

Examining the realities of poultry farming technologies as enablers to smart farming in Lira city, mid-north Uganda

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Abstract: This study aimed to examine the realities of poultry farming technologies as enablers of smart farming in Lira city. A descriptive design was adopted targeting one poultry farm in the city of Lira and data were collected using observation, discussions and in-depth interviews. The outcomes were analysed using thematic analysis and findings suggest that the four major aspects were identified in this study, namely; the major characteristics of the artificial incubator selected or preferred by the farmer, the eggs incubation and hatching processes, feeding and growth process for the chickens, and marketing processes have a reliable potential in enhancing smart farming among urban farmers in Lira city and beyond. However, there are threats arising out of chicken diseases, which result into deep loses on the side of a farmer and have disappointed many a poultry farmer in the city. These outcomes may be used as empirical resources for the Lira city authorities to develop a clear strategy for poultry farming as well as safety measures aimed to mitigate poultry diseases for higher profit. The study is a positive contribution to the knowledge and dynamics involved in poultry but also as a pathway to attaining one of the global targets of smart farming.

Keywords: Poultry, incubator, feeding, chicken, incubation.

1. INTRODUCTION

Following a field visit to any smart farming practices. A visit to Gift Poultry Farm, located in Anyangapuc Village, Ngetta Ginnery parish, Lira City East Division revealed that local chicken farming is being commercialized. Reportedly domesticated around 5,000 BC in Southeast Asia, chicken is globally kept and as of 2018, with the introduction and use of modern solar-powered, electricity-powered or fuel powered incubators, the number of chickens increased to about 23.7 billion. In sub-Saharan Africa, and Uganda (which had about 1,274 incubators as of 2014), most farmers still hold-on to the traditional reproduction of chicks as opposed to using incubator. The GQF Thermal Air Hova-Bator was preferred by Gift poultry Farm due to its economical and efficient benefits. This motivated the student because the technology is used for the production of local chicken and its products. Through discussion, interview and observation, the student was able to cover specific aspects of this incubator that included its features; the eggs incubation and hatching processes; feeding and growth process for the chicks; and marketing processes.

The outcome of these aspects were found to be major: that this type of incubator which has a temperature and humidity regulator needs to be placed in a dark room without open windows in order to control light; and that it is able to incubate and hatch between 150-200 chicks and any one round of hatchery period. Generally, it was established that chicken reproduction cycle takes a minimum of 21 days when the eggs can begin to hatch. To ensure that the eggs are fertilized, Gift Poultry Farm management ensures that the egg-laying hens mix freely with cocks. The farm attendants collect 60-100 eggs every morning and evenings to be placed in the incubator which is pre-set fully to ascertain that it is ready for the eggs by ensuring that temperature is regulated a range of 99-100 degrees F. In the incubator, eggs are turned frequently between 4-17 days and thereafter locked completely until they are hatched. After hatching, chicks are transferred to the

brooder, and later to a growing wing. Upon maturity, excess cockerels are sold-off. The farm management uses internet to advertise or receive payments but make a physical delivery of chicken to its customers.

Background to poultry farming technology

The poultry industry makes up a large portion of Missouri's agricultural system. It provides millions of people with affordable and nutritious meat and eggs and other useful products such as fertilizers and livestock feed additives. The industry has grown tremendously in the last few decades. It began as small backyard farming systems and has now developed into large commercial enterprises with millions of birds. "Poultry" can be defined as domestic birds or fowls that include chickens, turkeys, geese, ducks, guinea fowl, and doves that are raised for the production of flesh, eggs, feathers or entertainment (Ullengala, Pawswan, Prince, Muthukumar, Haunshi, Reddy & Chatterjee, 2020). The domestication of poultry is believed to have taken place around 5,000BC to 3,000BC, notably in Southeast Asia. By domesticating poultry, ancient farmers might have targeted many benefits: eggs production, meat production, feathers, and entertainments in form of cock-fighting and birds' songs by quail. Over different centuries, selective breeding for fast growth, egg-laying ability, conformation, plumage and docility took place.

Having descended from the red jungle fowl of Asia with some additional input from grey jungle fowl, chickens have traditionally held their characteristics of a very fleshy red combs and wattles on their heads with the males or cocks usually having a larger and more exaggerated plumage bold colour than females or hens. Chicken farming is specifically believed to have reached the Indus Valley in around 2,000 B.C; and reaching Egypt at around 1,750 BC largely for their eggs and meat globally, a large number of breeds of chickens have been established to be kept on a commercial basis. By 1800^S, chickens began to be kept on a larger scale, and the United Kingdom started a high-output poultry farms at around 1920. With a total population of 23.7 billion as of 2018, up from more than 19 billion in 2011, there are more chickens in the world than any other bird due to the advent and use of artificial incubators. Since 2010, approximately 16 billion birds are raised annually for consumption making poultry to be the second most widely eaten type of meat in the world, accounting for about 30% of total meat production worldwide.

Invention and usage of the Incubator

According to Das, Jani, Nagababu and Kachhaha (2020), the use of modern solar-powered, electricity-powered or fuel energy-powered incubators have increased the global broiler meat production to 84.6 million tonnes with the largest producers being the United States (20%), China (16.6%), Brazil (15.1%) and the European Union 11.3%. Between 2000 and 2010, egg production was growing globally at around 2% per year, and the global egg production was expected to reach 65.5 million tonnes in 2013 which was aimed at surpassing all the previous years. In Italy, the Agricola Italiana Alimentare, a member of Grupo Veronesi which is Italy's largest poultry producer undertakes the production of over 350 million birds in over eight production facilities with each producing around half a million tons of chicken and turkey meat annually. The company also produces more than 1 billion eggs each year. According to two sisters food group in the United Kingdom, the "2 Sisters Food Group" which is one of the U.K.'s largest food producers, produces its stock using artificial incubators and delivers supplies of about one-third of all poultry products consumed in the country, and slaughters 317 million birds annually.

In sub-Saharan Africa, more chickens are kept than any other type of poultry, with over one billion birds being raised each year as a source of meat and eggs. Traditionally, such birds are kept extensively in small flocks, foraging during the day and housed at night. In most developing countries like Kenya, women often make important contributions to family livelihoods through keeping poultry. In Uganda, there were 1,274 incubators as of 2014, and that commercial poultry production was being boosted by the use of incubators, although the farms are virtually concentrated in Central region with very few farmers practicing it in up-country locations. Further an estimated 23 million chickens were being kept in Uganda. The rising urbanization especially in Central Uganda has led to the bulk of production being in larger, and more intensive, with farm locations being close to where the feed is grown or near to where the meat is needed, and result in cheap, safe food being made available for urban communities (Aryemo, Akite, Kule, Kugonza, Okot & Mugonola, 2019). In Lango sub-region, in spite of the emergence of few commercial poultry farmers using incubators, free-range poultry husbandry in which the birds can roam freely outdoors for at least part of the day is a very common practice. Often, the birds have access to natural conditions and can exhibit their normal behaviours.

The smart farming technology taken by TAF agri-tourism farm

There are many technologies in use by Gift Poultry Farm: the temperature and humidity sensor installed in the chicken rooms, the automatic piped-line drinkers, and the artificial incubator. The farm attendant explained that an incubator is literally a device that is powered by fuel, solar or electricity to help in the hatching processes of poultry species like ducks, chicken, turkey, doves, and geese. In this farm, the attendant explained that an incubator is specifically used for chicken reproductive purposes only. Accordingly, there are many types of incubator, and that the management plans to procure a metallic coated incubator. Currently, this farmer uses the GQF Thermal Air Hova-Bator which is a free-standing incubator made of a plastic material and white in colour with a dimension of 46.35 x 46.35 x 13.08 inches in length, width and height, respectively.

The preference of TAF farm for smart farming technology is based on that fact this Thermal Air Hova-Bator is the most economical and efficient incubator because it is cheap to buy; the heated air flows out the exhaust vents on top and draws fresh air through the bottom vent; includes two small windows on top for easy viewing of eggs and hatching chicks; and can be safely used for different poultry varieties. Having visited the Netherlands and many other European countries on a New Vision agricultural-sponsored, the proprietor of Gift Poultry Farm considered diversifying his bee-keeping business with both fish-pond and poultry farming. According to the proprietor, the idea of this enterprise was to provide both forward and backward linkages to other enterprises, for instance chicken droppings are mixed with other ingredients to prepare feeds for the fish; and that the demand for products from local chicken is very high and fetches higher prices than the genetically modified chickens. A strong reason that motivated the student to consider this farming technology is its ability to promote the production and consumption of local chicken and its products as opposed to the production and consumption of exotic breed of chickens. Four major aspects were identified and covered, namely; the major features or characteristics of the artificial incubator selected or preferred by the farmer; the eggs incubation and hatching processes; feeding and growth process for the chickens; and marketing processes.

2. METHODOLOGY

Multiple methods were used to gather data and information from this farmer, including observation, discussion and an in-depth interview. All the three approaches were concurrently applied, although discussion and interviews over-rode observation during the study. In essence, discussion refers to dialogues or conversation, whether asked or not based on a specific topic being shared by two or more people in the farm, discussions were held to ascertain the origin of 'a dream to establish an incubator in the chicken farming'. On the other hand, interview refers to a one-on-one question and answer session held between two or more people on a pre-determined issue or a specific issue that needs an in-depth answer or explanation. The advantage of using discussion and interview during this visit was that the two methods created a true rapport between the student and the farm attendant which made it possible for a free interaction during the entire visits. It was however, a disadvantage in that both methods were time consuming given that the same attendant was needed by other farm customers for different purposes or reasons at the same time the student also needed him. To mitigate this, interruptions or interrupted time to carry on with observation methods was undertaken to ascertain some of the factual issues raised during discussion and interview time.

3. THE OUTCOMES

This section covers the results of discussion, interview and observation made during the field visit at Gift Poultry Farm. It includes the findings from: the major features or characteristics of the incubator used by the farmer; the eggs incubation and hatching processes; feeding and growth process for the chickens; and marketing processes of chicks and chickens or its products.

The major features of the poultry farming technology

This sub-section presents the characteristics of GQF Thermal Air Hova-Bator incubator. According to the Farm Attendant in charge of chicken department, this incubator, which hatches between 150-200 chicks at any one round of hatchery, is believed to have originated from France although its manufacturing has now gone global; and that the GQF Hova-Bator has been wide recognized for over 30 years as the world's best small incubator. This incubator has a heat source that is controlled by a switch and has a way to add humidity to the air inside of the incubator. This incubator also has a chamber in which water can be added to the water reservoir as necessary to maintain the humidity. The hatching rate for this incubator stands at about 80-95%, depending on many factors like the fertility rate of eggs before their placement in the

incubators; and temperature control. Among some of the important aspects to be considered when a farmer plans to have a higher hatching rate are: the ability to expose egg-laying hens to cocks, proper packing or placement of eggs in the incubator, a fan to circulate air in the incubator, an automatic egg turner to turn the eggs periodically or manually doing it, an installing a device to ensure the digital display for temperature, humidity, and hatch day countdown. The incubator is always set up to run for at least 24 hours prior to setting the hatching eggs inside in order to allow the environment inside the incubator to stabilize. Another important aspect with the incubator is its location in the room. The incubator ought to be placed or put in a room that maintains a constant temperature; free from drafts; away from windows and direct sunlight; and in a very safe and strong room where other parties cannot bump or disturb it during the 21 day incubation period.

Eggs Incubating and hatching Processes

Generally, chicken reproduction cycle can either be done naturally or artificially with a minimum of 21 days for the eggs to hatch. For any reproduction to take place, the hen lays a fertilized egg which hatches into a new chick. In a natural reproduction setup, the proprietor of Gift Poultry Farm explains that after laying the eggs, the hen typically sits on them until they hatch, calling it 'the brooding period for the hen'. The hen usually cares for the chicken for several weeks and then starts losing her interest in them as they grow. By then, she also gets ready to lay the next batch of eggs. In an artificial nature of chicken reproduction, Edoke contends that hens only do one thing: "lay the fertilized eggs as many as possible because these eggs are taken away on a daily basis to be put in an incubator. In this type of chicken reproduction, hens can lay as many as 300 eggs in one year". He continued that sometimes they also buy eggs from Busia and then administer the same process as seen above and were the demand of chicks are too high, they also go as far as ordering already arched chicks from Kampala because they don't want to disappoint their customs.

To ensure that the eggs are fully fertilized, Gift Poultry Farm management have built a big house where cocks are allowed to mix up freely with the laying hens, which are intentionally designed to help in the fertilization of eggs laid. Usually numbering about 60-100 eggs, the farm attendants collect these eggs every morning and evenings to be placed in the incubator. Before these eggs are loaded into the incubator, Edoke explains that the incubator is set fully to ascertain that it is ready for the eggs. Issues examined during this time are the temperature regulation for forced-air incubator using a fan to ensure a range of 99-100 degrees F; and still-air incubator without a fan which can be at a range between 100^o and 101^oF.

Using a pencil, the farm attendants always mark each egg with letters 'T' to mean 'top' on one side of the shell, and 'B' to mean 'bottom' on the other end in order to enable visualization and a proper egg-rotation for perfections of egg-turning during incubation period. The eggs are packed in a cardboard egg-carton that is put in the same room where the incubator is placed for temperature acclimatization. After few hours in the incubation room, the eggs are properly arranged in the incubator. Within seven days in the incubator, a few blood vessels could be seen radiating in the eggs; and by the fourteenth day, the embryo is much larger with an egg hardly seen through using candling. Between 14-17 days, the farm attendant keep on turning the eggs in the incubators after every eighth hour while also monitoring or controlling both the temperature and humidity. Between the eighteenth days to 20th day, the incubator is kept totally closed until after all chicks have hatched and dried off because by the eighteenth day, the chicks are nearly fully developed and will begin positioning themselves inside the egg to prepare for hatching. In this period, the humidity can be increased to about 65-70% while also preparing the brooder to receive or host the chicks. By the twenty first day, hatching begins and can take a full 24 hours for all chicks to complete the hatching-process. Once the chicks are completely dry and fluffy, the incubator can be opened to remove the chicks which are placed in a waiting brooder. The farm attendants always clean and disinfect the incubator.

Feeding and growth of the chicks

Within twenty four hour, according to the farm attendants, a chick is termed as a day-old-chick and can tentatively survive without either water or any feed! However, a farm attendant contends that chicks should always have water and food at their disposal; and that what is important is that within the first month, temperature in the brooding area is always kept in the range of 95^o-100^o Celsius but after a month, temperature can be reduced by about 5 degrees. Between 2-4 weeks after birth, the chicks will have started developing feathers. Due to the appearance of these feathers for warmth, they can then be moved to a normal chicken houses. By the eighth weeks the chicks will grow adult plumage and can be fed a mixture made for growing chicks which is termed as the 'growers-mash'

Marketing

- a) *Potential customers:* The management of Gift Poultry Farm uses smart technology in marketing of its different farm products. Currently, the customers include: the surrounding households; individual consumers from within Lira City or neighbouring districts of Alebtong, Dokolo and Lira district; and eating houses and hotels in Lira City. Both the cockerels; and excess eggs which are not due for reproduction are packed in egg-trays to be sold-off.
- b) *Mode of advertisement:* Using smart phones, and laptop computers, the management has created a network or links with users of Facebook, Watts Up and other social media forums to advertise for the availability of chicken products in this farm. The use of short message services, radio or television announcements, and print media are also embraced by the farm management to advertise for the availability of chicken products.
- c) *Mode of payments:* Payments for these products are also electronically made through their bank accounts given out to the public or specifically to their customers; and can also be made through mobile phone services like the mobile money for MTN subscribers or Airtel money for AIRTEL subscribers. Due to COVID-19, the management has decided to minimize physical cash transaction, although it is not wholly impossible to avoid it completely.

Mode of delivery: Deliveries of product are of two fold in that the intending buyers can walk to Gift Poultry Farm to get their supplies, the management does not carry out physical delivery of the products, and the buyer buys and collects the product. This according to the management is because of the liability involved because it involved incurring transport cost which sometimes the buyers may not be able to meet and also most customers are from within Ngetta, Lira city though some come from neighbouring districts like Kole, Alebtong, and Dokolo.

4. CONCLUSION

The domestication of poultry by ancient farmers might have targeted many benefits like eggs production, meat production, feathers, and entertainments in form of cock-fighting and birds' songs by quail. The introduction and use of incubators by many chicken farmers have led to the increase in chick production. Through the Internet of Things, smart farming in chicken production therefore encompasses the use of technology in aiding chicken production processes like hatchings, feeding, growth and marketing by any prospective chicken farmer.

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