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Full Length Research Paper

Economic analysis of indigenous chicken production: The case of smallholder farmers in Makueni and Kakamega Counties, Kenya

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Indigenous chicken (IC) play a crucial role in addressing food insecurity in rural households. Smallholder farmers rely on IC for income generation, asset accumulation and nutritional requirements. Indigenous chicken products (meat and eggs) are preferred for their good taste, leanness and the organic nature of production. Therefore, improving productivity of IC through rearing improved breeds would enhance commercialization. However, information on profit and determinants of profitability among smallholder farmers in Makueni and Kakamega counties, Kenya remained scanty. A total of 384 households were sampled using stratified random sampling procedure. Primary data was collected using a structured questionnaire. Secondary data was accessed from Makueni and Kakamega livestock offices. Gross margin analysis (GMA) and multiple regression econometric model was employed using STATA 13. Results of the profitability analysis, showed that investing in indigenous chicken production was profitable. However, rearing improved indigenous chicken (IIC) proved more profitable with an annual gross margin of Ksh. 14238 and Ksh. 9824 per 100 birds for IIC and IC, respectively. Flock size, farm size, group membership, access to credit and distance to the training centre significantly influenced profits. Policies should prioritize on formation of social groups to encourage collective action in IC production and marketing.

Keywords: Indigenous chicken, credit, ecotypes, group membership, flock size, profitability.

INTRODUCTION

Poultry subsector has been identified as an exit strategy towards poverty alleviation (RoK, 2010). According to Kyule *et al.,* (2014), poultry subsector boost the overall economic development in Kenya. Therefore, poultry production remain crucial livelihood activity among smallholder farmers who produce approximately 80% of the total national poultry production (RoK, 2010). Poultry products (eggs and meat) have been identified as the best source of cheap and quality protein especially for those suffering malnutrition in Sub-Saharan Africa (Adomako *et al.,* 2009; David, 2010). Other roles played by poultry production include; employment, income generation, asset accumulation, cultural practices (Das *et al.,* 2008; Moreki *et al.,* 2010;Okello *et al.,* 2010). The subsector is estimated to constitute 29 million birds in Kenya (RoK, 2010; FAO, 2011). Notably, the subsector produce 2000 Metric Tonnes (MT) and 1,255 million of meat and eggs per annum respectively (RoK, 2008).

Out of the total population of birds (29 million), indigenous chicken (*Gallus domesticus*) accounts for 70% (FAO, 2011 and Olwande *et al.,* 2012). About 90% of the smallholder farmers derive their livelihood from indigenous chicken (IC) production (King'ori *et al.,* 2010). Indigenous poultry production has been recognized as

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the dominant poultry production system and accounts for over 70% of rural households (RoK, 2008). Indigenous chicken products (meat and eggs) account for 47% and 55% of the total poultry eggs and meat, respectively (King'ori *et al.,* 2010). Most of the smallholder farmers have foregone rearing exotic breeds for indigenous chicken due to increased cost of inputs such as; feeds, medication and labor (Siyaya and Masuku, 2013; King'ori *et al.,* 2010 and RoK, 2010).

Over the decade, the demand for poultry products (meat and eggs) have been on the increase (RoK. 2010). The increased demand is attributed to consumer preference for white meat due to health consciousness (RoK, 2010). Moreover, the population pressure, growth of urban areas and increased per capita disposable income have triggered increased demand for poultry product (USAID, 2010). Consequently, consumers prefer the attributes of IC products (meat and egg) which include; leanness, tasty products and are recognized as organic products (WSPA, 2012). As revealed from the previous report, the country per capita poultry eggs and meat consumption is estimated at 36 and 0.65 kilograms respectively (RoK, 2010). These estimates are lower than the recommended consumption requirements by World Health Organization (WHO) on poultry product (RoK, 2010). Therefore, there exist unmet demand of the IC products in Kenya (WSPA, 2012). Most of the citizens have not met the recommended animal proteins requirement (FAO, 2011).

In both Makueni and Kakamega Counties, IC has been recognized as an avenue to improve livelihoods of the rural households by increasing productivity (RoK, 2015 and USAID, 2010). Scientists, researchers and other poultry production stakeholders such as; KAPAP, KALRO and TechnoServe have pursued a vital role in improving the IC production through dissemination of improved indigenous chicks to the smallholder farmers in Kenya aiming at increased productivity (KAPAP, 2012). Improved indigenous chicken is a superior crossbreed of different IC ecotypes from the various selected Kenyan localities and widely known as KARI-Kienyeji. It was developed through the joint initiative of the Ministry of Livestock and Development and the Kenya Agricultural Institute (KARI), currently known as Kenya Agricultural and Livestock Research Organization (KALRO) to serve a dual purpose (meat and eggs). Additionally, the improved IC is characterized by the ability to; produce more eggs and meat compared to the typical indigenous chicken, to mature faster and to reach the market size earlier. (KARI, 2011). The strategy aims to transform IC industry into a profitable, commercially oriented and internationally and regionally competitive economic activity (RoK 2010). The strategy is therefore in line with the stipulated government strategy of the social and economic pillar of Kenya Vision 2030 and the agricultural sector development (ASD). However, information on profitability of improved indigenous chicken and socioeconomic factors influencing profitability among the smallholder IC farmers in both counties remained scanty. Therefore, this study aimed at filling this gap and contribute positively to the body of knowledge. It is anticipated that results from this study will be beneficial to the stakeholders involved in disseminating the improved IC and enabling them to evaluate their achievements on the expected goals. To the smallholder farmers, the results would help them in decision making on adoption of improved IC, as they aim to improve and expand on their stocks.

MATERIALS AND METHODS

Study area

Makueni County is located in Southern part of Eastern Kenya. It lies between Latitude 1°35′, South and Longitude 37°10′ East and 38°30′ East. This county covers an area of 8008.8 km^2. Temperature in Makueni county range at 12 ºC - 28 ºC and bimodal rainfall range at 150-650 mm per annum, which is typical of ASALs in Kenya (RoK, 2010). Low rainfall and high temperatures in this county hinder crop production thus livestock production remains a priority. On the other hand, Kakamega county is located in Western Kenya and lies between Latitudes 07'30' North and Longitudes $34^0$32'. It covers a total area of 1394.8 km^2. The annual rainfall ranges between 1250 – 1750mm (RoK, 2010).

There was a rapid dissemination of improved indigenous chicken as one of the major component of improved poultry production technologies by the various stakeholders such as; KAPAP, KALRO and Technoserve in the two counties which are known to be main producers of indigenous chicken (Muthee, 2009 and KARI, 2011). Consequently, the two counties are located in areas that have favorable agro-ecological conditions that are required for the production of IC and are listed as leading areas in IC production (MoLD, 2011).

Sampling procedure and Data Collection

A multi-stage sampling procedure was used for the study. The first stage used purposive sampling of Kakamega and Makueni Counties which have large population of small-scale farmers practicing IC production. The two counties had rapid dissemination of the improved poultry production technologies. The second stage used stratified random sampling to select regions within the sub-counties located in Kakamega and Makueni Counties. The random stratified sampling was preferred since it was able to reduce the biases associated with sampling. This ensured that there was no over presentation or under presentation of the smallholder farmers in the different strata. Subsequently the researcher randomly picked Lugari, Shinyalu and Lurambi districts from Kakamega County. Furthermore, the researchers randomly sampled Makueni and Kaiti from Makueni County. The total sample of 384 households includes adopters and non-adopters of improved indigenous chicken from Kakamega and Makueni County. Data was collected from the selected households using a structured questionnaire. Further,

secondary data was accessed from the county agricultural offices located in Kakamega and Makueni.

Data Analysis & Model Specification

A gross margin (GM) analysis was used to compute profits between the adopters and non-adopters of improved indigenous chicken. The gross margin approach has been used in various studies (Sumy *et al.,* 2010; Kumar *et al.,* 2013; Etuah *et al.,* 2013). It was determined by the following calculation;

Total Cost (TC) = TFC + TVC ……. (*1)*

TR = Total sales from(IC + Eggs)…… (2)

Gross Margin (GM) = Total Revenue (TR) – Total Variable Cost (TVC)… *(3)*

Net Profit (π) = Gross Margin (GM) – Total Fixed Cost (TFC) ……..… *(4)*

The total variable costs used to compute the margins included: cost of day old chicks, feed cost, labor cost, fuel cost, and medication and vaccination costs. On the other hand, total fixed costs included; housing and equipment costs. Depreciation costs on housing and equipment was used to compute the net profit. Consequently, the total revenue was derived from sale of indigenous chicken and eggs.

A multiple linear regression (MLR) analysis was used to determine the socio-economic factors that influenced profitability of IC among the smallholder farmers in both counties. The model has been used in previous studies (Ayieko *et al.,* 2013; Siyaya and Masuku, 2013). Therefore, the exponential logarithmic functional model was specified as;

$LnY = \beta_0 + \beta_i X_i + \ldots\ldots\ldots\ldots\ldots B_j X_j + \mu_i \ldots\ldots\ldots\ldots$ (5)

$LnY = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \ldots\ldots\ldots$
$\beta_{13} X_{13} + \mu_i \ldots\ldots\ldots$ (6)

Where Ln Y = Natural logarithm of profit; β_0 = intercept term ;($X_1 - X_{13}$) represented the independent variables while (β_1-β_{13}) represented the coefficients of ($X_1 - X_{13}$) respectively. The coefficients were computed by the percentage change in Y as a result of percentage change in X. Subsequently, μ_i represented the disturbance term which catered for the unobserved random effects. The model errors in this study were assumed to be independent, normally distributed {N (0, σ^2)} and conditional on X*i.*

RESULTS AND DISCUSSION

Descriptive statistics

Table 1 presents the socio-economic characteristics of the surveyed households. Descriptive statistics such as mean and percentages were used to achieve a clear phenomenon of the sampled households.

The survey results revealed that approximately 60% of the sampled households had adopted the improved indigenous chicken (IIC). The mean age of the household head was 47.45 years. Out of the sampled households, 72.66% were headed by male (Table 1). Results revealed that majority (46.09%) had attained secondary education and worth noting that a good proportion of respondents had accessed formal education (Table 1). The average household size of the sampled households was 7 members whereas farm size owned by the majority ranged from 1-3 acres. The average mean of the flock size was 81 chickens. On the other hand, majority of the respondents participated in social groups which included farmers group and common interest group (CIG). Chicken production and marketing were the main activities of these groups. Farmers in the study area accessed information on indigenous chicken from the extension officers, radios, mobile phones and through internet access. Majority (85.67%) of the sampled households had been trained on poultry production. Results also revealed that 31.51% of the sampled households had access to credit whereas 45.57% of the sampled households generated incomes from other off farm activities estimated at an average of Ksh. 16, 257 per month (Table 1). However, only 46% of the farmers had access to credit for both counties whereas majority (96%) were aware of the improved indigenous chicken (1).

The results in 2 show the main components of production costs and gross profit for a flock size of 100 birds for both ecotypes. The major components of production cost included; cost of day old chicks, feed cost, labor cost, fuel cost, medication cost and depreciation cost on housing and equipment.

The results revealed that the total cost of production was Ksh. 94100 for IIC and Ksh. 76903 for LIC, respectively (Table 2). Variable cost constituted the highest proportion of 74.50% for IIC and 70.70% for LIC of the total cost (Table 2).

Feed cost comprised the highest percentage of the total variable cost at 46% and 50% for IIC and LIC, respectively (Table 2). Majority of the farmers sourced ingredients from the nearby shops and local farm produces such as; grains, sorghum & sunflower and carried out feed formulation both as a group and as at the farm level. The findings concur with those of Ayieko *et al.,* (2014); Siyaya & Masaku, 2013; Kumar *et al.,* (2013) whose results revealed that feed cost constituted the highest proportion thus resulting to reduction in gross profit.

Labor cost for the production of IIC constituted 11% as compared to 6% for the LIC of the total variable cost (Table 2). This cost was computed based on man hour's basis. However, findings on labor for both enterprises contradict those of Menge *et al.,* (2005) whose findings revealed higher proportion of labor cost at an average of 31% of the total variable cost. Additionally, results from the study by Sumy *et al.,* (2010) reported a higher proportion of 24% of the total variable cost on profitability

of backyard chicken in Pabna District, Bangladesh.

Medication cost for the IIC was 14% of the total variable cost while that of LIC was 14% (Table 2). The proportion on medication cost for the study is in line with Ayieko *et al*., (2014) whose findings revealed that medication cost constituted 15% of the total variable cost in determining the profitability of IC producers in Makueni County constituted 15% of the total variable cost. However, results by Kumar *et al.,* (2013) revealed lower percentage on medication cost which constituted 2% of the total variable costs in production performance of indigenous chicken in Rajshahi, Bangladesh.

Table 1. Distribution of adopters and non-adopters of improved indigenous chicken in both Kakamega and Makueni counties.

Variable	Pooled(N=384)		Adopters(N=231)		Non-adopters(153)	
	Mean	Std.Err	Mean	Std. Err.	Mean	Std. Err
Age (years)	47.45	0.57	47.78	0.71	46.94	0.97
Sex of household head(Male = 0, Female = 1)	0.27	0.02	0.23	0.03	0.33	0.04
Level of education (0= Never gone school, 1=primary 2= secondary, 3=tertiary, 4=university)	2.04	0.04	2.12	0.06	1.91	0.07
Household size (No. of active family members)	7	0.04	2.75	0.06	2.69	0.07
Size of the farm (Acres)	2.34	0.05	2.35	0.06	2.32	0.07
Flock size (Number of birds/households)	81.60	4.33	91.74	6.06	66.30	5.68
Social group membership (0= No, 1= Yes)	0.82	0.02	0.91	0.02	0.68	0.04
Training on poultry production (0= No, 1= Yes)	0.86	0.02	0.94	0.02	0.74	0.04
Number of times trained (Number)	2.89	0.09	3.16	0.10	2.48	0.16
Distance to the center (Kilometers)	1.96	0.07	2.27	0.08	1.49	0.10
Access to credit(0= No, 1= Yes)	0.32	0.02	0.39	0.03	0.20	0.03
Off-farm activities(0= No, 1= Yes)	0.46	0.03	0.49	0.032	0.41	0.04
Awareness on IIC(0= No, 1= Yes)	0.96	0.01	0.99	0.00	0.92	0.02

Source; Survey Data, (2015)(N=384).

Table 2. Comparison on profitability of the improved indigenous chicken (IIC) and local Indigenous Chicken (LIC).

Variable	Improved Indigenous Chicken	Local Indigenous Chicken
	Cost (Kenya shillings)	Cost (Kenya shillings)
Day old chick (100 chicks)	10000	10000
Feed cost	31952	27098
Labor cost	7520	3247
Fuel cost	9832	6476
Medication cost	10797	7553
Total variable cost	**70101**	**54374**
Housing cost	18227	17785
Depreciation Housing cost (10%)	1823	1779
Equipment cost	3590	2695
Depreciation Equipment cost (10%)	359	270
Total fixed cost	**23999**	**22529**
Total cost (TFC+TVC)	**94100**	**76903**
Sale of chicken	63839	50098
Sale of eggs	20500	14100
Gross income	**84339**	**64198**
Less: Total Variable Cost	(70101)	(54374)
Gross margin(GI – TVC)	**14238**	**9824**
Less: Total Fixed Cost	**(2182)**	**(2049)**
Net Profit	**12056**	**7775**

Source: Own Computation, Field Survey (2015).

The cost of the day old chick constituted 15% of the total variable costs for IIC while that of LIC was 18% for the local indigenous chicken. Fuel cost showed a proportion of 14% for IIC and 12% for LIC of the total variable cost. Sumy *et al.,* (2010) findings reported that the cost of day old chick constituted 11% of the total variable cost. The percentage composition on the day old chick contradicts those of Kumar *et al.,* (2013) whose findings was higher

at 41% of the TVC in production performance of the indigenous chicken in Bangladesh. On the other hand, fixed costs comprised of; housing cost, depreciation of the housing (10% of the housing cost), equipment costs and depreciation cost of the equipment (10% of the total cost of equipment). Depreciation costs for equipment constituted the least proportion of the total cost for both ecotypes as shown in Table 2. Previous studies revealed lower proportion of depreciation costs for both housing and equipment costs of the total costs. Depreciation costs for both housing and equipment were considered in calculation of the net profit in production of indigenous chicken (Ayieko *et al*., 2014; Kumar *et al*., 2013 &Sumy *et al.,* 2010).

Table 3. Factors affecting profitability among IC producers in Makueni and Kakamega Counties.

Profit1	Coef.	Std. Err.	T	P>t
Age of the respondent	-0.0068	0.0049	-1.39	0.166
Gender of household head	-0.1740	0.1165	-1.49	0.136
Level of education	0.0680	0.0626	1.09	0.278
Household size	-0.0270	0.0614	-0.44	0.661
Size of the farm	-0.1014	0.0606	-1.67	0.095*
Flock size	0.0043	0.0006	7.1	0.000***
Group membership	0.3694	0.1660	2.23	0.027**
Training on poultry production	0.2796	0.2464	1.13	0.257
Number of times trained	0.0214	0.0390	0.55	0.583
Distance to the training centre	-0.1655	0.0521	-3.18	0.002***
Access to credit	0.3230	0.1157	2.79	0.006***
Other off-farm activities	0.1048	0.1067	0.98	0.326
Awareness on IIC	-0.0915	0.2694	-0.34	0.734
_cons	10.2618	0.3922	26.17	0.000

Source: *Data Survey (2015)*; **** significant at 1%, ** significant at 5%, * significant at 10 %;(N= 384).*

The results in Table 2 revealed venturing in indigenous chicken enterprise was profitable for both ecotypes with gross income of Ksh. 14238 and Ksh. 9824 for IIC and LIC respectively. However, results revealed that rearing improved indigenous chicken was more profitable compared to the local indigenous chicken. As shown in Table 2, the average profit per bird was Ksh. 121 and Ksh. 78 for IIC and LIC respectively. The differences in net profits may be attributed to smaller flock size and low productivity for the local indigenous chicken farmers. However, various studies revealed that rearing of indigenous chicken was a profitable venture (Aboki *et al*., 2013; Adomako *et al*., 2010; Ayieko *et al*., 2014; Bwalya and Kalinda, 2014; Kumar *et al*., 2013; Kyule *et al.,* 2014; Hosen, 2010; Siyaya and Masuku, 2013 & Sumy *et al*., 2010).

Table 3 presents the socio-economic characteristics that influenced profitability among smallholder farmers in Makueni County. There were 5 independent variables that were found significant to influence profitability. These included; size of the farm, flock size, group membership, access to credit and distance to the training centre.

The results in Table 3 revealed that size of the farm had a negative significant effect on profitability of indigenous chicken. It was statistically significant at 10% (P< 0.10) level of significance (Table 3). The coefficient showed that if farm size increased by one unit (acre) while holding other variables constant, profitability decreased by 10.14%. The findings contradict those of Etuah *et al.,* (2013) where farm size had a positive and significant effect on profitability of broiler production in Ashanti region of Ghana.

The flock size had a positive and significant effect on the profitability of IC production. It was statistically significant at 1 %(P< 0.01) level of significance (Table 3). The coefficient showed that an increase of flock size by one unit while holding other variables constant increased profit by 0.43%. This may suggest that the higher the number of indigenous chicken kept by the farmer, the more IC available to sell. The finding are in line with Siyaya and Masuku (2013) where the flock size had a positive and significant effect on profitability of indigenous chicken in Swaziland.

The farmer group membership had a positive and significant effect on profitability of IC. It was statistically significant at 5% (P< 0.05) level of significance (Table 3). This indicated that being a member of a farmer increased profit by 36.94%, while holding other variables constant. This implies that information related to production and marketing was discussed and disseminated during the farmers meetings. Moreover, farmers achieved economies of scale through collective action. Therefore, the households develop a good social and economic network. The findings confirms those of Yang and Liu

(2012) where group membership among farmers in China had a positive and significant effect on returns.

The distance to the training center had a negative and significant effect on profitability of IC production. It was statistically significant at 5% (P< 0.05) level of significance (Table 3). The coefficient indicated that an increase in distance to the training center by one unit (kilometer) decreased profit by 16.55%, while holding other variables constant. This implies that farmers who got trained on IC production incurred high costs on transport among other opportunity costs hence, reducing returns. Previous studies have recommended for minimization of variable cost in order to increase profitability (Islam *et al.,* 2016; Bwalya & Kalinda, 2014; Hosen, 2010).

The results also revealed that access to credit had a positive and significant effect on profit. It was significant at 5% (P< 0.05) level of significance. The coefficient indicated that the household which had access to credit increased profit of IC by 32.3%, while holding other variables at ceteris paribus (Table 3). This depicts that farmers who had access to credit were able to purchase the required inputs such as day old chicks (DOC), feeds, labor, vaccinations etc. during the period of IC production. This results are consistent with those of Ayieko *et al.,* (2014) which revealed that access to credit led to higher profits among the IC producers in Makueni County, Kenya.

CONCLUSION AND POLICY RECOMMENDATION

The results of the gross margin analysis showed that investing on indigenous chicken was profitable for both ecotypes. Rearing improved indigenous chicken proved more profitable with annual gross margins of Ksh. 14238 and Ksh. 9824 per 100 birds for IIC and IC, respectively. On the other hand, flock size, group membership, access to credit and distance to the training center had a positive and significant effect on profit. However, farm size had a negative influence on profitability. Policymakers should prioritize on formation of social groups among the smallholder IC farmers. This would encourage collective action for both IC production and marketing leading them to achieve economies of scale. Farmer associations will reduce production costs specifically on the total variable costs which constitute the highest proportion of the total cost. This can be realized when farmers join efforts by formulating their own feeds. Moreover, purchasing feeds in wholesale which will benefit with arrays of discounts attained while purchasing feeds.

CONFLICT OF INTEREST STATEMENT

The authors whose names are listed in the authors list certify that they have no affiliations with or involvement in any organization or entity in the subject matter or materials discussed in this manuscript. Therefore, we declare that we have no competing interests.

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