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Effects of Climate on Chicken Production in Ilorin, Kwara State, Nigeria

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ABSTRACT

This paper explores the role which climate plays on the severity of diseases and seasonal mortality rate of chicken in the guinea savanna ecological zone of Kwara State, Nigeria. Data on climate and mortality rate of chicken collected over a period of 23 years (1991-2013) were partitioned according to characteristics weather types. Correlation and simple regression methods were used to analyse the data. The results of the analyses showed that weather types of each season affect outbreak of various diseases and mortality rate differently. In the dry season weather types outbreak of Newcastle and Gumboro diseases prevailed mostly during harmattan when mortality rate of chicken exhibited a strong positive relationship of 0.711 with rainfall and a strong negative relationship of 0.604 with maximum temperature. The last two months of dry season (March-April) witnessed the reverse of the above but with Newcastle disease and heat stress plaguing chicken production. The most prevalent chicken disease of rainy season in the study area is Coccidiosis. During the first weather type of wet season (two months before August break) mortality rate of chicken exhibited a strong positive relationship of 0.861 and 0.845 before August break, 0.775 and 0.894 during August break with both rain fall and relative humidity. However the relationship was negative with both maximum and minimum temperatures. Suggestions are made on how to manage both major weather types and poultry operation for efficient poultry farm development in the tropics.

Keywords: *chicken, climate, diseases, guinea savanna, weather types*

INTRODUCTION

The human body requires both plant and animal proteins to function efficiently. Protein which has been described by Olusanya (1990) as a conglomerate of amino acids that can be grouped into two classes based on the composition of amino acids. For instance, proteins that are rich in essential amino acid that the body cannot produce are referred to as first class proteins. They are often of animal origin e.g. second class proteins majority of which are obtained from plants lack one or more essential amino acid (Olusanya 1990). The importance of proteins in diets is revealed by various roles they performed. Proteins promote growth and repair the worn out body tissues, responsible for the transmission of hereditary characters from parents to offspring, and assist the body in fighting against diseases and infections among others.

As important as this class of food is in diet, its supply is very low in the tropical countries. For instance, Kenneth (1999) reported a low production of meat and milk in Africa. Starr (1986) has also noted a tremendous potential for more animal production in the tropics than in the temperate. But great disparity exists when the two regions are compared with the animals

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of the tropics being subjected more to various diseases. Infact, tropical environment has been described as a nuisance to livestock production (Loosli and Henry, 1999). Poultry constitutes one of the livestock productions that contribute significantly to human source of food (Tilakasiri *et al*., 1988; Demeke, 2004).

Poor performance of livestock production in the tropic is also evident in Nigeria. According to Mohammed (1983), the cost of protein is beyond the reach of many in Nigeria because it is in short supply. This shortage had led to importation of poultry products by Federal Government of Nigeria for so many years. However the Federal Government of Nigeria recently decided against importation of some lists of goods in which poultry products is one (Kazeem, 2003). The step was taken not because Nigeria is self sufficient in poultry but rather to safeguard Nigeria hard currencies, the scarcity of poultry may be sustained and even worsened if nothing is done to redeem the situation.

In order to solve the problem of protein shortage in diets, the root cause of scarcity of poultry products must be tackled. Disease and climate problem have been described by Oppong (1999) as the main limitations to modern animal husbandry in the tropical areas. Smith (2007) associated high relative humidity in chicken's pen with mortality of young poultry birds. Ajiboye (2014) linked decline in dairy cow milk production in Shonga farm, Kwara State to climatic variables of which high temperature was most critical. To alleviate this problem several authors, emphasized the need to know the role played by climate and weather in animal health so that prediction of animal production will be accurate and effective (Starr, 1986; Ajibade and Ogunbodede, 1999). Thus, this work is aimed at exploring the role played by climate on the severity and spread of the major chicken diseases and on the seasonal mortality rate of chicken in Ilorin and its environs.

MATERIALS AND METHODS

The study area

Ilorin, the state capital of Kwara State lies within latitude 08^0 30'N and longitude 04^0 35'East. Its climate is controlled by the two major winds of West Africa (i.e. the South West wind during rainy season and the dry North East continental during the dry season). The rainy season starts in April and lasts till November with an August break. However, in dry year the rain usually starts very late (late April or early May) and ends early around October. The mean annual rainfall of Ilorin was 1,318mm (Adeyemi, 1983). However, Olaniran (1986) observed a drop from this value to about 1,200mm. Temperature is high throughout the year. The dry season is exceptionally hot, except during the harmattan and it begins late November and lasts until February. The weather is cold and dry during this period coupled with a hazy atmosphere with dust particles flowing around. Such climatic conditions favour the development and spread of crop/animal pathogens in the tropics.

According to Hopkin (1979), physiognomic classification, the vegetation of the study area can best be described as tree savanna with floristic composition of mainly grasses of different specie whose height varies between 1.5 and 5 meters. Such area, according to Hill (1999) is characterized by an extensive type of husbandry and houses large concentration of livestock.

Sources of data

Meteorological data and chicken mortality rates were used in this study. The meteorological data (rainfall amount, relative humidity, minimum and maximum temperature) were collected from Nigeria Meteorological agency Ilorin Airport while monthly chicken mortality rate data were obtained from Nigeria Veterinary Research as reported by poultry farms in Ilorin

for twenty three years period that spanned between 1991 and 2013. Also collected was the list of diseases to which chickens were susceptible for the same period. The diseases were Newcastle, Coccidiosis, Gumboro, heat stress, Colibacilliosis and fowl Typhoid.

Data processing

The raw climatic data were first partitioned into two seasons of wet (May-October) and dry (November-April) season. Each season was further partitioned into its own characteristics weather types. Based on this, wet season was further grouped into months before August break (May-June), during August break (July-August) and months after August break (September-October). Similarly, dry season was further partitioned into months of harmattan (November-February) and months after harmattan (March-April). Also, monthly mortality rates with the associated diseases were partitioned based on different weather types as described above. Meteorological, chicken mortality and outbreak of various diseases data were summarized quantitatively. Correlation and simple regression analyses were then used to study strength of relationship between various climatic variables and chicken mortality rates.

RESULTS AND DISCUSSON

The average monthly climatic pattern and monthly mortality rates between year 1991 and 2013 is presented in Table 01.

The vulnerability of chicken to climate pattern varies during the period of study. However, it appears that increase in monthly rainfall brings about corresponding increase in chicken mortality rate for most of the months considered except for the months of May, October and December. For instance, in January when rainfall amount received was 5.3mm, mortality rate was 11.3%. In February, a drop in rainfall amount to 4.6% brought a corresponding drop (10.1%) in mortality rate. A sharp departure from the above pattern was observed in May when high rainfall of 173.9mm attracted mortality rate of 16.8% compared to 21.4% reported in April. However between June and September, former trend in which mortality rate rises with increase rainfall amount was re-established but the reverse sets in again in October and December (Figure 01).

Relative humidity did not follow rainfall trend closely. For instance, a drop in rainfall amount during February and July did not bring about a drop in relative humidity and an increase in September rainfall did not bring about a rise in relative humidity. Compared with mortality rate of chicken, relative humidity though important may not be as crucial as rainfall. For instance, the month of highest mortality rate does not coincide with the month of highest relative humidity (Figure 02).

In fact, the highest mortality rate was reported in October when relative humidity was 77.5%. The highest relative humidity of 93.0% was reported in August when the mortality rate stood at 18.8%.

Temperature was high throughout the period of study, although with some slight variations. The highest maximum temperature of 35.7^{o}C was recorded in February while the lowest of (26.0^{o}C) was recorded in August. When the minimum temperature concerned the highest of 23.2^{o}C was recorded in March and April but the lowest of 20.0^{o}C was observed in January and November. The interactions between the mortality rate in chicken and temperature did not follow any regular pattern (Figure 03).

Table 02 describes the relationship between climatic parameters and mortality rate of chicken at various weather types of dry season.

During harmattan period, a strong positive relationship exists between chicken mortality rate and the rainfall while a negative correlation was established with temperature. The reverse was the case for the period after harmattan

(March-April). While a very strong negative relationship exists between rainfall, relative humidity and mortality rate, a very strong positive relationship was established between the temperature (maximum or minimum) and the mortality rate of chicken.

The implication of this is that, increase in rainfall amount with a drop in temperature during harmattan results in high chicken mortality rate. However, high temperature is more crucial after harmattan. For efficient poultry development Scott (1999) emphasized that the temperature of a chicken pen must not go beyond 35^{o}C for any prolong of time.

Table 01: Average climatic pattern and mortality rate of chicken at Ilorin (1991-2013).

Months	Mortality (%)	Rainfall (mm)	R.H (%)	Maximum Temp (^{0}C)	Minimum Temp (^{0}C)
Jan	11.3	5.3	51.1	32.6	20.0
Feb	10.1	4.6	53.9	35.7	21.8
Mar	21.5	41.4	66.4	35.4	23.2
Apr	21.4	98.7	72.6	34.0	23.2
May	16.8	173.9	78.5	32.2	22.1
Jun	20.4	183.2	82.0	30.5	22.0
Jul	12.9	160.9	84.0	29.1	21.3
Aug	18.8	164.5	93.0	26.0	20.8
Sep	27.5	257.9	84.9	29.7	21.0
Oct	28.7	151.1	77.5	31.1	21.3
Nov	13.8	12.8	66.2	29.8	20.0
Dec	18.7	4.8	60.2	33.8	20.1

Source: National Veterinary Research Institute, Ilorin.

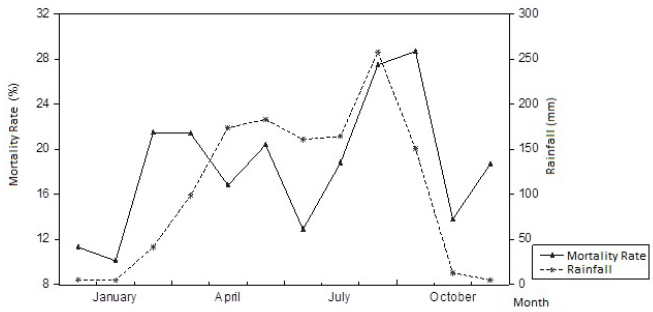

Figure 01: Mortality rate and rainfall (mm) 1991- 2013.

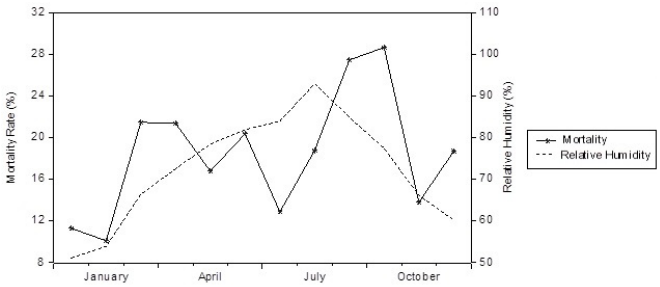

Figure 02: Mortality rate and relative humidity (%) 1991-2013

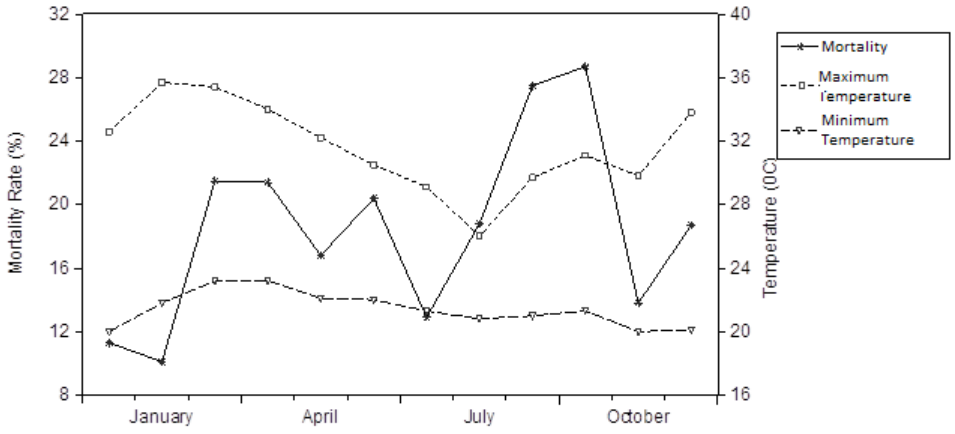

Figure 03: Mortality rate and temperature (^{O}C) 1991-2013.

From the foregoing, rainfall appears to be the most crucial factor for chicken mortality rate in Ilorin.

Table 02: Correlation between climatic parameters and mortality rate during Harmattan (November-April) 1991-2013.

Dry Season Months (Nov-April)	Rainfall (mm)	Relative Humidity (%)	Maximum Temperature (^{0}C)	Minimum Temperature (^{0}C)
During harmattan	0.711	0.249	-0.604	-0.449
After harmattan (Mar-Apr)	-0.818	-0.842	0.936	0.879

The increase vulnerability of chicken during dry season may be attributed to physiological imbalance created by various weather types. For instance, it is not impossible that harmattan chill makes chicken more susceptible to diseases. However after harmattan, much chicken died of heat stress and Newcastle disease (Table 03). For efficient poultry development Scott (1999) emphasized that the temperature of a chicken pen must not go beyond 35^{o}C for any prolong of time. This opinion is supported by strong positive relationships of 0.94 and 0.89 established between chicken mortality rate and both maximum and minimum temperature after harmattan period (March-April).

Table 04 reflects the relationships between various climatic parameters and mortality rates during the weather types of the wet season.

During the first two months of wet season (i.e. period before August break), the mortality rate of chicken exhibited a very strong positive relationship with both rainfall and the relative humidity but very strong negative relationship with temperatures. Such relationship is also sustained during the August break. However, the months after August break witnessed the reverse.

Various major poultry diseases associated with different weather types of the wet season are shown in Tables 05. Observation showed that poultry farms are more prone to certain diseases than to others during various weather types. The period between August break and period of August break (May-August) witnessed the outbreak of poultry diseases of which Coccidiosis was the highest followed by Gumboro, Newcastle diseases and others. After August break, outbreak of Coccidiosis alone prevailed.

Frequency in outbreak of various poultry diseases of different weather types during the wet season in Ilorin and its environ is shown in Table 05.

Table 03: Frequency of outbreak of some poultry diseases of the dry season weather types in Ilorin and its environ (1991-2013).

	Months	Newcastle diseases	Coccidiosis	Gunborom	Heat Stress	Colibacillosis	Marek's diseases	Respiratory Infection*	Fowl typhoid	Lymphoid lecitcosis	Mortality rate
Harmattan Periods (Nov-Feb)	Nov	7	3	1	1	0	0	0	0	0	12.5
	Dec	11	5	5	3	0	2	2	2	0	9.0
	Jan	10	4	6	0	0	0	4	1	0	12.1
	Feb	8	3	7	2	4	5	2	1	0	10.1
	Total	36	15	19	6	4	7	8	5	0	43.7
	Mean	9.0	3.7	4.7	1.5	1.0	1.7	2	1.2	0	10.9
After harmattan (MAr-Apr)	Mar	12	5	3	13	4	3	0	3	0	20.1
	Apr	9	4	1	6	2	0	1	1	0	21.2
	Total	21	9	4	19	6	3	1	4	0	41.3
	Mean	10.5	4.5	2.0	9.5	3.0	1.5	0.5	1	0	20.6

Source: Authors' Computation from National Veterinary Research Institute (NVRI), Ilorin (2013).
**This the way NVRI has named and categorized the data.*

Table 04: Correlation between climate parameters and mortality rate before August break (May-June) during August break (July-August) and after August break (September-October) 1991-2013.

	Rainfall (mm)	Relative Humidity (%)	Maximum Temperature ($_0$C)	Minimum Temperature ($_0$C)
Before Aug. break (May-Jun)	0.861	0.845	-0.982	-0.739
During Aug. break (Jul-Aug)	0.775	0.894	-0.935	-0.860
After Aug. break (Sep-Oct)	-0.918	0.974	0.708	0.845

Source: Authors' Computation from National Veterinary Research Institute, Ilorin (2013)

Table 05: Frequency in outbreak of some poultry diseases of different weather types during the rainy season in Ilorin and it's environ (1991-2013).

	Month	Newcastle Diseases	Coccidiosis	Gumboro	Heat stress	Colibac-cillosis	Marek's diseases	Respiratory Infection*	Fowl typhoid	Lymphoid leucosis	Mortality rate (%)
Period before August break (May-June)	May	3	6	4	0	2	0	0	0	0	22.4
	June	0	5	3	0	0	1	0	1	1	22.0
	Total	3	11	7	0	2	1	0	1	1	44.4
	Mean	1.5	5.5	3.5	0	1.0	0.5	0	0.5	0.5	22.2
Months of August Break (Jul-Aug)	July	2	3	1	0	1	0	2	0	1	12.9
	Aug	1	2	3	0	1	0	0	0	2	18.8
	Total	3	5	4	0	2	0	2	0	3	31.7
	Mean	1.5	2.5	2.0	0	1.0	0	1.0	0	1.5	15.8
Months after August Break (Sep.-Oct.)	Sep	1	7	1	0	0	0	3	0	0	27.5
	Oct	2	5	1	0	1	1	0	0	0	28.7
	Total	3	12	2	0	1	1	3	0	0	56.2
	Mean	1.5	6	1	0	0.5	0.5	1.5	0	0	28.1

Source: Authors' Computation from National Veterinary Research Institute, Ilorin (2013).
**This the way NVRI has named and categorized the data.*

Poultry diseases witnessed during the period before August break (May-June) arranged in order to magnitude were Coccidiosis, Gumboro, Newcastle disease, Colibacillosis, Marek's disease and Lymphoid leucosis. Poultry farms were free from heat stress and respiratory infection under the above weather condition. Average mortality rate resulted from various diseases enumerated above was 22.2%.

The period of August break (July-August) experienced almost similar pattern of poultry diseases observed during the period before August break but with a milder impact. For instance, the average mortality rate stood at 15.8% compared with 22.2% as witnessed during the period before August break. The little difference observed in the pattern of diseases outbreak manifested in the mild outbreak of respiratory disease which was nil for the period before August break.

Poultry farms in Ilorin were highly susceptible during the months after August break (September-October.) for Coccidiosis being the major poultry disease. September-October weather type recorded the highest mortality rate of 28.1% of all weather types of the wet season. Comparing wet and dry seasons, temperature seems to be crucial for outbreak of Newcastle diseases during the dry season and in particular during the months after harmattan while rainfall and relative humidity seem to make chickens more vulnerable to diseases of which Coccidiosis is most prominent during the rainy season months of May-August. This finding has modified the assertion made by Scott (1999) that high relative humidity is the most difficult factor to cope with in poultry development in the tropics. Climatic parameter that will be considered as the most crucial for poultry development depends on the season and types of poultry diseases in question.

Table 06 reflects various weather types with poultry disease of economic importance in Ilorin for the period of study.

Oppong (1999) described Newcastle as the most fearsome poultry diseases of economic importance in West Africa. However, the findings as reflected in Table 06 have added to the list of such dreadful diseases to include Coccidiosis and Gumboro. As a matter of fact Coccidiosis appears to be most fearsome followed by Newcastle and Gumboro for Ilorin in Kwara State.

It becomes obvious from Table 06 that the wet season weather types present greater risk to poultry farming in Ilorin. For instance, the percentage total of mortality rate recorded during the dry season weather types was 31.5%. This was more than double during the wet season weather types (66.1%).

Table 06: Prevalent poultry diseases and average mortality rate during different weather types of dry and wet seasons in Ilorin (1991-2013).

Season	Weather Type	Prevalent Diseases	Average Mortality Rate (%)
Dry Season	Period of harmattan (November-February)	Newcastle Gumboro Coccidiosis	10.9
	Period after harmattan (March –April)	Newcastle Heat Stress Coccidiosis	20.6
Total			31.5
Wet Season	Period before August break (May-June)	Coccidiosis	22.2
	Period during August break (July-August)	Coccidiosis Gumboro	15.8
	Period after August break (September-October)	Coccidiosis Gumboro	28.1
Total			66.1

CONCLUSION

Various poultry diseases and other stressors recognized were enumerated and classified based on weather types of wet and dry seasons. Newcastle, Gumboro diseases and heat stress characterized the weather types of the dry season while Coccidiosis and Gumboro diseases prevailed during the wet season. Increase in rainfall brought about increase in mortality rate of chicken. The effect of temperature and relative humidity did not show any regular pattern.

Poultry farms are exposed to risks during wet and dry seasons however, for the period under consideration, chicken were more vulnerable to various diseases hence mortality rate was higher during wet season weather types. It can therefore be concluded that greater loss in poultry farming occur during wet season in Ilorin and its environ.

PLANNING IMPLICATION

Based on the three climatic factors identified as crucial to the severity in the outbreak of chicken diseases and chicken mortality rate in Ilorin, it is important to educate poultry farmers on the use of appropriate materials in constructing their poultry pens. Awoniyi, (2003) stressed that better productivity of chicken is a function of the type of material used in roofing poultry pen. For instance, iron roofs and cement blocks encouraged rapid absorption and radiation of heat and hence widespread of poultry diseases which often result in high mortality rate. Thatched roof and mud block may discourage these because they absorb and emit heat at a very slower rate and may be able to prevent the temperature of the poultry pen from reaching extremes. Again artificial micro climates that can suppress the harshness of each weather type could be created in the pens as each weather type approaches. For instance when it is very hot means of cooling off the heat should be provided in the pens and vice-versa.

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