Pattern of Management Interventions' Adoption and their Effect on Productivity of Indigenous Chicken in Kenya

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Abstract

Despite intensive dissemination of management intervention package, there is low productivity and commercialization of indigenous chicken (*Gallus domesticus*) in Africa. The management intervention package comprises feed supplementation, housing, chick rearing, brooding and vaccination. Smallholder farmers often regard these management interventions as costly, risky, unprofitable, and inaccessible and that they require high technical knowledge. This paper emphasizes the role of management intervention package in productivity of smallholder indigenous chicken farmers. Principal Component Analysis combined with Cluster analysis was used to determine three homogenous groups adopting management interventions. The three groups are; feed supplementation and vaccination adopters, feed supplementation and brooding adopters and Full management intervention package adopters. The effect of these adopted management interventions was then analyzed using log linear regression model which takes the form of Cobb-Douglas production function. The results indicated that farmers who had adopted full management intervention package as recommended by extension had higher productive performance than farmers who modified and selectively adopted components of management intervention package. Other socio-economic factors that significantly influenced productivity were farm production assets, expenditure on feeds, labour, access to extension, group membership and female gender. The study recommends the formulation and implementation of pro-poor policies aimed at improving socio-economic conditions of the smallholders to enable them fully adopt the recommended management intervention package. This would increase productivity of indigenous chicken thereby improving food and income security in rural areas of Africa.

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1.0 Introduction

In most developing countries indigenous chicken is kept by households using family labour and occasionally use commercially and locally available feed resources. They are usually kept under scavenging production systems often with very limited application of management interventions to improve flock productivity. Indigenous Chicken (IC) is of great importance to smallholder farmers in Kenya but they face the challenge of improving productivity of their flock that could benefit them by increasing financial and food security.

This challenge is particularly great in Western Kenya where majority (80%) of the rural households keep indigenous chicken. Here, indigenous chicken production is characterized by low levels of inputs and outputs (Okitoi *et al*, 2007), with low productivity levels which limits their potential for commercialization. The indigenous chickens are of low commercial exploitation compared to the industrial hybrid poultry because of low productivity. Many farmers in Africa have always ignored the growing preference for meat and eggs from indigenous chicken for their tasty, safety and nutritious qualities. However, consumers are increasingly shifting their preference towards traditionally produced animal products (Upton, 2000) which often fetch premium prices relative to the industrial hybrid chicken.

IC enterprise is common among poor rural households as it is better adapted to production circumstances of scavenging systems characterized by continuous exposure to disease incidence,

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inadequate quantity and quality feeding, poor housing and health care (Guèye, 1998). To achieve increased productivity of IC, extension service has continuously disseminated management intervention package to smallholders for mitigating these constraints. However, majority of smallholder farmers with flock size averaging 10 to 50 chickens hardly realize improved productivity, which could be explained by manner in which they adopt disseminated management intervention package. The management intervention package designed to improve productivity of indigenous chicken includes housing, feed supplementation, vaccination, brooding, and chick rearing (Njue *et al,* 2006). Farmers often regard these management interventions as costly, risky, labour intensive, unprofitable, inaccessible and require high technical knowledge Proper adoption of the management intervention package should improve productivity and enhance commercialization of the indigenous chicken flocks. This paper therefore, intends to give insights on the effect of management intervention package on productivity of IC in Western Kenya.

2.0 Research Methodology

2.1 Study Area.

The survey covered Rongo and Homabay districts, South Nyanza, Western Kenya. The districts are within the Lake Victoria basin and about 54% of the households live below the poverty level (RoK 2005). The study area was chosen because most of the households predominantly keep indigenous chicken as source of food and income and management interventions had been disseminated to the smallholder farmers to enhance productivity levels as a process towards greater commercialization. The national extension services and NGOs have for a long time

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targeted the two districts for dissemination of management intervention package designed to improve productivity of chicken flocks (Okitoi et al 2007).

2.2 Data Collection Approach

Smallholder farmers keeping indigenous chicken in Rongo and Homabay districts was the target population. The study applied stratified random sampling by population density and market prominence, based on local expert knowledge to obtain the sample farmers. In each district, two divisions were selected with one representing low Indigenous chicken population density and low markets while the other division represented high Indigenous chicken population density and high markets. The sampling frame was obtained from the list of farmers provided by Kenya Poultry Farmers Association (KEPOFA) and Poultry Farmers Associations in the two districts. Application of simple random sampling yielded 30 farmers from each of the four divisions giving a total of 120 respondents.

The study employed farm household's survey using structured interview schedule and focus group discussions. The data collected included household socio-economic characteristics, management interventions adopted, access to extension services and credit facilities, distance to major market outlet, sources of household income, costs and revenues realized from Indigenous chicken flock during 2008 production year.

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2.2 Econometric Models

A combined approach of Principal Component Analysis (PCA) and Cluster Analysis (CA) was first employed to determine homogenous groups of famers adopting different management interventions package. Applying the PCA for management intervention and then their attributes separately yielded new variables (PCs), which were then combined in a Cluster Analysis to obtain homogenous groups of farmers defined by their adoption patterns for management interventions and preference for the attributes of those management interventions. PCA is a statistical method for exploring unknown trends in the data and simplification of the description of a set of interrelated variables by reduction of data dimensionality while Cluster Analysis attempts to identify relatively homogeneous groups of cases based on selected characteristics, using an algorithm that starts with each case in a separate cluster and combines clusters until only one is left. The cluster analysis using automatic cluster criterion yielded three clusters that had a small Schwarz Bayesian Criterion Information (BIC) value and a small change in BIC between adjacent numbers of clusters. The derived clusters forms relatively homogeneous groups based on adopted management interventions and their attributes, within which productivity of indigenous chicken were then computed. The log linear regression model was then used to evaluate the effect of adopted management intervention package on indigenous chicken productive performance. The regression model takes the log specification because not all the explanatory variables (X_i) are linearly related to value of output (Y_1) and parameters estimates can be interpreted as elasticities. It takes the form of flexible Cobb Douglas Production function. Log linear regression model is a transformed model and assumes that there exist a linear relationship between log dependent variable and log explanatory variable. This transformation

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into logs allows estimation by traditional OLS procedure where LnY_i is a linear function of logs of regressors, logs of X's (Gujarati 2003).

$$LnY_1 = \propto_0 + \propto_1 lnX_1 + \propto_2 lnX_2 + \propto_3 lnX_3 + \propto_4 lnX_4 + \propto_5 lnX_5 + \propto_i D_i + \propto_c D_c + \propto_g D_g + \propto_{gr} D_{gr} + \propto_e D_e + \varepsilon$$

Where: Ln-Natural logarithm, α_0 –constant term, α_1 –α_5 and α_r ,α_i- parameters to be estimated, Y-Value of output for the year 2008 which comprised of value of chicken sold, consumed at household, eggs sold, eggs consumed, given as gifts and value of chicken on farm. X_1-Labour, X_2-Expenses on feed, X_3-Value of production assets (Capital Expenditure), X_4 –Age of the farmer, X_5 – Flock size, D_i- Logical variable for the adopted components of management interventions (1, 2 and 3) obtained from PCA followed by Cluster Analysis (Ochieng *et al,* 2010) and D_c, D_g, D_{gr}, D_e– Dummy variable for credit access, group membership, female gender and extension services respectively and ε – Error term (ε independently, normally distributed with zero mean and constant variance- ($V_i \sim N(0, \delta^2)$). The tests were done to determine whether explanatory variables were correlated based on Variance Inflation Factor (VIF) or tolerance of variables (TOV) (Gujarati, 2003; Greene, 2003).

3.0 Results and Discussion

From PCA, two PCs grouping from management interventions and three PCs grouping from the attributes of management interventions were derived and further subjected to Cluster Analysis, generated three homogenous groups of farmers. These three groupings contain most of the variation relevant to characterization of smallholder indigenous chicken farmers in terms of adoption of management interventions and their associated attributes per farmers' preference Corresponding Author: jastopheli@yahoo.com

rating. Table 1 shows the results from PCA and CA which yielded three homogenous groups namely;

Table 1: Percentage Means of Management Interventions and Attributes of Smallholders

	Full package adopters **(1)**	Feed supplementation and vaccination adopters **(2)**	Feed supplementation and brooding adopters **(3)**	Overall sample
Households (n)	29	38	53	120
Proportion (%)	24.2	31.7	44.2	100
Management Interventions				
Feed Supplementation (%)	100	100	96.2	98.3
Vaccination (%)	96.6	72.5	43.4	72.5
Housing (%)	86.2	10.5	3.8	25.8
Brooding (%)	89.7	2.6	94.3	64.2
Chicken rearing (%)	93.3	44.7	11.3	41.7
Attributes of interventions				
Costly (%)	86.2	68.4	62.3	70.0
Risky (%)	44.8	34.2	43.4	40.8
Profitable (%)	89.7	68.4	94.3	85.0
Labor intensive (%)	37.9	21.1	28.3	28.3
Accessible (%)	100	89.5	88.7	91.7
Require high technical knowledge (%)	89.7	92.1	67.9	80.8

Source: Survey Results

Considering the characteristics and the manner in which this group of farmers adopted management interventions disseminated by extension service, the first cluster was considered to be **full management interventions package adopters**. In the sampled farmers, they were fewer (24.2%) than those who selectively adopted management interventions (76%) to suit their production circumstances.

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The second cluster of farmers was 31.7%, characterized by adoption of feeding supplementation (100%) and vaccination (72.5%) against NCD. Of less important to them were risky (34.2%) and labour intensive (21.1%) attributes of interventions. These farmers provided feed supplements and vaccinated the chicken so as to improve growth and reduce high mortality from deadly NCD. NCD vaccination increase survival rates dramatically but a major constraint is that farmers have to repeat it at regular intervals, which discourage farmers from adopting it (Udo *et al.,* 2005, Nahamya *et al.,* 2006). This group of farmers was called **feed supplementation and vaccination adopters.**

The third cluster of farmers was the largest with 44.2% of farmers who were prominent in adopting feeding supplementation (96.2%) and brooding (94.3%). These farmers were risk averse and selectively adopted management interventions that were less risky (43.4%) or not labour intensive (28.3%) but profitable (94.3%), accessible (88.7%) and require high technical skills (67.9%) for application. This group of farmers was called **feed supplementation and brooding adopters**. Pousga *et al.* (2007) demonstrated that feed supplementation can lead to better performance and therefore, farmer's generally adopted it. The brooding activities included selection of eggs for brooding, controlling broodiness, preparing brooders and ensuring hatching of eggs. A study by Batz *et al.,* (1999) indicated that technology characteristics influence the rate and speed of adoption. Farmers evaluate management interventions available and compare with their traditional alternatives. These farmers were risk averse and selectively adopted management interventions that were less risky but profitable and required less technical skills. Farmers will not make choices exposing them to unacceptable chance of loss even if the choice has a higher

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payoff. Studies in Uganda also reported lower profitability among non-vaccinated chicken than vaccinated ones (Nahamya *et al., 2006*).

In the log linear regression models both dependent and independent variables have been transformed into logs thus OLS estimation procedure is appropriate. The assumption is that there exist a linear relationship between log of dependent variable and independent variables. Socio-economic characteristics were included in the model on assumption that they influence indigenous chicken productive performance. The estimated coefficients of value of production assets, cost of feed, labour, credit, flock size, group membership, gender and adopted management interventions were positive while for age was negative.

Table 2: Multiple Regression Estimates for Determinants of Chicken Productivity

Parameters **Dep: ln Value of output (Kshs)**	**Std** **Coefficient**	**Std Error**	**t-value**
Constant	2.59	2.29	1.13
Female gender (0,1)	0.508	0.300	1.69**
Age (Years)	-0.567	0.418	-1.36
Group membership (0,1)	0.714	0.309	2.31***
Access to extension (0,1)	0.439	0.264	1.66**
Access to credit (0,1)	0.0086	0.252	0.03
Flock size (#)	0.0652	0.203	0.32
Value of feeds (Kshs)	0.299	0.134	2.24***
Labour (Kshs)	0.344	0.206	1.67**
Production Assets (Kshs)	0.177	0.0993	1.78**
Adopted Interventions (1-3)[1]	0.177	0.151	2.50***
R-Squared	0.48		
Model test (F(10, 92))	8.41***		
Variance Inflation Factor (VIF)	1.44		
Number of Observations (n)	103		

Notes: [1]-Dummy for adopted management interventions (1= Feeding supplementation and Brooding, 2=Feed supplementation and Vaccination 3= Full Management Intervention Package)
The signs **, *** indicate significance at 10% and 5% respectively.

Source: Survey Results

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The coefficient for production assets was 0.177 and significant at 10% level of significance, an indication that assets such as chicken house, feed troughs, water troughs and brooders were very important for production of indigenous chicken. Hence, farmers with relatively higher number of these assets had higher productivity compared to farmers with few assets. Chicken production assets are used to protect flock from bad weather, reduce disease infestation, watering and feeding, all for improved productivity.

The coefficient of value of feed (0.299) was positive and significant at 5% indicating that 1% increase in feed input resulted in 29.8% increase in value of output. This means that feeding supplementation was an important contributor to chicken productivity because of protein and energy requirements for egg and meat production. Limited resource feed restricts the potential productivity of indigenous chicken (Mekonnen, 2007). According to Sonaiya 2000, energy is the first limiting nutrient as feed available as it contains a lot of crude fiber. This may be reason why energy supplements may increase production of indigenous chicken significantly. Therefore, income from indigenous chicken can be increased by improving the feed quantity and quality.

Labour contributed positively to chicken productivity since its coefficient was 0.344 and statistically significant at 10%. Labour activities involved giving feeds, repairing chicken production assets, cleaning chicken house, preparing brooders and ensuring that all the flock goes back to their house in the evening.

The group membership (0.714) was positive and highly significant at 5% levels, indicating that there was a significant difference in indigenous chicken productivity between group and non-group members. The difference can be attributed to easy access to credit, extension, training and

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group based vaccination by farmers in groups. Groups can also be entry points for New Castle (NCD) control programmes. Ndegwa, *et al,* 2000 found groups to be very effective especially in pooling external inputs and disseminating information.

The coefficient of female gender was positive and highly significant at 10% level, indicating that there was significant difference between female and male farmers. The female dominated enterprises had higher productivity than male. This may be because more women (75.8%) were involved in indigenous chicken production and they stay more at home caring for indigenous chicken (Ochieng *et al*, 2010). The implication is that women generate more income from indigenous chicken than men. Thus strategies for improving indigenous chicken productivity should consider women as the entry point. Alubi and Aruna (2006) reported similar findings on productivity of chicken among women headed households. The findings are further affirmed by a study in Siaya and Vihiga districts (Okitoi *et al,* 2007).

The estimated coefficient of adopted components of management intervention package was positive and highly significant, indicating that there was a significant difference in indigenous chicken productivity between farmers selectively adopting components of management interventions package and full package adopters. The smallholder farmers intensifying their production by using full package had higher productivity. The value of output increases as farmers increased adoption of components of management intervention package to full package comprising feeding supplementation, poultry house, vaccination, brooding and chick rearing. A study in Nigeria by Alabi and Aruna, (2006) found that productivity increases as innovations related to improved management are adopted into the production system. About 98% of farmers

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were giving feeding supplements, with few able to vaccinate and build chicken house for their flock. The differences can also be attributed to access to veterinary services and general improved management of the flock among full package adopters.

Intensification of indigenous chicken production require large amount of inputs making many farmers to shy away from adopting management interventions as a package. However, efficient use of management interventions with limited wastage of resources would lead to higher productivity of indigenous chicken. KARI, (2006) also reported that indigenous chicken was profitable if managed well and controlling of common diseases improves survival rate of chicks by at least 30% while improved feeding, housing and disease control increases survival rate up to 80%.

The estimated coefficient of farmer's age was negative (-0.567) but statistically insignificant. However, this shows that productivity declines with increase in farmer's age. This time round, conventional assumption that age has a significant positive impact on chicken productivity due to increase in experience therefore does not hold in this study. In the study area, few younger farmers who adopted the management interventions package realized higher productive performance. The coefficient of extension services (0.439) was positive and statistically significant which indicates that there was high productivity among farmers who had access to extension services. Inability to access extension services is an indication of unstable government policies (Adebayo *et al,* 2005). Accessibility to extension service significantly improves free range indigenous chicken production systems (Farooq *et al*, 2000).

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The results on credit were positive but insignificant. Nonetheless, it indicates that access to credit plays an important role in improving indigenous chicken productivity. The fungibility of credit allows the borrowers to meet array of needs ranging from medical, school fees, food and social emergencies like funerals, accidents to inputs purchases.

The mean variance inflation factor (VIF) was used to test for multicollinearity in explanatory variables. The mean VIF of 1.44 was below the acceptable range of 10 VIF (Gujarati, 2003). The F-test of 8.41 was significant at 95% confidence interval with 10, 92 degrees of freedom, further implying that management intervention package significantly influenced productivity. Thus there exists a significant difference in indigenous chicken productivity between farmers using full package and those using some components of management intervention package.

4.0 Conclusion and Recommendations

Only a few (24%) farmers were able to adopt the full management interventions package as recommended by extension service while majority (76%) modified and selectively adopted components of management intervention package. Adoption of full management intervention package has higher influence on productivity of indigenous chicken. Farmers who had adopted fully management intervention package had higher productivity than farmers who modified and selectively adopted components of management intervention package. Besides, key determinants of indigenous chicken productivity include available production assets, expenditure on feeds (local and commercial feeds), labour input, access to credit facilities and extension services, group membership and management interventions adopted. Therefore, rural farm households should adopt management intervention package as recommended by the extension service to

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increase productivity thereby improving financial and food security in rural areas. The policy makers and stakeholders in this industry should design a programs aimed at increasing access to inputs, encourage formation and farmers participation in self help groups, awareness campaigns through extension and provision of credit targeting improvement of productivity of Indigenous chicken flock of smallholder farmers.

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