

Adaptation Strategies of Poultry Farmers to Rising Temperature in the Greater Accra Region of Ghana

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Abstract

Increasing temperature is being observed in Ghana by about one degree Celsius since the 1970s and this is affecting poultry production due to the vulnerability of the bird to high temperature. This paper examines the awareness of increasing temperature on poultry farms and identifies the adaptation methods in response, by farmers in the Greater Accra Region of Ghana. A systematic sampling approach was employed to gather data from thirty eight registered poultry farmers. Results indicate that, most poultry farmers are aware of the increasing temperature mainly through the news media but not from observations on their farms. The observed signs of heat stress in birds were birds spreading their wings, pecking the feathers of other birds in the form of cannibalism and gasping. These responses, as the farmers point out, negatively affect poultry production by decreasing their feed consumption which eventually leads to their low weight and delayed time of maturity. Most farmers also perceive that increasing temperature will increase the price of poultry products and cause a reduction in stock density. The findings further showed that since there is a limit to which birds can adapt to increasing temperatures, farmers are willing to invest in devices or strategies that can control the temperatures on their farms. One paramount practice is tree planting on the farm.

Introduction

Agriculture is an economic activity that is highly dependent upon weather and climate in order to produce the food and fibre necessary to sustain human life. This agriculture is vulnerable to climate variability and change, and thus impacting food security (Thompson et al., 2010). This issue is of major importance to the international scientific community, and this concern is reflected in Article 2 of the UNFCCC (1997), which calls for the: stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent serious anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to: (i) allow ecosystems to adapt naturally to climate change; (ii) ensure that food production is not threatened; and (iii) enable economic development to proceed in a sustainable

manner.

Livestock plays a critical role in the development and poverty reduction in Africa (IUCN, 2010), however, the relationship that exists between the livestock sector and climate change is less well understood (Seo & Mendelsohn, 2007). The contributions livestock production makes to the livelihood of people in many developing countries include employment and income generation; food and protein to feed the ever increasing population; a form of savings that is used when unexpected situations occur; provision of manure applied to farms; and lastly as a form of collateral for both formal and informal transactions (Taruvunga et al., 2013). Chicken meat and eggs provide not only high-quality protein, but also important vitamins and minerals to humans. Activities in poultry production are aimed at ensuring that the best

possible environment such as good air quality, optimum temperature and humidity, and right nutrients are provided to the birds.

Over the past three decades, the poultry sector has been growing at more than 5 per cent per annum and its share in world meat production increased from 15 per cent three decades ago to 30 per cent (FAO, 2006). For example, the Organization for Economic Cooperation and Development and Food and Agriculture organization (OECD-FAO, 2017) estimated that poultry meat production in 2018 will be around 119,205Mt whilst its consumption for 2018 will be around 119,208Mt. Poultry production projection for 2020 was estimated at 122, 461, showing a modest increase over the period (OECD-FAO, 2017). The increasing air temperatures across the world due to climate change are affecting feed-grain availability (Islam & Wong, 2017; Shwartz, 2016) and also favouring the emergence of certain diseases (Rojas-Downing et al, 2017; Heffeman, 2018).

Livestock generally function within a range of thermal conditions and maintain a relatively stable body temperature in their behavioural and physiological activities (Adesiji & Baba, 2013). High ambient temperature, leads to higher energy (feed) needs than thermo-neutral environments. This less efficient conversion of feed to meat will result in major biological losses, which adversely effects poultry health and productivity (Olanrewaju et al., 2010) and income of farmers. Since temperature is noted to be increasing throughout the world, the aim of this paper is to identify measures employed by poultry farmers in adapting to the rising temperature on their farms.

A Study by Nkwusi et al. (2015) in four Nigerian states revealed that majority of the farmers interviewed confirmed that the

intensity of average daily temperatures has increased. Further observations revealed that majority of the farmers were of the opinion that they noticed the impact of the changing temperature in their lives. Godfrey et al. (2009) in their study on climate change awareness revealed that majority of people in Africa who are vulnerable and being affected by climate change are not aware of its impacts however, other authors like Taderera (2010) and Alade & Ademola (2013) points out that, people on the African continent are noted to be aware of the changing weather patterns but are not informed about global climate change (Taderera, 2010) and how it is affecting their major sources of income like agriculture. A study by Alade & Ademola (2013) showed that 88% of poultry farmers receive information on the changing climate through radio and the rest through family and friends. The findings agreed with the work by Yahaya (2012) that radio is a potent source of information to farmers.

Changing climate in Ghana

Kankam-Yeboah et al., (2012) opined that, there is no doubt that the climate in Ghana has changed significantly with impacts being felt almost everywhere in the country. The Government of Ghana (2012) points out that, there is 1°C increase in temperature over a 30-year period from the historical records; increased evaporation is occurring; decreased and highly variable rainfall pattern in the country; and frequent and pronounced drought spells are being observed. Ghana's Environmental Protection agency (EPA), in 2008 points out that over a forty (40) year period (1960-2000), average annual temperatures have been rising steadily in five of the six agro-ecological zones of Ghana. Hansen et al

(2012) also noted that temperatures in Ghana have increased by about one degree Celsius (1°C) over the past 40 years resulting in more frequent warm extremes. Climate forecast and climate change situations for Ghana predict a more severe and frequent pattern of situations such as drought and flood events (GoG, 2012). The warning is that there will be an increase in air temperature for all agro-ecological zones. The frequency of days and nights that are considered “hot” in the current climate is projected to increase, and the frequency of those considered “cold” will decrease. In this case, farmers have to adapt to these changing temperature patterns in order to stay in business.

Climate change and poultry production

Birds, as a result of global warming now grow so fast that muscle development outpaces bone development leading to metabolic bone disease (Shields & Orme-Evans, 2015). It is not only metabolic bone disease that rapidly growing broiler chickens do suffer from but they are also susceptible to metabolic disorders. Some of the diseases they suffer from include, Sudden Death Syndrome (SDS) which are caused by sudden convulsions and wing-beating, and are frequently found lying on their backs (Julian, 2005).

Heat and poultry

Poultry farmers have to consider making adaptations to reduce costs associated with climate change and global warming. This is because, it was noted by ICAR Network Project on Climate Change that, as ambient temperature reached $\geq 34^{\circ}\text{C}$ the mortality due to heat stress increases in broilers (8.4%) as compared to layers (0.84%) and native type (0.32%) chickens (ICAR, 2010). Thus, birds

do experience stress as a result of increase or decrease in temperature. Environmental stressors, such as heat stress, are particularly detrimental to animals (Renaudeau et al., 2012). Rainfall and wind during the rainy season (April-July in Africa) brings relief to heat stressed birds but this is also becoming scarce.

Behavioural and physiological effects of heat stress

Lucas & Rostango (2013) emphasized that under increasing temperature conditions, poultry birds change their behaviour and physiological homeostasis seeking thermoregulation, thereby decreasing body temperature. A study by Mack et al (2013) showed that birds subjected to heat stress conditions spend less time feeding, more time drinking and panting, as well as more time with their wings elevated, less time moving or walking, and more time resting. Fedde (1998) earlier noted that air sacs are very useful during panting, as they promote air circulation on surfaces contributing to increase gas exchanges with the air, and consequently, the evaporative loss of heat. This hampers blood bicarbonate availability for egg shell mineralization and induces increased organic acid availability, also decreasing free calcium levels in the blood. This process is very important in breeders and laying hens, as it affects egg shell quality (Marder & Arad, 1989). Heat stress can affect the reproductive function of poultry in different ways. In females, heat stress can disrupt the normal status of reproductive hormones at the hypothalamus, and at the ovary, leading to reduced systemic levels and functions (Elnagar et. al., 2010).

Similar work by Adesiji & Baba, (2013) in Ondo state, Nigeria concluded that, egg

and meat production patterns are affected by climate change because periods of high temperature and sunshine intensity makes the birds to drink more water which reduce feed intake thus resulting in low egg production and low feed conversion ability of the birds to meat. At the end of the day, there is low meat production or high mortality of the birds. Findings by Ravichandran & Mohamed (2015) in a similar research work in Namakkal district, India, was generally not different from the study by Adesiji & Baba, (2013). Their study also revealed that low egg and meat production and prices of feed grains are usually high in hot and dry seasons as a result of effects of climate change which may affect cost of production and also affect the number of birds to raise for egg and meat production in the farm.

Heat Mitigation strategies in poultry production

As animals become a little productive, they require more feed intake to support the energy requirements associated with growth, but the proportion of total energy requirements required for maintenance decreases (Wall, Simm & Moran, 2010) as a result of climate change. This leads to reduction in the feed input per unit of product (Daghir, 2009). In Ghana where basic veterinary care like vaccination; getting clean drinking water for the animals; shade and husbandry skills and other vital resources needed to cater for the birds are problematic, farmers have no other option than to use their own indigenous techniques to manage the farms. Here comes the great potential for improvement. According to Besbes et al., (2012) vaccinations, supplementary feeding of balanced rations and basic biosecurity education could improve

the welfare of the birds thus ensuring adequate provision of nutrition from birds and eggs to alleviate poverty in many African countries. These days, fat is being added to the diets of poultry, especially broiler feeds in hot regions like Ghana to boost the energy level. Dietary levels of protein and amino acid are being adjusted in the diets of the birds to ensure that the birds benefit from essential nutrients (Daghir, 2009).

Halls (2014) noted that the regulation of body heat in poultry occurs mainly through radiation, conduction, convection, evaporation and excretion. Thus, the mechanisms through which heat can be prevented from entering the housing are microclimate modification. This can be done by ensuring that outside air can easily flow into and out of the house. Conditions should be created such that outside air should be made to circulate and not build-up heat within the house (Butcher & Miles, 2012). Tree cover on the fields surrounding the poultry house will reduce the reflection of sunlight into the house. The roof should also be conditioned through ceiling to prevent heat from coming directly to the house of the roof (ROSS, 2010).

These days, farmers are taking advantage of genetic selection of birds to avoid heat stress as a result of climate change (Hoffman, 2010). Selection for production traits has increased the line's susceptibility to stressors. According to Cahaner & Leenstra (1992) there are a lot of genes that affect heat tolerance of birds. Some genes like the naked neck, affect the trait directly by reducing feather cover. Other heat resistant genes includes dwarf frizzle can be used to counter increasing temperature due to climate change. To maintain increasing trend in poultry production on the African continent and Ghana in particular, improved thermos-

tolerance along with disease resistance is being encouraged.

Whether poultry farmers are producing meat or eggs, it is a well known fact that effectively managing environmental conditions will reduce the total cost of production. Nin et al. (2007) assert that livestock could be important to the adaptation strategies of poor people in developing countries like Ghana. Given the paucity of research in the field of environmental management within the livestock sector of developing countries coupled with the economic benefits of effective environmental management to the farmers, it is necessary to understand the adaptation strategies being employed on the farms in the greater Accra region of Ghana. The objective here is to ascertain the environmental conditions being created by farmers to lessen the increasing temperatures on their farms in order to “maximize flock performance, achieving optimum and uniform growth rate and feed efficiency in meat yield while ensuring that bird health and welfare are not compromised”

(ROSS, 2010; 3). The methods used to gather data for the study is discussed next.

Study area and Methodology

Study area

The study was conducted in the Greater Accra region of Ghana. The Greater Accra region is one of the ten regions in Ghana with a total land area of about 4,540 km² which spans from Weija Municipal district in the West to Dangme East in the East. Although the smallest administrative region in Ghana, the Greater Accra Region is the second densely populated region due to its industrial and commercial importance.

The capital of the Greater Accra Region, Accra, is also the administrative capital of the country. Its population was 4,010,054 people (GSS, 2012) in 2010. The vegetation is mostly coastal savannah grassland with remnants of forest vegetation at Achimota and Dodowa and Mangrove and Swampy vegetation along the coastal lagoons.

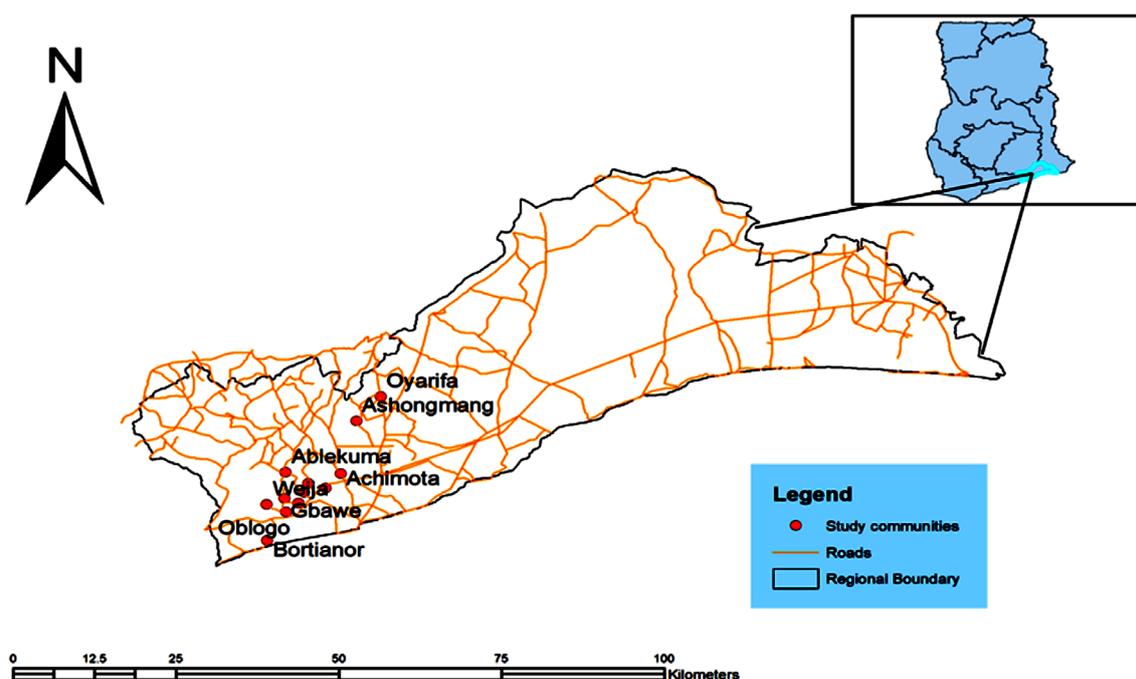


Figure 1: Map of the Study communities

Research design

A descriptive survey was used to collect data from a specific population, or a sample from that population. This study utilizes a questionnaire or an interview as the survey instrument (Robson, 1993). Surveys are used to obtain data from individuals about themselves, their households, or about larger social institutions (Mugenda, 2003). Sample surveys are an important tool for collecting and analyzing information from selected individuals. They are widely accepted as a key tool for conducting and applying basic social science research methodology (Rossi, Wright, & Anderson, 1983).

A systematic sampling approach was employed to enable every poultry farmer identified by the Greater Accra Region Association of Poultry Farmers (GARAPF), the probability of being selected. The systematic sampling method is an equal probability selection method which is used to easily identify suitable sampling frame (CASRO, 2011). Its disadvantages are difficulties in assessing the precision of estimates and large raw data sets that are time consuming to process.

Out of 134 registered poultry farmers, at least 25% were to be selected so that the conclusions that will be made from the study can be generalized. The study therefore selected 38 farmers (representing 28% of the registered poultry farmers) using the systematic random sampling approach. Before farm visits, individual farmers were contacted via mobile phone to arrange for a convenient place and time for the survey. Questionnaires were administered personally to each farmer to analyse and evaluate their perceptions on awareness of the rising temperature, their sources of the information, signs in birds showing heat stress and adaptation strategies

being employed on farms. Responses were analysed using the Software Package for Social Science (SPSS) to determine the awareness and adaptation strategies of the respondents. The findings are discussed in the next section

Results and Discussion

Demographic data

A total of 38 questionnaires were administered to poultry farmers. Table 1 show that males formed the majority (84%) of the farmers interviewed. In Ghana, although women play a vital role in agriculture, they constitute less than 20 per cent in poultry farming on a large scale (FAO, 2006; Tuffour & Sedegah 2013). A female poultry farmer who participated in the study points out that she started rearing birds as a hobby. She developed the habit of rearing birds on a small scale but realized she can turn it into her profession leading to her becoming a poultry farmer.

The majority of the respondents had minimum of secondary school level education, i.e., senior high school graduates (50%) and tertiary graduates (32%). This finding shows that poultry farmers, at least in the Greater Accra region of Ghana, can better understand and appreciate literature on new methods of production, basic directives to drug administration and keep more accurate records. Majority of the farmers are therefore in the position to benefit from education on rising temperature (and climate change at large).

On the production capacity of the poultry farms, more than 70% of the farms are managed by the owners and less than 30% by employed attendants. Almost 80% of the farms have a capacity of more than five hundred birds. Even though all sampled farmers were active commercial farmers, they practice small scale

(50-5000 birds) commercial production, which does not meet the demands of consumers. In Ghana, there is high importation (up to 90%) of frozen chicken. For example, in 2013 about 170,600 metric tonnes of poultry products were imported, of which 68,800 metric tonnes were from USA, 55,900 metric tonnes from the European Union and 40,200 metric tonnes from Brazil (UN Comtrade, 2015). Ghanaian production of poultry products has grown over the years, rising from 32,939 metric tonnes in 2003 to 73,788.4 metric tonnes in 2012 (Ewur et al., 2015), except for a drop in production in 2009. Due to this high importation of poultry products, poultry farmers are finding it difficult to sell the 10% chicken produced. The reason for the high demand for imported poultry products can be said to be due to the price of the locally produced birds. The higher prices of locally produced poultry in Ghana can be attributed to the high production cost (feeds and drugs) and competition from human

beings. The maize that is used as poultry feed is what is also being used by households as staple foods. The frozen chicken from abroad are cheaper due to the subsidies enjoyed by farmers in developed economies and the low tariff being imposed on imports into the country.

Over half of the sampled farms have been in poultry production over the past 10 years, with 80% of the farmers experienced in the poultry business. Their experience give indication that, the farmers could have confronted many challenges and survived hence will be able to adapt to any change that might seem to alter production.

Awareness of the rising temperature

Heat stress during production has quickly become a great point of interest in animal agriculture, particularly due to public awareness and concerns (Nienaber & Hahn 2007, Nardone et al., 2010; Renaudeau et al.,

TABLE 1
Gender, Educational Level, Farm Ownership & Number of Birds of the Farmers

	Number of Responses	Percent (%)
Gender of poultry farmers		
Male	32	84.2
Female	6	15.8
Total	38	100.0
Educational level of farmers		
Basic/Primary	5	13.2
Secondary/Senior High	19	50.0
Tertiary	12	31.6
Vocational school	2	5.3
Total	38	100.0
Farmer's position		
Farm Manager	11	28.9
Farm Owner	27	71.1
Total	38	100.0
Number of birds		
Below 500	8	21.1
500-1000	6	15.8
Above 1000	24	63.2
Total	38	100.0

Source: Field work, 2016

2012) on the quality of poultry products being consumed. About 90% of the poultry farmers are fully aware of the rising temperature, which they explained is evident in the increased heat intensity from the sun.

The difference between the responses of 'strongly agree' and 'agree' lies in the certainty of the respondents on whether they agree that the earth's temperature is rising. Those who responded strongly agree are those who are sure the phenomenon is occurring while those who responded 'agree' are ambivalent. The literature however points out that the increase in temperature is as a result of climate change (Dumenu & Obeng, 2016). Also the rains are becoming erratic and the duration for the rains seems to have reduced (Adiku, 2013; GoG, 2012).

Table 2 below also informs us of farmers' source of information on the known issue pertaining to the temperature. About 95% of the poultry farmers have received information about climate change, weather and the rising temperature in particular (Table 2), with the majority (87%) hearing about it from television and radio news. Example is during

Ghana Television news.

None of the farmers was able to categorically point out that s/he has observed the increasing temperature on the farm. They could have observed this on their farms since they have thermometer that they used to monitor temperature. It can however be argued that the farmers could not observe the change in temperature on their farms due to the level of margin of the temperature rise. Kolstad (2002) points out that the optimum temperature for performance or thermoneutral zone of birds is between 19-22°C for laying hens and 18-22°C for growing broilers.

Signs in Birds Showing Heat Stress

The farmers in the study were able to describe some signs of heat stress on poultry like gasping, panting, spreading of wings, pale cones and wattles, closed eyes, lying down, drop in egg production, reduced egg size, poor shell quality, increased thirst, decreased appetite, loss of body weight and increased cannibalism, as has been described in literature (Dayyani & Bakhtiari, 2013). Figure 2 below is the response of poultry farmers when they

TABLE 2
Rising Earth's Temperature and sources of their Information

Response	Number of responses	Percent (%)
The earth's temperature is rising		
strongly agree	22	57.9
Agree	12	31.6
Don't know	2	5.3
Strongly disagree	2	5.3
Total	38	100.0
Source of information		
News	33	86.8
Social media	1	2.6
Studied it in school	1	2.6
Read it from books	2	5.3
Heard it from friends	1	2.6
Total	38	100.0

Source: Field work, 2016

were asked to state the symptoms that show birds are uncomfortable due to too much heat. According to 31.6% of the farmers, birds will generally spread their wings to increase surface area to allow heat loss from the body. About 21% of respondents also points out that the birds would feed on each other in the heat stress state. The response further indicates that about 10% of the birds would lie down to reduce metabolic activities to prevent further generation of heat and just 7.9% of the farmers pointed out that the birds would pant as a sign of discomfort due to heat. The response somehow corroborates the study by Mack et al (2013), which explained that, birds

temperature also affects birds' immune response thus their susceptibility to diseases. To avoid the above mentioned production losses in birds as a result of increase in temperature, it is highly important that farmers observe the signs of heats stress and device the necessary measures in order not to incur cost of losing their birds.

Ghana as noted already is vulnerable and experiencing increasing temperature which will affect poultry production. Since the poultry sector has the potential to provide food and nutrition to Ghanaians, it is important to curb any phenomena that will lead to a decrease in poultry production. Farmers'

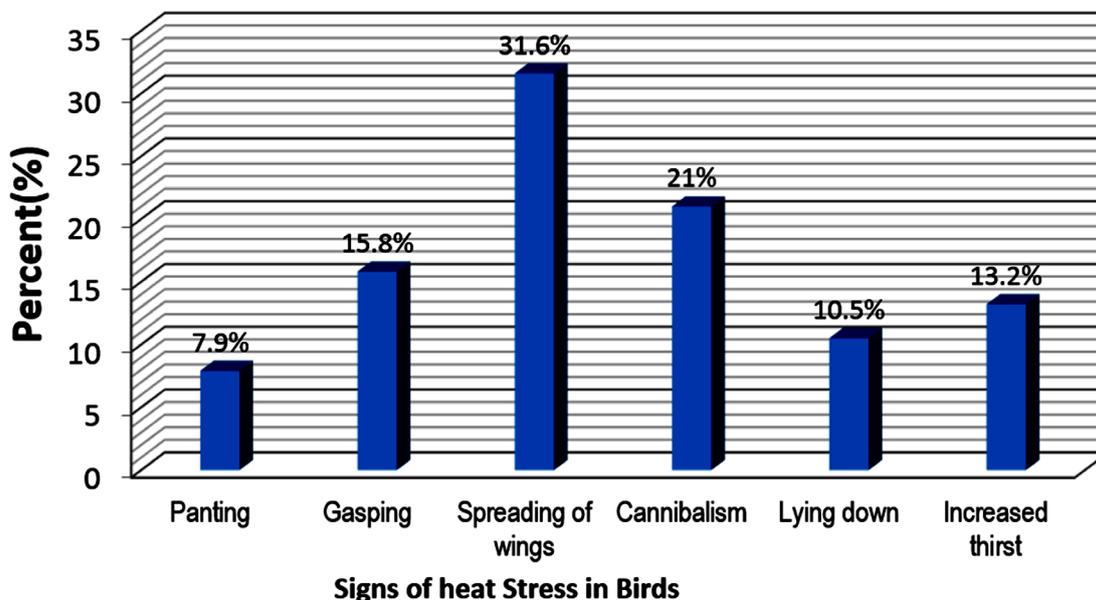


Figure 2: Signs in Birds Showing Heat Stress

Source: Field work, 2016

subjected to heat stress conditions spend less time feeding, more time drinking and panting, as well as more time with their wings elevated, less time moving or walking.

Adaptation methods being used on farms

When birds are kept in hot environment, their reproductive performance and, metabolic health status are affected. In addition, their growth-weight, egg yield and egg quality-are impaired (Vasantha, et al, 2016). Increasing

adaptation strategy to increasing temperature is a matter of urgency (FAO, 2009; Mkonda & He, 2017). Poultry farmers need to consider making adaptations to reduce cost, risk of losing their birds and livelihood in the future. Poultry farmers in the study said they are planting more trees on their farms to reduce the ambient temperatures while others are installing mist blowers (table 3). These methods are widely preferred by the farmers as they are relatively cheaper (Oloyo, 2018).

Even though studies are not conducted in Ghana to show how planting of tree actually reduce temperature, one can liken the effects of temperature change in a house where there are trees and a house without trees. Another method being used by 7.9% of respondents is to improve ventilation. Improving ventilation on the farm is done through the use of low side walls. Low walls provide natural ventilation by opening up the house to allow outside breeze into the house and inside air to flow through the house.

About 7.9% of the respondents point out that they have reduced the stocks of birds in the house. Reducing stock levels per meter square is considered to be too expensive to the farmers. This is because, few birds would be kept which would decrease the amount to be realized from birds during the season. Table 3 below provides a summary of the adaptation strategies of the farmers in the study area.

According to 79% of the poultry farmers, birds cannot adapt to any level of heat as they are sentient creatures that can die from exhaustion as a result of heat stress. Despite the challenges of increasing temperatures, many of the farmers (58%) indicated that they will continue poultry production since

it is their only means of earning a livelihood. They intend to seek adaptive measures such as reduce the number of stock (i.e. reduce the stocking density), feed birds with chilled water, replace the three course short wall with net (for ventilation) and ultimately plant more trees. More than 80% of the farmers are willing to purchase any device that will help mitigate increasing temperature in their farms. A farmer explained that during high temperatures, the birds are fed with chilled water. Though some farmers (42%) agreed to stopping production if temperature continues to rise beyond tolerable level of birds, 79% agreed to continue production if there is a device that will reduce the heating effect. All respondents practised the deep litter system of intensive poultry production. This is a method of spreading straw on the floor of the house. This practice is easy, economical and results in a beautiful place where birds can even lay their eggs. Bird's droppings can also be easily removed.

About 26.3% of the poultry farmers suggested that the short wall of the deep litter house should be reduced to a one course structure. Other farmers also suggested that the housing should have the roof sealed with a cardboard,

TABLE 3
Adaptation Strategies of Poultry Farmers

	Frequency	Percent (%)	Mean	Rank
Planting more trees	15	39.5	0.395	1
Install mist blowers	12	31.6	0.316	2
Reformulate the diet	4	10.5	0.105	3
Feed birds with chilled water	3	7.9	0.079	4
Reduce stock levels per meter square	3	7.9	0.079	5
Provide enough ventilation	1	2.6	0.026	6
Total	38	100.0		

since it is a cheap material and will help reduce the impact of heat radiation absorbed by the aluminium roofing sheet. More than half of the farmers proposed that the design be maintained.

Conclusion

The paper sought to ascertain adaptive measures employed by poultry farmers' to manage the increasing temperature on their farms. The findings show that majority of the poultry farmers are aware of the rising temperatures, which could be associated with the changing climate. The degree of adaptive capacities of poultry farmers to the various adaptation strategies is however limited. Majority of the farmers confirmed that the intensity of average daily temperature has increased but they were not able to attribute it to signs on their farms. The temperature rise has compelled most farmers to resort to planting more trees on their farms, installation of mist blowers, feeding birds with chilled water to help reduce the heat stress. Housing (deep litter) design will be least affected by the increasing temperature. Birds cannot adapt to any level of heat, hence the high willingness of farmers to purchase any device which can ameliorate such crisis.

The findings necessitate education on the best adaptable practices to ensure continual production in these changing times. Based on the findings of this study one can conclude that poultry farmers in Ghana especially the southern sections of the country are aware of the rising temperature, however, the knowledge is not in depth. In order to address this, training seminars should be organised in partnership with the Ministry of Food and Agriculture and non-governmental organisations to educate poultry farmers more

on the increasing temperature, the known and the perceived impacts and the adaptation methods that they should use. Farmers should undergo periodic interview sessions to assess the knowledge on the changing climate and other adaptation measures to employ.

Also, there is the need to look into cooling systems and air conditioning that is devoted for poultry houses. Many types of air conditioning systems specifically designed for poultry farms can be tried. The first that can be applied on a commercial scale is fan. Properly operating fans create an air pressure that is different between the inside and those outside. This air pressure difference causes the air flow that produces the air exchange required as part of a mechanically ventilated poultry house. Since some farmers have already shown willingness to install these equipments, they can be promoted in the country. Other air conditioning systems that can be introduced to farmers are one: fogging systems, which work by using very fine droplets of water in order to increase the water surface in contact with the air thereby reducing the temperature in the room; Pad system; with pad cooling system, the ambient air within the building is cooled down forcing air into the building through a wet pad (Renaudeau et al, 2012). The use of air cooling systems in the form of adaptation and mitigation techniques to climate change is what is being employed by farmers in countries like the USA, Brazil and indeed the European Union leading to the enjoyment of competitive advantages accounting for about 90% of all poultry imports to Ghana. Their ability to compete with the local market cannot only be attributed to government subsidies, but also their ability to adapt to climate change.

Major advances have been chalked in environmental management like improved

housing and cooling systems can lessen the effect of heat stress on poultry production. Air temperature can be lowered by air conditioning, but the expenditure that farmers will be making on such a device will make it impractical for cooling poultry (West, 2003). There is the need to employ scientific methods to ascertain the suitability of the various cooling systems that can be used in poultry production.

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