



# **Indigenous Chicken Productivity and Associated Farm-Level Attributes among Producers in the Western Parts of Kenya**

**Joseph Kipkorir Cheruiyot<sup>1\*</sup> and Merina Adhiaya<sup>2</sup>**

<sup>1</sup>*School of Agricultural Sciences and Natural Resources, University of Kabanga, Kericho, Kenya.*

<sup>2</sup>*Kenya Climate Smart Agriculture Project (KCSAP), Kakamega County, Kenya.*

## **Authors' contributions**

*This work was carried out in collaboration between both authors. Author JKC designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Author MA managed the data collection procedures and protocols. Both authors read, edited and approved the final manuscript.*

## **Article Information**

DOI: 10.9734/JAERI/2021/v22i230184

### Editor(s):

(1) Dr. Daniele De Wrachien, State University of Milan, Italy.

### Reviewers:

(1) Jan Polcyn Stanislaw Staszic, State University of Applied Sciences in Pila, Poland.

(2) Worapol Aengwanich, Mahasarakham University, Thailand.

(3) Bassim Haleem kshash, AL-Qasim green university, Iraq.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/67280>

**Received 03 February 2021**

**Accepted 06 April 2021**

**Published 20 April 2021**

**Original Research Article**

## **ABSTRACT**

Indigenous chicken production is an important sub-sector in Kenya. About 90% of rural communities keep indigenous chicken in small flocks. They provide the much needed high value protein and income for the rural households. Despite its importance; the productivity of the sub-sector greatly varies depending on the management systems deployed by the producers. The management systems are thought to be influenced by demographic; socio-economic and information literacy factors. This study investigated the potential links between these factors and indigenous chicken productivity in two regions in the Western parts of Kenya. The survey study adopted a descriptive approach. Semi-structured interview schedules were used to collect data from a sample of 106 smallholder producers. Purposive and multi-stage sampling techniques were used to select the participants from among producers who had shown interest in the commercialization of indigenous chicken following awareness meetings conducted by public extension agents in the two regions. Data was analyzed by use of descriptive statistics and

\*Corresponding author: E-mail: [cheruiyotjoseph@gmail.com](mailto:cheruiyotjoseph@gmail.com);

correlation estimates using Kendalls' tau-b and Goodman-Kruskalls' Gamma coefficients. Gender; education levels; flock size; information literacy and access to markets had significant association ( $P < .05$ ) with some indigenous chicken productivity indicators that were investigated.

*Keywords: Demographic; socio-economic; information literacy; Indigenous chicken production; nandi; kakamega; Kenya.*

## 1. INTRODUCTION

### 1.1 Background Information

Kenya's agriculture sector contributes 27% to the country's Gross Domestic Product and provides well over 20% of formal employment [1]. The agricultural sector in Kenya includes activities involving the production and management, processing, marketing of crops, livestock and fishing resources for food, income and industrialisation. It involves the use of natural resources for socio-economic development. In the livestock sub-sector there are about 22 million indigenous chickens in Kenya; kept by about 90% of the rural communities in small flocks, mainly under free-range systems [2]. The free range indigenous chicken provides high quality protein and income to a rapidly growing human population [2]. Despite the importance of indigenous chicken to the livelihoods of the rural poor, its productivity greatly varies based on the production systems in use [3]. This wide variation in productivity happening even as the demand for indigenous chicken products in urban centres continues to grow rapidly [4].

Although the variation in productivity of indigenous chicken has been attributed to production systems [3] and to challenges such as diseases and lack of access to quality markets [4], the productivity challenges have been least understood from the perspective of the farmers who practise it in Kenya. This sub-sector has been variously referred to as small-scale poultry or scavenging chickens, village chickens or backyard poultry [5] or family poultry [6] suggesting its strong association with a low scale of operation. Despite this low scale of operation, indigenous chicken have a number of advantages for resource-poor farmers; eggs inside their shell are sterile, intact and easy-to-cook loaded proteins, slaughtered chicken can be consumed by a household in a single meal without the need of costly preservation as may be required for larger animals [5]. The small scale poultry are integrated with human livelihoods and it enhances the diet, income and food and nutrition security of the rural poor

(Alders & Pym, 2009 as cited by [5]). The indigenous chicken production also enhances food security in in-direct ways such as improving nutrient use and recycling in the environment. It enables access to healthcare and education and empowers women [7]. In many developing countries, raising poultry under backyard systems have significant contributions to socio-economic development. In Bangladesh for example it contributes 1.6% in gross domestic product, but like in Kenya the sub-sector is equally faced with challenges [8].

Indigenous chicken have important socio-economic and nutritional roles in the study areas of Nandi and Kakamega counties [9,10]. In Kakamega County it is the main source of animal protein and it has cultural and traditional importance among the native communities [11]. Kakamega County has an estimated indigenous chicken population of 959,749 [9]. In Nandi County indigenous chicken is a major source of income among smallholder producers and partly contributes to household protein supplies [10]. Nandi County has a poultry population of 642,459 with an estimated 93% being indigenous chicken [10]. These chicken populations suffer low productivity due to a number of challenges some of which are socio-economic and information-related in nature.

There are several challenges associated with indigenous chicken production. One such major challenge is the high flock mortalities due to predation and regular disease outbreaks. These challenges hamper the productivity of small scale poultry production. Poor quantity, quality and availability of food resources have also been cited as major challenges, as well as lack of organised marketing systems and low rates of vaccination, particularly against Newcastle disease [7]. These various challenges have colluded to diminish the productivity of smallholder poultry production. The challenges, however, appear to vary from one region to another. Although poultry production has at times been blamed in view of the food-feed competition that it poses, poultry accounts for about 33% of the global meat consumption [12]. In Ethiopia for

example, the largest off-take rates of indigenous chicken are associated with holidays and festivities; this suggests a high value attributed to its meat [12]. This means that the challenge of food-feed competition among other challenges needs to be addressed.

## 1.2 Chicken Ecotypes and their Productivity

In most developing countries, indigenous chicken populations are a result of uncontrolled cross-breeding programmes [2]. This observation suggests that the level of information literacy among small scale producers in developing countries, on aspects of breeding, may be low. Distinct indigenous ecotypes with varying productivities have been identified in Kenya based on their phenotypic characteristics. The common ecotypes in Kenya are; frizzled-feathered, naked-neck, barred feathered, feathered-shanks, bearded and dwarf-sized (Nyaga, 2007 as cited by [2]). The naked-neck ecotypes are heavier than the feathered chicken (Ndirangu et al, 1991; cited by [2]). Selection of the ecotypes to rear in many cases depends on the farmers' own management experiences and other socio-economic factors. Aside from the challenges based on the management of the small scale poultry production, [13] suggests that there is a strong link between the ecotypes raised and the productivity of the production system.

The indigenous Naked-neck chicken for example, has good heat dissipation mechanism and has been reported to adapt well to harsh tropical environments and poor nutrition. It is highly resistant to diseases and superior to *full-feathered* in regards to growth rate, egg production, egg quality and meat yield traits [14]. In Bangladesh the Naked-neck ecotype fetches higher prices compared to exotic types [14]. A study conducted in Rwanda by [15] revealed that the Dwarf ecotype was the most widely kept indigenous chicken at about 38% prevalence. Although it was considered to have poor growth, it had better prolificacy than other indigenous ecotypes. The current study investigated the indigenous chicken ecotypes raised by the small scale poultry farmers of Nandi and Kakamega Counties. The farmers practice on the ecotypes they raise is thought to be related to their level of information literacy and in turn related to the productivity of their indigenous chicken enterprises. Information literacy in agricultural production has been explained by [16] as the ability of the farmer to seek relevant information,

access it and use it in the practice of farming. This concept has been measured in the current study through the farmers' perceived level of access to technical information on indigenous chicken production.

## 1.3 Constraints to Indigenous Chicken Productivity

Among the challenges that have been associated directly with the indigenous chicken production in Kenya is the high mortality of chicks. The mortality rates range between 40% and 60%; mostly attributed to diseases and poor management [2]. Pests such as fleas, lice and mites sometimes also cause death in chicks. The most prevalent diseases in Kenya are the Newcastle disease, fowl typhoid and coccidiosis. The prevalence of Newcastle disease has similarly been reported in Bangladesh where about 66% of small scale poultry farmers suffered productivity losses due to its infections on the indigenous chicken [17]. The Newcastle disease can best be controlled through vaccination. King'ori (2004) as cited by [2] observed that the vaccination of chicken against Newcastle disease increased the flock size per household, the number of eggs laid per hen per year, indigenous chicken off-take and sales income from chicken and eggs. Whereas Newcastle disease can effectively be prevented through regular vaccinations and result in production increases, Fowl typhoid and coccidiosis are best prevented by proper hygiene in the chicken house [2].

In Kenya, regular vaccinations against Gumboro, Newcastle disease and fowl typhoid have been reported to increase chicken survival and productivity [18]. According to [19], flock sizes doubled when interventions on housing, feed supplementation, vaccination and de-worming were implemented by farmers. This was observed during implementation of a technology testing and transfer project among small-holder farmers in 3 counties of Kenya; Likipia, Nyandarua and Nakuru. A study conducted in Bangladesh observed that 86% of the studied population did not follow vaccination programs [17] and yet about 66% and 30% of them reported incidences of Newcastle disease and fowl pox respectively. Although vaccination was hardly practiced, an economic analysis showed that vaccination of the local birds was profitable in Bangladesh [12]. The absence of the preventive measures against diseases adversely affected chicken productivity. This is a factor that could be related to farmers' socio-demographics

and information access and is a subject of the current study.

The Indigenous chicken in most developing countries are characterized by a low performance. An average production of 60 eggs per hen per year and a body weight gain of 1.5 kg in 24 weeks have been reported in Ethiopia [12]. These low productivity levels have been attributed to management constraints. The high cost of commercial poultry feed discourages its use in supplementing local chicken, in a number of cases its quality is even low [12]. Vaccinations against contagious diseases such as Newcastle diseases are not carried out. Author [20] reported that the major constraints to village chicken production were; mortalities which were reported by as many as 95% of households in their study, feed shortage reported by 85% of households and low chicken sales reported by 72% of their study population in South Africa. Poor and youth-headed households who could not afford vaccination were said to be more vulnerable to Newcastle disease infections on their chicken. Accessibility to veterinary services and vaccines was also low for such households. In another study by [21] in Swaziland, the significance of feed costs, market price, flock size and number of chicken in influencing profitability was reported. Profitability was measured as returns per unit cost of feed consumed by the chicken; suggesting a low measurement of productivity based on feed resources. This may partly explain why most farmers avoided supplementary feeding. Most indigenous chicken in developing countries scavenge for insects, food waste, green grass, leafy vegetables and any scattered grains [2].

A study conducted in Kenya revealed that the improvement of chicken house to control sanitation-related diseases, vaccination and supplementary feeding of the indigenous chicken can increase egg production from an average of 40-100 to about 150 eggs per hen per year [2]. Olwande et al. (2009) as cited by [2] reported that the average egg production in Kenya was in the range of 40 to 100, laid in 3 to 4 clutches. Based on their findings the authors suggested that birds laid as low as 40 eggs in a whole year, probably laying an average of 10 eggs in one clutch, a low productivity by many standards as compared to what can be realized through improved hygiene, vaccination and feed supplementation. A study in Bangladesh reveals a variety of housing conditions for indigenous chicken. Some chicken are housed in coops inside the human dwellings, others inside the

human dwellings without a coop, some outside the dwelling but in a coop and others in the kitchen and other resting places [17]. Their study observed that a majority (60%) of the farmers kept their chicken in a coop in the living room and very few kept their chicken in a coop outside (9%). The households had an average flock size of 5.62 and average egg production per clutch of 13.47 with average clutches per year of 2.75 and a hatchability of 76%.

Newcastle disease and poor management of chicks; less than 6 weeks of age, were reported as major constraints to the village chicken production in Myanmar [22]. The authors observed that regular vaccination with thermo-stable Newcastle vaccine markedly reduced the proportion of mortality attributed to the disease. Their study demonstrated that chick management using confinement and supplementary feeding improved the health and the production of village chickens. An additional factor that has been blamed for low productivity in village chicken is the prolonged broodiness associated with some indigenous chicken types. Chicken that remains broody for long periods spend much of their time brooding at the expense of the time spent in egg-laying. The harsh traditional measures used to suppress broodiness, such as immersion in cold water, hanging the bird upside-down, starving or pulling out vent feathers, worsen the situation rather than correcting it [2]. Such harsh measures may even lead to cessation of egg-production all together. A recommended approach would be to isolate the broody bird by caging it at least a metre above the rest of the flock for at least 3 to 4 days [2]. The broodiness will normally disappear in the 3-4 days for the bird to start a new laying cycle.

Despite the many constraints faced by indigenous chicken productivity in developing countries, it has been recognized that they provide utility among all wealth categories in rural societies [12]. This suggests that it is contributing widely to rural socio-economic prosperity. It has the ability to initiate economic growth (Adrian & Michael, 2009 as cited by [9]). It is noted, however, that the sub-sector evidently faces technical and physical constraints which adversely hampers its contribution to socio-economic sustainability of the rural livelihoods (Vincent et al., 2010 as cited by [12]). The current study focuses on the farm-level factors that play a role in indigenous chicken production and therefore its contribution to the socio-economic wellbeing of the producers.

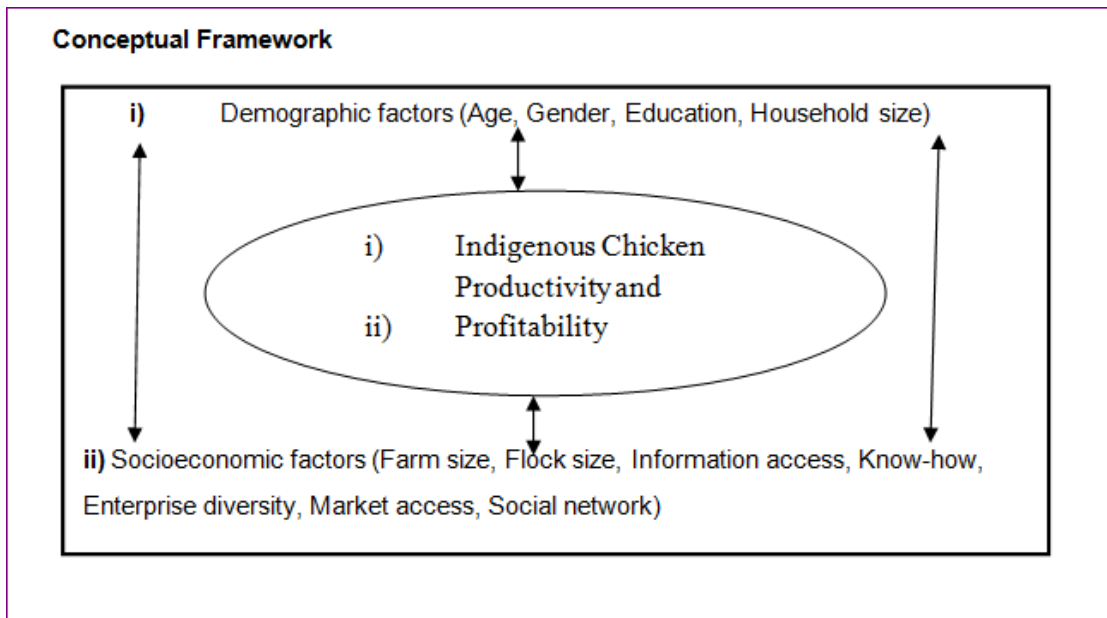
**1.4 Purpose of the Study**

The purpose of the current study was to investigate indigenous chicken productivity and related farm-level attributes among small scale poultry farmers in the Western parts of Kenya. The study focused on some potential household and farm factors that were thought to be associated in some way to indigenous chicken productivity. Socio-economics, demographics and farmers' access to information and markets were investigated for their potential to explain indigenous chicken productivity among communities in two locations. One of the locations is a predominantly maize-tea-dairy county of Nandi and the other is a predominantly subsistence-agriculture based densely-populated county of Kakamega. The specific objectives of the study were:(i) to examine the links between selected farmers' socio-economic attributes and indigenous chicken productivity (ii) Investigate the association, if any, between information access and indigenous chicken productivity and (iii) assess the links, if any, between perceived ease of market access and the productivity of the indigenous chicken among producers in the western parts of Kenya.

**1.5 Variables in the Study**

The farm-level attributes that were thought to be associated with indigenous chicken productivity were included in the study. Gender, education,

age of farmer, household size, land size and number of farm enterprises and flock size were considered important socio-economic attributes of a farm with potential association with indigenous chicken productivity. Social networks maintained by the farmers were also included and measured through membership to a group. Access to information was measured through a self-assessed perception of the farmer on their ability to access technical information on indigenous chicken management practices. Access to markets was evaluated through a self appraisal rating on the extent to which they readily accessed markets for indigenous chicken and its products. All the proposed potentially-linked variables were measured on a ranking scale except gender which was a dummy variable (coded 1 for male and 2 for female). Productivity on the other hand was measured through proxy indicators. The number of eggs laid per clutch per chicken per year, the number of clutches per year per chicken, the number of chicks hatched per clutch, number of hens sold per year were considered useful proxy variables for productivity. The number of eggs sold per year, number of chicken consumed within the household and the price fetched per egg sold were also used. The profitability of the indigenous chicken was measured on a ranking scale (poor to very good) based on the perception of the farmer.



**Image 1. Conceptual framework on factors associated with indigenous chicken productivity**

## 2. METHODOLOGY

### 2.1 Study Site

This study was conducted among farmers who had expressed interest to participate in poultry commercialization projects in their respective sub-counties in Nandi and Kakamega counties. The two counties in the Western parts of Kenya (Fig. 1) were selected for the study based on their indigenous chicken supplies and demand. Nandi County is a source of some indigenous chicken life birds sold in Kakamega for consumption. Kakamega was viewed as a 'sink' since it is a major consumer of indigenous chicken from Nandi County; the source. Based on previous observed trends, Nandi is a *source*, while Kakamega County could be regarded as a *sink* in the indigenous chicken supply and demand patterns. There is a relatively low consumption of indigenous chicken in Nandi County which exports some of their life birds to Kakamega County. The latter is a major producer and consumer of indigenous chicken. The projects in both counties were aimed at improving indigenous chicken productivity by introducing appropriate interventions to address the challenges faced by the poultry producers. The study was carried out before implementation of any intervention measures based on the new projects. One tenth of the small scale farmers who had registered in the selected wards were randomly selected to participate in the study as suggested by [23]. This category of small-scale farmers who had already identified themselves

as small-scale poultry farmers during open public meetings and had registered as such with the Departments of Agriculture were purposively selected for the study. Simple random sampling was then used to select a sample from among the small-scale poultry farmers to participate in the study. The study targeted two Sub-counties in Kakamega and two Sub-counties in Nandi.

The county of Kakamega lies between longitudes  $34^{\circ}32'$  and  $35^{\circ}57'30''E$  and between latitudes  $0^{\circ}07'30''N$  and  $0^{\circ}15''N$  of the equator. The county covers an area of  $3051.3 \text{ Km}^2$ . The altitude ranges from 1240 to 2,000 metres above sea level and receives an annual rainfall of 1280 to 2214 mm per annum [9]. The county has an estimated population of 2,079,669 persons and a density of 682 per  $\text{Km}^2$ . Nandi county on the other hand lies between latitude  $0^{\circ}34'N$  and longitudes  $34^{\circ}45'E$  and  $35^{\circ}25'E$ . It covers an area of  $2884.4 \text{ Km}^2$  and borders Kakamega County to the West [10]. The altitude ranges from 1300 to 2500 metres above sea level and the county receives an annual rainfall of 1200 to 2000 mm with mean temperature ranges of  $18^{\circ}$  to  $22^{\circ}C$ . Nandi County has a population of 996,677 persons and a population density of 346 per  $\text{Km}^2$ . This study was carried out in the two counties and adopted an ex post facto design. The design presumes that cause and effect have already occurred and therefore the study is carried out retrospectively. The study was designed to describe the conditions that exist and the possible linkages between the existing conditions [24].



**Fig. 1. Map showing the counties of Kakamega and Nandi**  
(Source: Primary map from Google Earth)

## 2.2 Sampling Procedure

Purposive and multi-stage random sampling techniques were used to identify participants in the study as illustrated in Fig. 2. In each of the two counties, Administrative Locations were selected to participate in the study based on the intensity of indigenous chicken value chain activities. From each Location, a similar criterion was used to select villages to participate in the study. In the selected villages, a list of small-scale farmers who had expressed interest to participate in indigenous chicken productivity improvement projects was used as the sampling frame. Each village was allocated a target number based on their proportional representation in the list of small-scale poultry farmers. Simple random sampling was carried out in each village to select 10% of the households to participate in the study [23]. This yielded a sample of 106 farmers who participated in the study.

## 2.3 Data Collection

Data from the sample of small scale poultry producers were collected between November 2020 and January 2021 through face-to-face interviews. A set of pre-determined questions was used for the interviews [25]. The interview schedule contained both structured and unstructured questions. The advantage of an unstructured interview schedule is that it has a flexible structure, flexible content and flexibility in interview questions. Its strength lies in the freedom it provides in terms of content and structure [26]. They can be used for both qualitative and quantitative research where response categorisations can be developed from the responses in case of quantitative research. In the case of qualitative research, the responses are used as descriptors. Pretesting of interview

schedules was carried out to ensure that the understanding and interpretation of the questions does not present problems to the respondents. A pre-test was carried out under actual field conditions similar to that targeted for the study, as suggested by [26]. The schedules gathered both qualitative and quantitative data.

## 2.4 Data Analysis

Data were analyzed by generating descriptive statistics and testing for associations between attributes. The strength and direction of the relationship between attributes was tested by running Kendall's tau analysis on SPSS version 20. The Kendall's tau-b correlation coefficient is derived from the formula:

$$T_b = \frac{P-Q}{(P+Q+X_o)(P+Q+Y_o)}$$

Where P refers to the number of concordant pairs; Q is the number of discordant pairs, while X<sub>o</sub> and Y<sub>o</sub> are the number of pairs tied on the X and Y variables respectively. The tau-b (T<sub>b</sub>) coefficient provides a typically smaller coefficient compared to other measures of monotonic relationships such as Pearson and Spearman's rank correlation [27]. A further test for correlations between attributes utilized the Kruskal's Gamma coefficient (G), derived from the formula:

$G = \frac{N_s - N_d}{N_s + N_d}$  where N<sub>s</sub> refers to the number of concordant pairs and N<sub>d</sub> is the number of discordant pairs. This further test was deemed appropriate as it is regarded as a more robust statistical technique for correlation analysis between ordinal-measured variables, especially when many tied ranks are expected in the datasets [28].

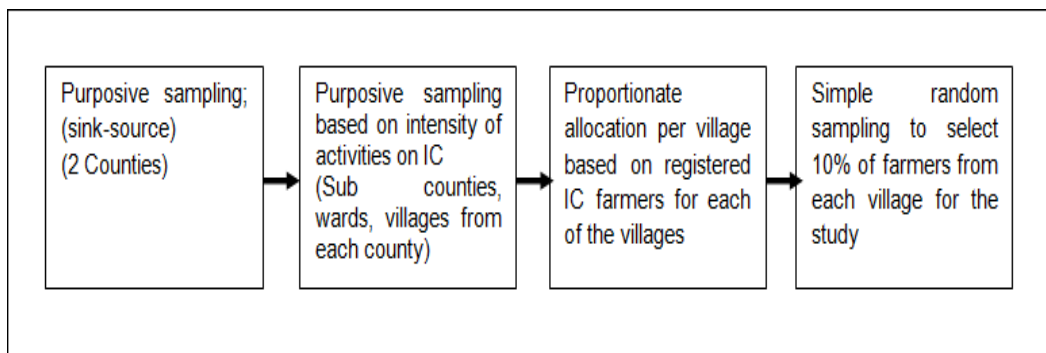


Fig. 2. Diagrammatic representation of the multi-stage sampling procedure for the participants

### **3. RESULTS AND DISCUSSION**

#### **3.1 Socio-demographics**

Majority of the participants in the study had primary level education (45.9%), there were a few youths aged below 35 years (Table 1). Majority of the households had 5-6 members and land sizes were mostly in the range of 1 to 2 acres. Most households had highly diversified crop enterprises with a majority having 5 and more crops in their farms (Table 1); probably a strategy to diversify their food and income sources. Livestock enterprises were less diversified compared to crops as expected, since livestock tend to require more land; except for the small stock. Majority of the small holders exhibited social networking as evidenced by their membership in social groups (84.7%), majority were members to at least one group, but some were members to as many as five and above (2.4%).

#### **3.2 Indigenous Chicken Production Data**

##### **3.2.1 Flock size**

Majority of the smallholders had flock sizes of the range of 11-30 (Table 2). The number of indigenous chicken kept from a minimum of 6 to a maximum of 205 with mean flock size of 42 birds. Chicks ranged from 0-72 with a mean of 19 chicks reported per household (Table 2).

##### **3.2.2 Productivity indicators**

The mean number of eggs laid per clutch was 14.78 and the mean number of clutches per year was 3.56. Consequently the average number of eggs laid per hen per year was 53. This observation compares well with the average of 60 eggs per bird per year reported by [12] from a study conducted in Ethiopia. It is also in tandem with a previous report by [2] that suggested an average of 40 to 100 eggs laid in 3 to 4 clutches per year. This finding, however, is slightly higher than the average of 13.47 eggs laid in 2.75 clutches per year as reported from a study in Bangladesh by [17], probably due to dissimilarities in agro-ecological zones. This finding reveals low productivity of the chicken, by many standards. A potential exists to achieve a production of 180 eggs per bird per year in an improved semi free-range system, with medium-level inputs where housing, feeding and disease control challenges are addressed [29]. As

regards fertility of the flock, an average of 11.92 eggs was hatched for every clutch, from the average of 14.78 eggs laid per clutch, suggesting an average of 80% hatchability. This finding is in agreement with the 80% hatchability reported by [29] and compares well with the 76% hatchability reported in Bangladesh by [17].

##### **3.2.3 Flock structure**

The indigenous chicken flock was largely composed of chicks (42.3%), fewer pullets (30.06%), mature hens (21.21%) and cocks (6.37%) as illustrated in Fig. 3. On average there were 8 hens and pullets for every one cock. This finding reveals that the indigenous chicken producers, on average, conform to the recommended practice of keeping one cock for every 10 hens for purposes for breeding [29].

##### **3.2.4 Chicken ecotypes**

The majority of the small holder producers did not have any dominant indigenous chicken ecotype in the flock but reared a mix of several ecotypes (42%). The long leg ecotype was reported to dominate the flock by 29% of the participants. Barred feathered reported by 11%, naked-necks (8%), Dwarf (7%) and frizzled feathered reported by 2% (Figure 4). In neighbouring Ethiopia, [12] similarly observed that mixed flock of indigenous chicken was rampant. Contrary to this finding, in another neighbouring country of Rwanda, [15] reported a dominance of dwarf ecotype at 38% prevalence.

### **3.3 Association between Farm-level Attributes and Productivity**

#### **3.3.1 Gender**

There was a significant correlation as estimated by Kendalls tau-b coefficient between gender and the number of eggs laid per clutch. Female farmers were associated with a lower number of clutches per hen per year ( $\tau_b = .234, P = .022$ ). A Kruskals Gamma test also showed a significant correlation ( $G = .410, P = .015$ ). This observation suggests that female-headed households may be losing out on the potential to maximize on the number of clutches laid per hen in a given period. This finding is consistent with what was reported by [15] suggesting that the female gender was less likely to adopt management practices that improve productivity.

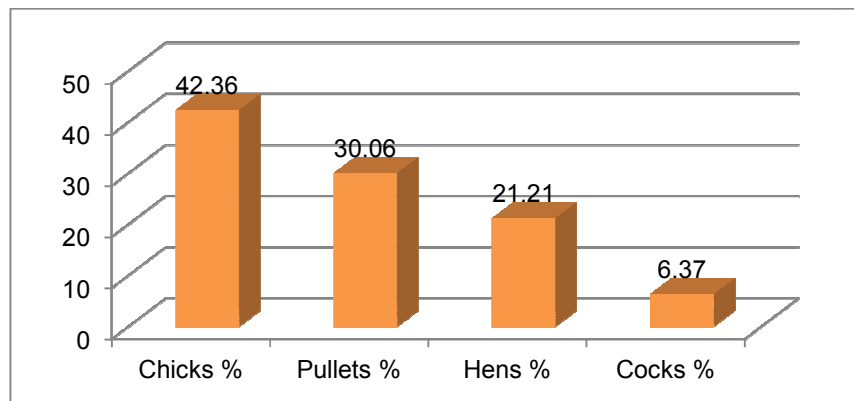


**Table 1. Participants' demographic and socio-economic data**

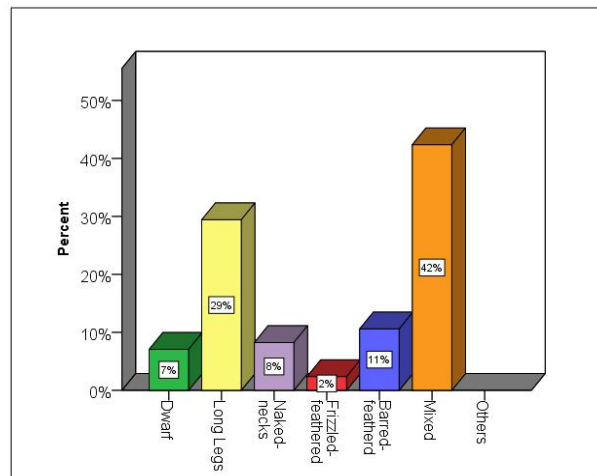
| <b>Education Levels</b>      | <b>%</b> | <b>Age Category (years)</b>       | <b>%</b> | <b>Household Size (Number of members)</b> | <b>%</b> |
|------------------------------|----------|-----------------------------------|----------|---|----------|
| No formal education          | 7.1      | Below 35                          | 11.8     | 4 and Below                               | 11.8     |
| Primary                      | 45.9     | 36-45                             | 34.1     | 5 - 6                                     | 37.6     |
| Secondary                    | 30.6     | 46-55                             | 22.4     | 7 - 8                                     | 29.4     |
| Tertiary                     | 16.5     | 56-65                             | 23.5     | 9 - 10                                    | 11.8     |
|                              |          | Over 65                           | 8.2      | Above 10                                  | 9.4      |
| <b>Land Size (Acres)</b>     | <b>%</b> | <b>Number of Crop enterprises</b> | <b>%</b> | <b>Number of Livestock enterprises</b>    | <b>%</b> |
| 1 and Below                  | 27.1     | 1                                 | 0        | 1   | 2.4      |
| Over 1 -2                    | 30.6     | 2                                 | 7.1      | 2   | 37.6     |
| Over 2-3                     | 25.9     | 3                                 | 7.1      | 3   | 30.6     |
| Over 3-4                     | 5.9      | 4                                 | 25.9     | 4   | 17.6     |
| Over 5                       | 10.6     | 5 and above                       | 60       | 5   | 11.8     |
| <b>Membership to a group</b> | <b>%</b> | <b>Number of groups</b>           | <b>%</b> | <b>Flock Size</b>                         | <b>%</b> |
| No                           | 15.3     | 0                                 | 15.3     | Below 10                                  | 4.7      |
| Yes                          | 84.7     | 1                                 | 34.1     | 11-30                                     | 44.7     |
|                              |          | 2                                 | 22.4     | 31-50                                     | 21.2     |
|                              |          | 3                                 | 24.7     | 51-70                                     | 11.8     |
|                              |          | 4                                 | 1.2      | Over 70                                   | 17.6     |
|                              |          | 5 and above                       | 2.4      |   |          |

**Table 2. Descriptive statistics (N= 106)**

|                            | <b>Min.</b> | <b>Max.</b> | <b>Mean</b> | <b>Std. Dev.</b> |
|----------------------------|-------------|-------------|-------------|------------------|
| Total Indigenous Chicken   | 6           | 205         | 42.86       | 36.021           |
| Chicks                     | 0           | 72          | 19.25       | 14.323           |
| Pullets                    | 0           | 165         | 13.66       | 20.435           |
| Mature Hens                | 2           | 62          | 9.64        | 10.063           |
| Cocks                      | 1           | 20          | 2.89        | 2.854            |
| Eggs Per Clutch            | 8           | 26          | 14.78       | 3.849            |
| Clutches Per Year          | 2           | 6           | 3.56        | .879             |
| Eggs laid Per hen per year | 20          | 150         | 53.0471     | 21.654           |
| Chicks Hatched/Clutch      | 7           | 20          | 11.92       | 2.800            |
| Hens Sold Per Year         | 0           | 206         | 24.34       | 34.446           |
| Price per Hen              | 350         | 1000        | 540.00      | 113.599          |
| Cocks sold per year        | 0           | 78          | 9.76        | 11.707           |
| Price Per Cock             | 400         | 1000        | 758.24      | 123.647          |
| Eggs sold per year         | 0           | 750         | 161.45      | 146.524          |
| Price Per Egg              | 10          | 20          | 14          | 3.948            |
| Chicken Consumed           | 0           | 36          | 9.73        | 6.505            |
| Price Per Chicken Consumed | 350         | 800         | 544.12      | 106.741          |
| Manure Sold (kg)           | 0           | 1000        | 203.88      | 196.457          |



**Fig. 3. Flock structure as derived from participants' reports**



**Fig. 4. Dominant chicken ecotype as reported by participants**

**Table 3. Correlations between selected farm-level attributes as estimated by Kendall's coefficient**

|                    |     | <b>CRD</b> | <b>GM</b> | <b>NOGS</b> | <b>NOC</b> | <b>ELPC</b> | <b>CHPC</b> | <b>HS</b> | <b>PROF</b> | <b>ESPY</b> | <b>PPE</b> | <b>CCPY</b> |
|--------------------|-----|------------|-----------|-------------|------------|-------------|-------------|-----------|-------------|-------------|------------|-------------|
| Gender             | CC  | -0.059     | -0.012    | 0.004       | -0.086     | -.234*      | 0.028       | -0.029    | -0.101      | -0.078      | 0.017      | -0.171      |
|                    | Sig | 0.568      | 0.91      | 0.969       | 0.39       | 0.022       | 0.786       | 0.77      | 0.319       | 0.445       | 0.874      | 0.087       |
| Education          | CC  | 0.161      | -0.102    | 0.12        | .205*      | -0.031      | -0.105      | .236*     | 0.046       | .204*       | 0.098      | .287**      |
|                    | Sig | 0.097      | 0.317     | 0.21        | 0.029      | 0.752       | 0.284       | 0.012     | 0.627       | 0.033       | 0.315      | 0.002       |
| Age                | CC  | 0.154      | .354**    | 0.117       | 0.02       | -0.029      | -0.085      | 0.101     | 0.101       | -0.024      | -0.051     | 0.042       |
|                    | Sig | 0.102      | 0.00      | 0.209       | 0.822      | 0.754       | 0.368       | 0.263     | 0.272       | 0.796       | 0.589      | 0.643       |
| Household size     | CC  | .217*      | 0.181     | .222*       | 0.082      | 0.04        | 0.087       | 0.077     | -0.075      | 0.07        | 0.023      | 0.048       |
|                    | Sig | 0.022      | 0.069     | 0.018       | 0.369      | 0.674       | 0.361       | 0.4       | 0.415       | 0.452       | 0.812      | 0.596       |
| Land Size          | CC  | 0.079      | 0.061     | -0.123      | 0.015      | 0.069       | 0.035       | -0.077    | .182*       | -0.077      | -0.069     | -0.027      |
|                    | Sig | 0.405      | 0.536     | 0.186       | 0.871      | 0.465       | 0.713       | 0.394     | 0.048       | 0.41        | 0.469      | 0.767       |
| Flock Size         | CC  | 0.015      | 0.105     | 0.169       | 1          | .231*       | 0.169       | .337**    | -0.03       | .321**      | .260**     | .330**      |
|                    | Sig | 0.872      | 0.293     | 0.072       | .          | 0.015       | 0.079       | 0         | 0.748       | 0.001       | 0.007      | 0           |
| Eggs Per Clutch    | CC  | 0.1        | -0.111    | -0.02       | .231*      | 1           | .389**      | 0.097     | 0.08        | 0.112       | 0.167      | 0.125       |
|                    | Sig | 0.308      | 0.284     | 0.84        | 0.015      | .           | 0.00        | 0.308     | 0.404       | 0.25        | 0.094      | 0.187       |
| Information Access | CC  | -0.042     | 0.069     | -0.066      | 0.04       | .244*       | 0.042       | 0.079     | 0.138       | -0.006      | -0.074     | -0.062      |
|                    | Sig | 0.667      | 0.499     | 0.493       | 0.665      | 0.011       | 0.666       | 0.395     | 0.143       | 0.946       | 0.452      | 0.509       |
| Market Access      | CC  | -0.024     | 0.054     | -0.1        | -0.061     | 0.105       | -0.061      | -0.029    | .386**      | -0.054      | -0.109     | 0.065       |
|                    | Sig | 0.804      | 0.596     | 0.295       | 0.509      | 0.271       | 0.532       | 0.751     | 0.00        | 0.572       | 0.262      | 0.485       |

\*\* Significant at .001, \* significant at .05 level of significance

Key: CRD-Crop diversification, GM-Group membership, NOGS-Number of groups to which participant belongs, NOC-Total number of chicken reported, ELPC-Eggs laid per clutch, CHPC-Chicks hatched per clutch, HS-Hens sold, PROF-Profitability, ESPY-Eggs sold per year, PPE-Price per egg, CCPY-Chicken consumed per year

### 3.3.2 Education levels

Education levels were positively correlated with the number of indigenous chicken raised ( $\tau_b = .205$ ,  $P = .029$  and  $G = .298$ ,  $P = .024$ ), the number of hens sold ( $\tau_b = .236$ ,  $P = .012$  and  $G = .332$ ,  $P = .011$ ), the number of eggs sold per year ( $\tau_b = .204$ ,  $P = .033$  and  $G = .308$ ,  $P = .028$ ) and the number of chickens used for household consumption per year ( $\tau_b = .287$ ,  $P = .002$  and  $G = .398$ ,  $P = .004$ ). The significant association between the number of hens sold and the number of eggs sold with the education levels of the respondents suggests that the more educated farmers tended to commercialize their indigenous chicken production. This observation has implications for the interventions planned by agricultural extension agents. It suggests that commercialization messages should target more on the less educated producers. A similar observation was made by [19] who reported a link between the management practices and the education levels of the farmers.

### 3.3.3 Age of farmers

The age of the farmer was positively correlated with membership to a group ( $\tau_b = .354$ ,  $P = .000$  and  $G = .767$ ,  $P = .000$ ). This highly significant correlation ( $P < .001$ ) suggests that the more elderly farmers were much more likely to embrace social-networking through groups compared to the youth. This observation has implications for extension targeting on the benefits of networking and group dynamics.

### 3.3.4 Household size

Household size showed a significant correlation with crop diversification ( $\tau_b = .217$ ,  $P = .022$  and  $G = .336$ ,  $P = .020$ ) and to the number of social groups to which the household head belonged ( $\tau_b = .222$ ,  $P = .018$  and  $G = .313$ ,  $P = .012$ ). This appears to indicate that crop diversification may be a strategy adopted by the household heads of large households to achieve food security. It further suggests that the household heads with large families tend to embrace social networking as indicated by the high number of social groups they joined. This may also be propelled by the need to cater for a large number of household members. Household size did not show significant relationship with the other socio-economic and productivity indicators measured ( $P > 0.05$ ).

### 3.3.5 Land size

The perceived profitability of indigenous chicken had a significant positive correlation with the land size owned by the household ( $\tau_b = .182$ ,  $P = .048$ ) as indicated in table 3. Further test gave a  $G = .246$ ,  $P = .045$ . This observation suggests that the availability of a large piece of land may be a factor in the profitability of indigenous chicken. Farmers interviewed indicated in general comments that they mostly left their chicken to free range for feed in order to cut on costs. That free range feeding practice, however, can only be feasible where large land is available for the chicken to freely fend for themselves.

### 3.3.6 Chicken sold

The number of chicken sold in a given period of time can be regarded as an indicator for commercialization of the indigenous chicken enterprise. The number of chicken sold was found to be significantly correlated to the education levels of the farmer ( $\tau_b = .236$ ,  $P = .012$  and  $G = .332$ ,  $P = .011$ ). A test for correlation with other attributes showed that it was correlated with the number of eggs laid per clutch ( $\tau_b = .231$ ,  $P = .015$  and  $G = .339$ ,  $P = .007$ ), the number of eggs sold per year ( $\tau_b = .321$ ,  $P = .001$  and  $G = .393$ ,  $P = .002$ ), the number of chicken consumed per year ( $\tau_b = 0.330$ ,  $P = .000$  and  $G = .456$ ,  $P = .000$ ) and the price fetched from the market per egg sold ( $\tau_b = 0.260$ ,  $P = 0.007$  and  $G = .395$ ,  $P = .017$ ). This observed associations appear to suggest that the enterprising indigenous chicken farmer is a better educated one, strives to sell more and sells at better market prices than the rest. Interestingly, the commercial farmer is also associated with a high number of chickens slaughtered for home consumption, suggesting that the enterprising farmer does not only produce for the market, but produces for household consumption as well. The commercialization of the indigenous chicken production appears to be related to the knowledge base of the farmer as evidenced by the strong links to the education levels.

### 3.3.7 Number of eggs per clutch

The number of eggs laid per clutch ranged between 8 and 26 with a mean of 14.78 (Table 2). This factor was statistically associated with the number of chicken reported by the producers ( $\tau_b = .231$ ,  $P = .015$  and  $G = .339$ ,  $P = .007$ ). Further cross tabulations showed that the number of eggs per clutch was correlated with

the number of chicks hatched per year ( $T_b = 0.389, P = .000$  and  $G = .560, P = .000$ ) and the access to information ( $T_b = .244, P = .011$  and  $G = .380, P = .001$ ). This observation underscores the significance of information literacy in chicken productivity. The number of eggs laid in one clutch by an individual bird has a bearing on its annual productivity; and as expected was related to the number that were eventually hatched. The association between the attribute and the level of access to technical information on indigenous chicken production suggests that there is a case for agricultural extension agents to step up information literacy on indigenous chicken production. This finding is consistent with the findings by author [16] which suggests a direct link between information literacy and the productivity of smallholder farmers' enterprises.

### 3.3.8 Access to information

The perceived ease of access to technical information was used as an indicator for information literacy. The indicator was significantly associated with the perceived ease of access to markets ( $T_b = .295, P = .002$  and  $G = .419, P = .002$ ). For small scale indigenous chicken producers this observation has implications as it suggests that farmers who are informed on best farm-practices tend to be equally informed on market intelligence aspects. Upgrading the value chain may call for efforts to raise information literacy for both farm-level best practices and market information.

### 3.3.9 Access to markets

The perceived access to markets was highly significantly linked to perceived profitability of indigenous chicken enterprise ( $T_b = .386, P = .000$ ) as captured in Table 3. When the datasets were further subjected to the Kruskals Gamma analysis, it revealed a highly significant correlation between the market access and profitability ( $G = .536, P = .000$ ). This observation implies that the producers who had the perception of ready access to markets made significantly better profits compared to those with a perception of weak access to markets. For the purposes of upgrading the indigenous chicken value chain, this observation suggests that the interventions should be targeted at availability of organized markets that reward each of the value chain players fairly. This finding supports the argument by [4] that access to quality markets is a challenge to indigenous chicken production systems in Kenya.

### 3.3.10 Profitability of indigenous chicken

The perceived profitability of the indigenous chicken enterprise was rated as medium to high by a majority of the participants (70.6%), suggesting that the indigenous chicken enterprise was widely viewed as profitable. Perceived profitability had significant association with land size ( $T_b = .182, P = .048$  and  $G = .246, P = .045$ ) and access to markets ( $T_b = .386, P = .000$  and  $G = .536, P = .000$ ). This attribute was not significantly related to flock size ( $P > 0.05$ ) suggesting that the scale of enterprise may not be a factor in its perceived profitability. Its linkage with land size, however, indicates that the scavenging nature of indigenous chicken requires large land area on which to forage for feed. This observation has implications for agricultural extension as it appears that interventions are required to improve on supplemental feeding through home-made rations as the land parcels get increasingly smaller with increasing human population.

## 4. CONCLUSION

This study established that there were links between some selected farmers' socio-economic attributes with the indigenous chicken productivity. Information access and perceived ease of market access was also associated with indigenous chicken productivity among the producers. There is evidence of great potential to improve on the indigenous chicken productivity in the western parts of Kenya, based on the observed huge productivity differences among the producers. The access to technical information on the Indigenous chicken value chain had a significant link to the productivity of the indigenous chicken at the farm level. The ease of access to markets, similarly, had a significant positive link with the profitability of the indigenous chicken at the farm level. It is recommended that interventions that are aimed at increasing information literacy and access to markets be initiated or up-scaled in order to increase the commercialization of the indigenous chicken enterprise in the region.

## ACKNOWLEDGEMENTS

We greatly appreciate the work done by the interviewers who volunteered to do the enumeration.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Ministry of Agriculture Livestock and Fisheries. National agricultural and rural inclusive growth project (NARIGP): Project implementation manual. State Department of Agriculture, Kenya; 2017.
2. King'ori AM, Wachira AM, Tuitoek JK. Indigenous chicken production in Kenya: A review. *International journal of poultry science*. 2010;9(4):309-316.
3. Omondi SO. Economic analysis of small-scale poultry production in Kenyan medium-sized cities of Kisumu and Thika. Paper presented at the 30<sup>th</sup> International conference of agricultural economists, July 28<sup>th</sup> to August 2<sup>nd</sup>, Vancouver; 2018.
4. Onono JO, Alarcon P, Karani M, Muinde P, Akoko JM, Maud C, Fevre EM, Hasler B, Rushton J. Identification of production challenges and benefits using value chain mapping of egg food systems in Nairobi, Kenya. *Agricultural systems*. 2017;159(2018):1-8.
5. Wong JT, de Bruyn J, Bagnol B, Grieve H, Li M, Pym R, Alders RG. Small-scale poultry and food security in resource-poor settings: A review. *Global Food Security*. 2017;15(2017):43-52.
6. Guèye EF. The role of networks in information dissemination to family poultry farmers. *World's Poultry Science Journal*. 2009;65(1):115-124. DOI:10.1017/S0043933909000099
7. Mississippi State University Extension. Importance of indigenous chickens to rural African communities. Publication Number: P3394; 2020.
8. Allam MA, Ali MS, Das NG, Rahman MM. Present status of rearing backyard poultry in selected areas of Mymensingh district. *Bangladesh Journal of Animal Science*. 2014;43(1):30-37.
9. County Government of Kakamega. County integrated development plan 2018-2022. County Government of Kakamega, Kenya; 2018.
10. County Government of Nandi. County integrated development plan 2018-2023. County Government of Nandi, Kenya; 2018.
11. Ipar BO, Otieno DJ, Nyikal RA, Makokha SN. The role of unregulated chicken marketing practices on the frequency of new castle disease outbreaks in Kenya. 6<sup>th</sup> African conference of Agricultural Economists, September Abuja, Nigeria. 2019;23-26.
12. Mengesha M. Biophysical and the socioeconomics of chicken production. *African Journal of Agricultural Research*. 2013;8(18):1828-1836. DOI:10.5897/AJAR11.1746).
13. Magothe TM, Okeno TO, Muhuyi WB, Kahi AK. Indigenous chicken in Kenya: Current status. *Worlds' poultry science journal*. 2012;68:119-132.
14. Islam MA, Nishibori M. Indigenous naked-neck chicken: A valuable genetic resource for Bangladesh. *World's Poultry Science Journal*. 2009;65(1):125-138. DOI: 10.1017/S0043933909000105
15. Mahoro J, Muasya TK, Mbuza F, Mbuthia J, Kahi AK. Farmers breeding practices and traits of economic importance for indigenous chicken in Rwanda. *Topical Animal health and production*. 2018;50(1):121-128. DOI:10.1007/S11250-017-1411-8
16. Sang NC, Cheruiyot JK. Farmers' information literacy and productivity performance of smallholder horticulture in a highland zone, Kenya. *Journal of Scientific Research and Reports*. 2020;26(6):89-99. Available:<https://doi.org/10.9734/jsrr/2020/v26i630274>
17. Shahjahan M, Bhuiyan A. Socio-economic condition and indigenous poultry production scenario in a selected cluster area of Bangladesh. *Asian-Australasian Journal of Bioscience and Biotechnology*. 2016;1(3):557-563.
18. GALVmed. Vaccines boost backyard poultry rearing in western Kenya. *WREN media*; 2018.
19. Ochieng J, Owuor G, Bebe BO. Determinants of adoption of management interventions in indigenous chicken production in Kenya. *AfJARE*. 2012;7(1):39-50.
20. Mtileni BJ, Muchadeyi FC, Maiwashe A, Chimoyo M, Mapiye C, Dzama K. Influence of socio economic factors on production constraints faced by indigenous chicken producers in South Africa. *Tropical animal health and production*. 2013;45(1):67-74. DOI: 10.1007/S11250-012-0175-4
21. Siyaya BJ, Masuku MB. Determinants of profitability of indigenous chickens in Swaziland. *Business and economic research*. 2013;3(2):205-217. DOI: 10.5296/ber.v3i2.4346

22. Henning J, Morton J, Pym R, Hlat, Meers J. Evaluation of strategies to improve village chicken production: Controlled field trials to assess effects of Newcastle disease vaccination and altered chick rearing in Myanmar. *Preventative veterinary medicine*. 2010;1(94):3-4. DOI: 10.1016/j.prevetmed.2009.04.007
23. Mugenda OM, Mugenda AG. *Research methods: Quantitative and qualitative approaches*. Nairobi Kenya ACTS press; 2010.
24. Singh YK, Bajpai RB. *Research methodology: Techniques and Trends*. New Delhi, APH Publishing Corporation; 2009.
25. Kothari CR. *Research methodology: Methods and techniques (2<sup>nd</sup> Ed.)*. New Delhi: New Age International (P) Limited Publishing; 2010.
26. Kumar R. *Research methodology: A step by step guide for beginners (5th ed.)*. New Delhi. SAGE; 2019.
27. Pennsylvania State University. *Design and analysis of clinical trials: Kendall's tau-b correlation coefficient*; 2021. Available: <https://online.stat.psu.edu/stat509/lesson/18/18.3>
28. Igweze AH, Agbedeyi OD. Robust method for testing the significance of bivariate correlation of ordinal data. *Mathematical theory and modelling*. 2015;4(11): 169-174.
29. Kenya Agricultural Research Institute. *Indigenous chicken farming: Training manual*. Technoserve (Kenya) & Kenya Agricultural Research Institute, Nairobi; 2012.

© 2021 Cheruiyot and Adhiaya; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>); which permits unrestricted use; distribution; and reproduction in any medium; provided the original work is properly cited.

*Peer-review history:*  
*The peer review history for this paper can be accessed here:*  
<http://www.sdiarticle4.com/review-history/67280>