelter, fresh air, proper food and clean water.

The brooder must be capable of providing a temperature of 33°C, even in the coldest conditions. It must be adjustable, so that a steady temperature can be maintained. Simple electric hobby brooders can be obtained from poultry equipment suppliers and will successfully brood up to 50 chicks. The brooding temperature for day-old chicks should be 33°C, about 50 mm above the litter.

Generally, supplementary heat can be discontinued at the end of the fourth week, but in wet season, it may be necessary to provide heat on very cold nights in the fifth week. Temperatures are to be used only as a guide, because the best way to adjust the temperature for the comfort of the chicks is to observe their behaviour (Mulugeta, 2012). If they crowd near the heat source and chirp loudly, the temperature is too low. If they move well away from the heat source and start panting, they are too hot. Ideally, they should be fairly quiet and spaced evenly under and around the heat source (Figure 1). During brooding, good observation skills and routine attention are essential, to ensure bird growth, health and low mortality.

A simple and effective means of brooding small numbers of chickens is to use an infra-red heat lamp. These lamps are designed for higher infra-red energy output and a lower light output than can be provided by ordinary electric light bulbs. The infra-red energy passes through the air without heating it, but when it strikes an absorbing body, such as a chick, the energy is absorbed and transformed into heat (Onwukwe, 2025). The litter is also heated and the surrounding air warmed by heat converted from the heated bodies.

A single infra-red lamp will brood up to 50 one-day-old chickens. The lamp should be suspended 350–400 mm above the litter and the temperature checked by laying a thermometer on the litter directly under the lamp. The temperature can be adjusted by raising or lowering the lamp. Heat lamps should be hung securely by a chain, to minimize the risk of fire. They must not be hung by the electric lead due to the possibility of a lamp failing, a spare globe should be available.

For brooding small batches of chickens (up to 50) a normal incandescent 100 W spotlight globe may be used, but these are not as efficient as the infra-red lamps (Corkery, 2013).

Clean and disinfect the brooding area some days before the chickens arrive, so there is time for the area to dry. Cover the floor with dry absorbent litter material (wood shavings, rice hulls, chopped straw, sawdust or shredded paper) to a depth of 50 mm.

Place a surround of cardboard, metal sheeting or Masonite around the brooding area. The surround should be about 450 mm high to protect the chickens from draughts, and the enclosed area should provide at least 50 cm^2 of floor space for each bird.

Figure 2 shows a plan for a brooding area. For the first two days the litter in the brooding area should be covered with newspaper. Starter feed and clean fresh water must be provided. Ideally, the water should be in specially designed drinkers consisting of a plastic jar inverted into a shallow circular trough. The drinkers hold about 2 liters of water, and the shallow troughs are designed so that the chickens cannot drown in them. Ordinary flat dishes can also be used, but if the water is too deep the chickens may drown. A large stone or block of wood placed in the centre of the pan will usually prevent drowning by reducing the amount of water in the vessel, without restricting access by the birds. Depending upon the outside temperature, switch the brooder on at least two hours before the chickens arrive, so that the area is warmed and the necessary adjustments to temperature can be made (Osorio *et al*., 2012).

Place feeders and drinkers near the heat source and, for the first two days, sprinkle food liberally on the newspaper to encourage the chickens to eat. Also, dip each chicken's beak in the water as it is placed in the brooder, to encourage it to drink. With large numbers it will not be possible to do this with all of the chickens, but it is generally worthwhile dipping the beaks of 10% of the flock.

The base pans from hanging feeders can be used as feeders for young chickens; as the chickens grow, the tube hoppers can be attached. The tube will hold enough feed for several days. To reduce feed wastage, the feeders should be gradually raised as the birds grow. Small flat pans or trays can also be used for feed for the first week.

Keep fresh food and water in front of the chickens at all times, and clean and refill the feeders and drinkers regularly. Cleaning will have to be carried out at least twice daily until the chicks have grown sufficiently and the feeders and drinkers can be raised above the litter. After three days, the newspaper can be removed, the feeders and drinkers moved further away from the heat source and the surround gradually expanded, until it can be removed completely at two weeks. Make sure that the brooder room is well ventilated, but that the chickens are free from draughts.

The study laid more emphasis on ways to determine the usefulness of fuel usage in poultry brooding in Ahiazu Mbaise Local Government Council of Imo State, Nigeria and investigated the sources of brooder energy sources for poultry.

Given the energy problem that Nigeria is facing and the commencement of its negative effect on energy, it is crucial to find a renewable source of energy to serve as a substitute for fossil fuel based poultry heating systems. Being used as an alternative energy source for numerous industrial and domestic applications, solar energy is intended to be investigated for space heating of poultry houses. One of the main challenges of this application is the storage of the harvested heat to cover the heating demand all over the day and night. Therefore, it is required to determine the amount of energy that is needed for this application and design a suitable storage system to ensure the supply of this amount.

In addition to solar energy, one of the promising sources of non-fossil fuel energy that was incorporated in this study is biogas. Since chicken manure is a free by-product produced in any poultry house, this study considered the application of biogas produced from chicken manure as an auxiliary heating fuel for the poultry house besides the solar heating system. Chickens that are to be grown for egg production need chicken starter crumbles or mash from day old to about eight weeks. The diet should contain 18%–20% crude protein and a coccidiostat if the chickens are to be reared on the floor. For small flocks from 9–18 weeks of age, growers' pellets or crumbles (15%–16% protein) are generally used. Birds should have unrestricted access to food and water. From 19 weeks, the pullets should be fed a laying diet, which should be available at all times. It can be supplemented with scratch grain and kitchen scraps.

Literature review

Heating for Poultry Housing

Wood energy has been used for centuries for heating but was replaced by cheaper more convenient fossil fuel sources. But with the increase in global energy costs and tight margins in the poultry industry, wood heating is a possible alternative. However, before an alternate energy source is considered, energy efficiency measures should be evaluated due to the higher return on investment. This could include adding insulation to the ceiling, closing up sidewall curtains and insulating, reducing unplanned infiltration (drafts), installing more efficient gas heating units, properly maintaining heating equipment, checking inlet vents are working properly, reducing over ventilation and improving litter management to reduce ammonia levels (Santos, 2008 and Osorio, 2010).

A boiler system can be located centrally on the farm with piping running to convection unit heaters in each barn. A fan in the convection unit pulls air across the hot coils and distributes the heated air horizontally above the floor radially from the unit. The units are positioned about 3-4 feet above the floor. The distance between units will depend on the throw distance of the air. The air flow will create a mushroom shaped pattern within the barn. Some units have a tube that goes to the ceiling to prevent stratification of the air in the barn. The temperature variation within a building should be very low (within 3F) if the air distribution system is sized correctly. Boilers with automated feed systems will require less thermal storage to reduce turndown periods than cordwood boilers. The capacity of the thermal storage will depend on the tank size and temperature differential above the distribution temperature. If the distribution temperature is 120ºF and the maximum temperature is 170ºF, there will be about 400 Btu of storage per gallon of water. The general recommendation for thermal storage sizing is 400 to 550 gallons per 100,000 Btu/hr of capacity for cordwood boilers, 100 gallons per 100,000 Btu/hr of capacity for wood chip boilers and 75 gallons per 100,000 Btu/hr of capacity for wood pellet boilers.

In order to compare different fuels, one needs to calculate the cost per 1,000,000 Btu delivered which takes into account the efficiency of the combustion appliance. Electricity is the most expensive heating source followed by an old style outdoor wood boiler and heating oil. Note that the low efficiency of the outdoor wood stove causes it to be more expensive than heating oil or propane. The least expensive heat source is natural gas and wood chips. Energy costs are a moving target and vary regionally so one should evaluate energy costs locally. The fuel savings must be high enough to cover the cost of combustion equipment, fuel storage, labor and maintenance.

Alternative Brooding Systems

Gas Brooder

Gas brooder uses LPG gas as a fuel for heating operation (Figure 1). If cost considerations are neglected then it can be most beneficial brooder as it install with proper setup **(**sensors, exhaust system, control panel)**.** As this is fully automated system there is no need of extra man power. Some limitations of this system are: initial and working costs are too high and difficult for small scale farmers to afford. There is problem of improper electric supply in rural areas so it can cause stopping of system. Continuous increase in price of LPG gas cylinder affects working cost.

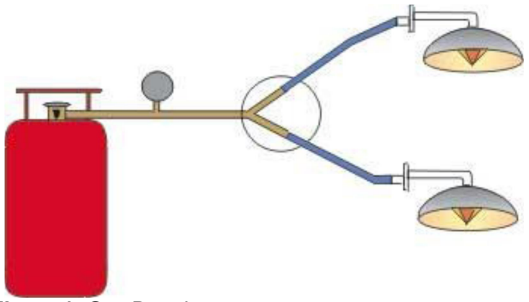

Figure 1: Gas Brooder

Radiant Tube heater

Radiant tube is use for heating purpose. It covers large space with radiant heat. Require less amount of

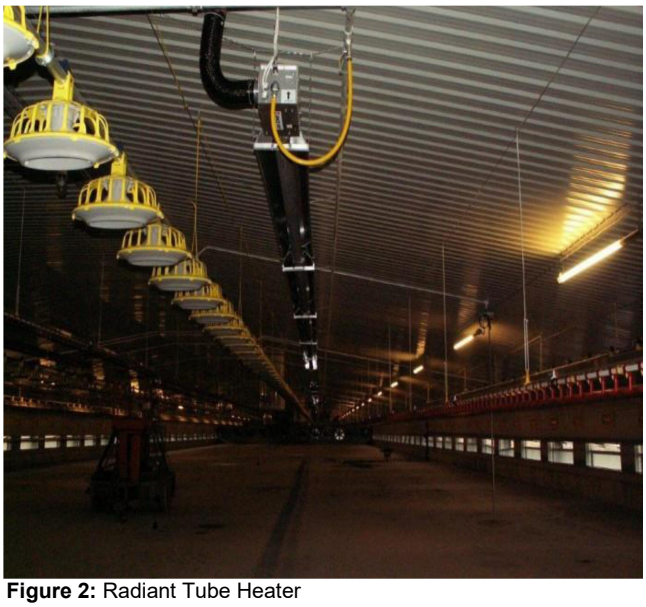

Figure 2: Radiant Tube Heater

electricity (Figure 2). Floor area cannot require as system installed at the sealing. Simple exhaust system can be used. Disadvantages are overheating can occur when temperature variation pass along tube length. Discontinuous power supply can cause problem.

Solar Heating System

Black absorber used to concentrate sunlight which converts sunlight to heat. Due to renewable source of energy, this system is eco- friendly (Figure 3). Energy can be stored and used whenever it requires. But it has some limitations as, high initial cost, maintenance requirement, accessories cost, temperature variation may occur due to change in climate (Okolie, 2012).

Figure 3: Solar Heating System (Chatterjee and Raitumar, 2015)

Under Floor Heating

This system depends on conduction, radiation and convection as means of heat transfer. Under-floor heating systems are using underground electric heating and underground pipes for heat transfer (Figure 4). These systems require external boiling and cooling system as it provide heating and cooling. But these systems require more space and high installation cost. (Vigoderis, 2006).

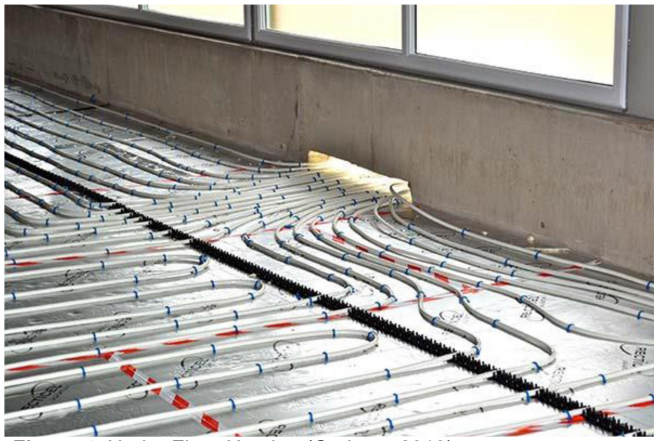

Figure 4: Under Floor Heating (Corkery, 2013)

Trombe Wall Poultry Chick Brooder

Trombe wall form an integrated part of the house duly oriented south ward for maximum solar energy collection all year around. This is made of 0.22 m thick solid block to form the thermal storage system (Figure 5). The external surface of wall which is exposed to environment is treated with black paint for the absorption of radiation energy from sun. Glazing through the glass reduces excess heat loss from long wave radiation (Onwukwe, 2025).

Figure 5: Tromb Wall Poultry Chick Brooder (Osorio *et al.*, 2012)

Kerosene Brooder

Kerosene brooder plays an important role in rural and remote area. This system requires 40 litres kerosene per day for approximately 1000 birds. Lamps are used in kerosene brooder for brooding operation. It creates health issue for chicken. Also availability of kerosene may create problem (Figure 6).

Figure 6: Kerosene Brooder (Corkery, 2013).

Pot Charcoal Brooder

In this brooder, charcoal is used as heat source which is applicable to remote and rural areas. Charcoal brooder is widely used since it is easily available and has low cost. In the economic sense charcoal is very efficient fuel. It burns easily and for longer period. Along with such benefits it carries some disadvantages that are; it creates smoke in high quantity which is harmful to chicken's health (Figure 7). In rainy season there is higher possibility that charcoal may get wait due to rain so proper care of storage is needed. Charcoal takes some time for initial heating (Mulugeta, 2012).

Figure 7: Pot Charcoal Brooder (Zhao *et al.,* 2007)

Cold brooders

The cold brooder is an alternative method of brooding which can be used for small numbers of chickens. It is easy to make, ideal for chickens that have been 'started' under a lamp and particularly useful where access to power is limited. Figure 8 shows the side view of a cold brooder. The cold brooder conserves the body heat of the

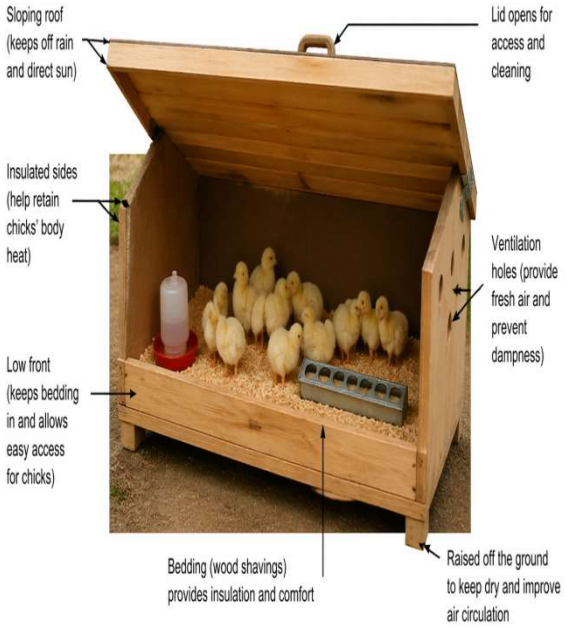

Figure 8: Side view of a cold brooder.

chickens and keeps them warm. A brooder suitable for up to 50 two-day-old chickens consists of a frame 100 mm deep, 750 mm long and 600 mm wide. The bottom of the frame is covered with wire mesh, and can be set above the litter on adjustable legs. The bottom of the brooder should be 80 mm above the litter when the chickens are started, and should be raised gradually as they grow.

Strips of plastic 50 mm wide and 80 mm long can be hung from the bottom edge of the frame to act as curtains. The curtains help to retain the body heat, while allowing the chickens to wander in and out. The mesh on the frame can be covered with hessian and overlaid with a 100 mm layer of rice hulls, wood shavings or straw. A second layer of hessian placed on top will prevent the chickens from scratching the litter material out of the frame. In this way, the brooder is covered with a porous material which will retain the body heat but allow air to pass through. The cold brooder can be set up in the surround in a manner similar to the heat lamp. However, for the first two days the chickens need to be confined close to the brooder.

The chickens should be introduced to the brooder in the evening and confined under it for the first night. This can be done by placing strips of hardboard over the curtains on three sides and wire mesh over the front curtain. This will keep the chicks warm while allowing air to pass through the brooder. The wire mesh can be removed after the first night; however, it may be necessary to use the hardboard strips for a few nights during cold weather (Roy and Boulard, 2005). The chickens in a cold brooder need more attention during the first few days, but these brooders are simple to make and very effective.

Floor space and equipment

Overcrowding and lack of feeder and drinker space can cause some chickens to grow slowly. For circular feeders and drinkers, the length of space available to the chickens can be found by multiplying the diameter of the feeder or drinker by three.

Environmental parameter

Relative humidity (RH), carbon dioxide (CO_2) and ammonia (NH_3) plays very important role in growth of chicken. Proper ventilation is required to control all these parameter. If RH exceeds above 70% then it will create undesirable effect and RH below 50% creates dust in poultry house. Modern techniques are trying to reduce heat losses for maintaining temperature of poultry farms. Due to this formation of CO_2 takes place. Gas heater helps in formation of CO_2 and also birds create their own CO_2. High levels of ammonia gas (NH_3) create impact on growth of chicken. It reduces rate gain of weight of chicken. Different rate of NH_3 production in farm gives different rate of growth. Various factors affect the rate of production of ammonia. They are. ambient temperature, ventilation rate, humidity, composition of food (Corkery, 2013).

MATERIALS AND METHODS

Ahiazu Mbaise is a Local Government Council of Imo State, Nigeria. It is as a result of a merger between Ahiara and Ekwerazu. Its headquarters are in the town of Afor-Oru (or Afor Oru). This study was conducted in Ahiazu Mbaise Local Government Council of Imo state, Nigeria (Figures 9-11). The headquarters is Afor Oru. It is among the 27 Local Government Areas in the state. It has an area of 144km and a population of 170, 902 persons. Ahiazu Mbaise is bounded in the North by Aboh Mbaise and Ikeduru LGAs, in the North-West and South –West by Ngor-Okpala and Owerri North LGAs, while in the North-East and South-East it is bounded by Ezinihitte Mbaise LGA and Ngwa South LGA of Abia State (www.imostate.gov.ng). Farming is the major occupation of the people and the major crops grown include maize, cassava, cocoyam, yam and leafy vegetables while goats, sheep, and domestic fowls are the major livestock reared (Madukwe, 2008). Purposive sampling technique was used to select respondents. Ten communities (10) were purposively used for the study from which six (6) poultry farmers were selected making a total of thirty (60) respondents.

A structured questionnaire was prepared and administered to the respondence. A multi-stage random sampling technique was used in selecting respondents used for the study. Data collected using well-structured questionnaire and interview schedules were analyzed using frequency tables, mean and percentages.

.A sample of 60 people was randomly selected using stratified random sample. The major instrument used for collecting date was questionnaire from the respondents. The basic frame work for analysis is found in the questioner. The data collected from the respondents were analyzed using percentages.

RESULTS AND DISCUSSION

From the (Table 1), Fuel Usage in Poultry Brooding in Ahiazu Mbaise Local Government Council, Imo State, Nigeria showed that the poultry farmers in the study area prepared for effective brooding so as to prevent morbidity and mortality in the early stages of brooding. Sixty six point seven percent (66.7%) of the respondents used kerosene brooder during the brooding stage as seen in (Table 1).

Socio-economic characteristics of the farmers

The socio-economic variables of the poultry farmers investigated included, sex and age as seen in (Table 1). Forty (40%) of the farmers are within the age limit of 20 – 30 years while 32% of the farmers are within 31 – 40 years of age respectively. This result is consistent with the findings of the study by Oloye *et al*. (2013) where majority of the poultry farmers in Oyo State, Nigeria were still young. This portends a good future for poultry farming in the study area as the farmers possess the physical strength required for poultry farming. It could also enhance their innovativeness considering the fact that young farmers are less conservative.

Sixty two percent (62%) are males indicating that men are more interested in poultry farming than their female counterparts. This suggested that poultry farming is relatively new to most of the farmers in the study area. This could be attributed to the increasing need for diversification of agricultural enterprises due to the numerous challenges facing agriculture in developing countries (Ahaotu *et al.,* 2026). Farmers as rational beings (Aboweli *et al.,* 2011) could resort to diversification of agricultural enterprises as a way of reducing the uncertainties and risks associated with agricultural production such as climate change (Ahaotu *et al.,* 2023). It could also be attributed to a way farmers maximize the use of resources such as land considering the increasing competition for them. However, low farming experience could mean low experience in terms of skills on poultry farming. The results in (Table 1) further showed that among all the challenges of poultry technologies by poultry farmers in the area, 32 percent of poultry farmers complained of inadequate finance and this hindered the purchasing of productive inputs and payment of hired labour. Poor marketing infrastructure with 40 percent is another challenge facing poultry farmers in the area. As a result of this, there is less awareness on the business of poultry production and marketing. Another challenge was lack of awareness with 18 percent; this is in conformity with (Ike, 2013) that lack of awareness makes poultry farming unproductive.

Figure 9: Map of Mbaise and its Surroundings

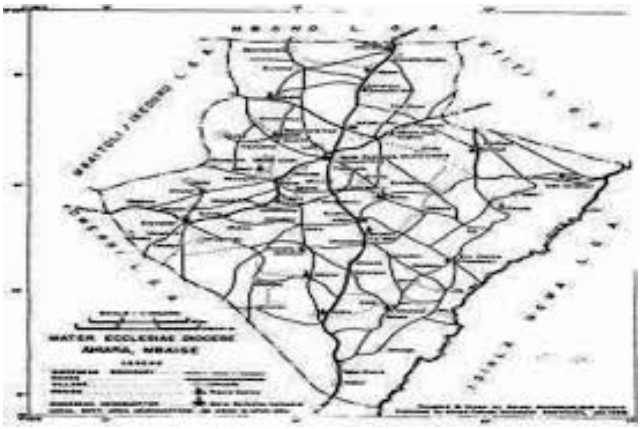

Figure 10: Map indicating Mbaise Community, Imo State, Nigeria.

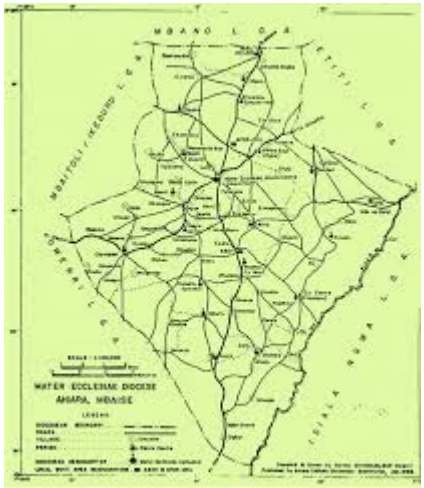

Figure 11: Map indicating Mbaise Community and its Entire Surroundings, Imo State, Nigeria

Table 1: Fuel Usage in Poultry Brooding in Ahiazu Mbaise Local Government Council, Imo State, Nigeria.

Number of Poultry Farms	Number of Farms owned	Number of Respondents (Number of Farmers)	Percentage (% Response)
	3-5	56	94
	1-2	4	6
	Total	60	100
Different Fuel Usage	**Response**	**Number of Respondents**	**Percentage %**
		5	8.3
		55	91.7
		60	100
Distribution of Poultry farmers according to their stocking rate Stocking rate	**(Number of Birds per Farm)**	**Number of Respondents**	**Percentage %**
	1 – 500	40	66.7
	500-1000	8	13.3
	1001-1500	5	8.3
	1501-2000	4	6.7
	2001 and Above	3	5.0
		60	100
Sources of Fuel Energy to Farms	**Sources**	**Number of Respondents**	**Percentage %**
	Radiant Tuber Heater	0	0
	Kerosene Brooder	40	66.7
	Pot Charcoal	15	25.0
	Gas Brooder	5	8.33
	Total	60	100
Sex Determination of Poultry Farmers	Sex	Number of Respondents	Percentage %
	Male	37	62
	Female	23	38
	Total	60	100
Age Distribution of Poultry Farmers	**Types**	**Number of Respondents**	**Percentage %**
	Below 20 years	0	0
	20-30	24	40
	31-40	19	32
	41-50	11	18
	Above 50 years	6	10
	Total	60	100
Major Problems Faced By The Farmers	**Types**	**Number of Respondents**	**Percentage %**
	Poor Marketing Infrastructure	24	40
	Lack of Access to Credit	19	32
	Awareness	11	18
	Poachers	6	10
	Total	60	100

Conclusion

The study has shown the nature of poultry farm management in and around Ahiazu Mbaise Local Government Area of Imo State, Nigeria. After installing brooder in poultry houses, productivity of farm increases. Implementing brooder in small poultry farms with low initial cost help poultry industry in Imo State, Nigeria to grow effectively. Health of chicken mainly depends on surrounding condition hence brooder makes it possible. In rural areas poultry farmers are not using brooder because it is costly hence their productivity is low by providing them economical brooder increases their profit.

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