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Research Application Summary

Economic analysis of Consumer demand for indigenous chicken eggs in Kenya

Ndenga, C.,[1*] Kabuage, L. W.[2] & Bett, E. K.[1]

[1]Department of Agribusiness Management and Trade, Kenyatta University, P.O Box 43844-0100, Nairobi, Kenya
[2]Department of Agricultural Sciences and Technology, Kenyatta University, P.O Box 43844 0100, Nairobi, Kenya
***Corresponding Author:** charlesndenga@yahoo.com

Abstract

The World Health Organization recommends a daily protein requirement of 55 grams per person to avert health and nutritional related problems. Indigenous chicken eggs have the potential to supply these proteins in developing countries where the requirement is hardly met. In Kenya, the average per capita egg consumption is low compared to other countries. To ascertain determinants of egg demand, 174 consumers were sampled in the two counties of Kenya. Data were analyzed with multiple regression model and Kendall coefficient of concordant test to establish preference levels for egg types. Results of the regression analysis indicated that gender, age, education, price, income and household size had a significant effect ($p<0.01$) on the demand for indigenous chicken eggs. Policy should focus on these factors in order to increase both consumption levels and competitiveness of the egg value chain.

Key words: Demand, eggs, indigenous chicken, Kendall coefficient, Kenya, multiple regression models

Résumé

L'Organisation mondiale de la santé recommande un apport quotidien en protéines de 55 grammes par personne pour éviter les problèmes de santé et de nutrition. Les œufs de poule indigènes ont le potentiel de fournir ces protéines dans les pays en développement où l'exigence est à peine satisfaite. Au Kenya, la consommation moyenne d'œufs par habitant est faible par rapport à d'autres pays. Pour déterminer les déterminants de la demande d'oeufs, 174 consommateurs ont été échantillonnés dans les deux comtés du Kenya. Les données ont été analysées avec un modèle de régression multiple et le coefficient de concordance de Kendall pour établir les niveaux de préférence de types d'oeufs. Les résultats de l'analyse de régression ont indiqué que le sexe, l'âge, l'éducation, le prix, le revenu et la taille du ménage avaient un effet significatif ($p <0,01$) sur la demande d'oeufs de poule indigènes. La politique devrait se concentrer sur ces facteurs afin d'augmenter à la fois les niveaux de consommation et la compétitivité de la chaîne de valeur des œufs.

Mots clés: demande, œufs, poulet indigène, coefficient de Kendall, Kenya, modèles de régression multiple

Introduction

Protein is an essential component of diet and is either sourced from plant or animal sources. Animal products contain more ratios of amino acids than plant products (Britton, 2003). Demand for livestock products is rapidly increasing in sub Saharan Africa (Delgado *et al.,* 1999). The incremental demand has been associated with the "livestock revolution" (Delgado, 2003; Thornton, 2010). Eggs have a potential to position themselves as a major source of proteins hence averting the malnutrition problem that characterizes most of the sub Saharan African countries. This is due to its low price compared to other sources of proteins. In Kenya, consumers exhibit high preferences for indigenous chicken (IC) eggs and are willing to pay 41.53% more compared to other exotic eggs (Bett *et al.,* 2012). The increase in consumer preferences for IC eggs is attributed to the fact that they have both nutritional and health associated benefits. Kenya has an estimated population of 40 million people who need a daily protein requirement of 55 grams per person according to the world Health Organization (WHO).

The growing population and purchasing power aggravated by increase in income levels are spurring demand for chicken products especially eggs in Kenya's urban and rural areas. The livestock sector contributes to 12% of Kenya's GDP, 40% to the agricultural GDP and 50% of employment in agricultural sector (MoLD, 2010). In 2010 the total number of chickens in Kenya stood at 37.3 Million distributed as follows: - 84% indigenous, 5.7% broilers, 8.3% layers and 1.7% other birds (USAID, 2010). Indigenous chicken (IC) contributes to 71% of the total egg and poultry meat production and therefore influencing significantly on the rural trade, welfare and food security of the smallholder farmers (Nyaga, 2007; Ndenga *et al.,* 2017). Indigenous chicken eggs are regarded as familiar, nutritious, economical and easy to prepare food as they provide balanced sources of nutrients for humans of all ages (Matt *et al.,* 2009). As Kenya transforms to middle level income by 2030 (Kenya Vision 2030), food consumption patterns are expected to shift from meeting basic dietary needs to a keener interest in health, convenient and superior value foods. Indigenous chicken eggs are expected to play key role during this transition face by supplying proteins and maintaining healthier lifestyles. However, consumption of eggs in Kenya is low compared to the world average consumption. For instance, per capita consumption of eggs in Kenya is 40 per annum compared to the world average per capita consumption of 200 eggs per annum (Hans *et al.,* 2013). The low consumption levels leads to low performance of the egg value chain making egg marketing channels unorganized and uncompetitive. For instance, majority of the producers sell their eggs to middlemen who then transport to major urban centres based on the prevailing demand. Assessment of factors influencing egg consumption levels and preferences would therefore inform value chain players and the government on the possible interventions to realize full potential and benefits of the egg value chain. In Kenya however information on determinants of egg demand and egg type preferences is scanty. The study sought to fill this void in information through across sectional survey design carried out in the counties of Nairobi and Makueni. The objectives of the study were to; characterize egg consumption, rank various egg types in the market based on consumer preference and to determine socio-economic factors influencing egg demand in the study area.

Several studies on food demand focused on chicken meat and other meat types in the market have been done by employing almost ideal demand systems (AIDS) model. For instance, Bett *et al.* (2012) analyzed the demand for meat in rural and urban areas of Kenya by employing Linear Approximate almost ideal demand system (LA/AIDS). Gamba (2005) characterized consumption of meat products

and eggs in the city of Nairobi. Apart from food expenditures, other studies have analyzed household food consumption levels; Issa *et al*. (2015) investigated home consumption of local chickens and found that price and taste are the main determinants of indigenous chicken consumption in Chad's N'Djamena city. The study found that households headed by women consumed more chickens than those headed by men. Upadhyay *et al*. (2014) employed regression analysis in determining consumption patterns of fish in urban area of Tripura. Results revealed that fish price, number of adult members in a family, quantity of consumption of chicken and mutton affected the quantity of fish purchase. Delgado *et al*. (2003) found that the demand for fish is positively related to income indicating that as peoples' purchasing power (disposable income) increases, they demand more quantity of fish. Toluwase *et al*. (2017) established that the demand for chicken meat in Nigeria was influenced by own price, household size, income and price of close substitutes (turkey and fish).

The above studies show that both socio-economic and demographic factors influence household demand for food. Evaluating determinants of household egg demand in Kenya would facilitate redefining strategies for consumption and marketing and would provide insights into policies targeting the poultry sector.

Materials and Methods

The study area and Sampling. This study were conducted in Makueni and Nairobi counties of Kenya. Makueni county lies between latitude 1035' South and longitude 370 10' East (Makueni county Integrated Development Plan (CIDP), 2013). Nairobi county on the other hand lies between latitude 10 17' south and longitude 36 0 49' East and has nine sub counties. The target population for this study consisted of all consumers of indigenous chicken eggs in Nairobi and Makueni counties. Multistage sampling technique was used and 174 consumers selected. Makueni was purposively selected because it represents both production and consumption region of indigenous chicken eggs whereas Nairobi represents a major consumption and terminal market for IC eggs in Kenya having consumers with varied socio-demographics.

Data collection and analysis. Primary data were collected with the aid of structured questionnaires administered by trained enumerators in a cross sectional survey design conducted between August and October 2015. Primary data collected included socio-economic factors; age gender, education, income, household size, price, quantity, county and types of eggs in the market. The vehicle for analysis was Kendall coefficient of concordant test that was used to rank various egg types and determine the level of agreement among the rankers/consumers. The Kendall's test is mostly used to rank constraints or problems from the most pressing to the least pressing and then measure the degree of concordance among respondents involved (Benjamin, 2011). The eggs were ranked using the numbers, 1, 2, 3, …….n from the most important to the least important type based on the consumers' own assessment. The total rank score computed was used to calculate concordance coefficient, W.

According to Benjamin (2011), the range of coefficient W is between zero (0) and one (1) where w=1 means same ranking for all respondents and w = 0 mean maximum disagreement between all the respondents. The formula for coefficient of concordance is

$$w = 12\frac{\left[\sum T^2 - \frac{(\sum T)^2}{n}\right]}{nm^2(n^2-1)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where T = sum of ranks for eggs types being ranked
W = coefficient of concordance
n = number of egg types being ranked
m = number of respondents (consumers)

The significance of coefficient of concordance was tested using the F – test. The null hypothesis stated that there is no significant agreement among consumers on the ranking of egg types.

Multiple Ordinary least square regression methods (OLS) in STATA version 11.0 statistical package was used to analyze factors that influence demand for IC eggs in Kenya. Kostakis (2013) employed multiple linear regression method to assess the determinants of households' food expenditure in Greece. In this analysis, it is hypothesized that consumers maximize utilities by consuming egg quantities dependent on socio-economic variables of that consumer. The factors influencing egg demand were therefore expressed as;

$$y = bo + bx_1 + e \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where y is the quantitative dependent variable, bo is a constant x is a vector of independent variables; b is the coefficient to be estimated and e is the random error term which is normally distributed (Gujarati, 1995). Multicollinearity occurs when there is a high degree of dependency among the independent variables making it difficult to identify the separate effect of one or more independent variables on the dependent variable because of the strong relationship existing among them (Gujarati, 2003). Multicollinearity results in large standard errors among the coefficients of independent variables and hence low significant levels. In this study, multicollinearity was tested using Variance inflation factors (VIF). Variables with VIF greater than 5.0 are kicked from the model since they posses serious multicollinearity problem (Greene, 2000). In this study, the mean VIF for indigenous chicken egg model was 2.10. Individual VIF ranged between 1.13 to 4.36. Therefore since all VIF were less than 5.0, there was no serious multicollinearity problem hence their inclusion in the model. Heteroscedasticity occurs when the variance in the error term is different for all combinations of outcomes of the independence variable (Woolridge, 2002). One of the assumptions of ordinary least square estimation procedures is that the error term is constant of all the variations in the independent variables a condition called homoscedasticity. Violations of this assumption imply that the estimators remains consistent and unbiased but will be inefficient hence unreliable. If the error term is heteroskedastic, coefficients of the independent variables will have large standard errors and small t-values hence likelihood of committing type 1 error (Gujarati and Sangheeta, 2007). The Breusch – Pagan statistics are the standard tests for the presence of heteroscedasticity (Baum *et al*., 2003). Consequently, in this study Breusch-Pagan test was used to test the hypothesis for homoskedasticity. The chi square value for the equation was 0.04. The low chi square value which was not statistically significant implied that the null hypothesis for homoskedasticity could not be rejected and hence heteroskedasticity was absent in the model.

Empirical model specification. The dependent variable was quantity of IC eggs bought while independent variables included both socio-economic; age, education, income, gender, household size and price of eggs. More specifically, the method that was used for econometric analysis was multiple regression model as stated below;

$$Y = \beta 0 + \beta 1GEN + \beta 2INC + \beta 3AGE + \beta 4EDU + \beta 5HS + \beta 6PRICE + \varepsilon i \ldots\ldots\ldots (3)$$

Table 1. Definition of variables used in the model

Variable	Definition
GEN	Gender: 1 – Male, 0- Female
AGE	Age in years
EDU	Education
	1 - up to primary school
	2 - Secondary school
	3 – Tertiary level
HS	Household size (continous)
INC	Income earned per month in Kenya shillings (Ksh.)
	1- Less than 10,000
	2- Between 10,000 and 30,000
	3- Greater than 30,000
PR	Price of indigenous chicken egg in Kenya shillings (Ksh)

Results and Discussion

Descriptive results. Socioeconomic characteristics of indigenous chicken eggs consumers are presented in Tables 2 and 3 below. Based on the findings, the average age of age consumers was 35 years implying a youthful age bracket. The youngest consumer was 17 years old while the oldest was 85 years. The number of household members averaged four where the lowest household had one member only and the largest household had 20 members. In the study area, majority of the IC egg consumers were male at 56.32% compared to women at 43.68%. The probable reason for men's dominancy in purchase and consumption of eggs can be attributed to flexibility and ease of preparation of eggs compared to other sources of proteins (Matt *et al.,* 2009). Majority of the egg consumers had secondary level of education at 48.28% while only 21.84% had primary level. This implies that consumers are enlightened on both nutritional and health benefits associated with consumption of IC eggs. Table 3 revealed an even distribution of income among the IC eggs consumers implying that IC eggs are consumed almost equally across different income groups. Consumers who earned less than Ksh. 10,000 per month were 37.93% which is almost the same as those earned Kh. 30,000 and above (33.33%). The average number of eggs consumed in the study area was 14 eggs while 1 and 60 eggs were the minimum and maximum eggs consumed respectively. This indicates an even distribution in consumption patterns of IC eggs as demonstrated by distribution in income levels. Market prices indicated that eggs were sold at an average price of Ksh. 17.90 per egg while they ranged from Ksh. 10 per egg to Ksh. 35 per egg (Table 2). These results are consistence with those of Matt *et al*. (2009) that eggs are among the least expensive sources of proteins for humans of all ages.

Preferences for egg types. Kendall coefficient of concordant was used to rank eggs of indigenous chicken, exotic chicken, quails, turkey and guinea fowls from the most important to the least important and ascertain the degree of agreement among the consumers in the ranks computed. Based on this, an attribute with the highest sum of ranks was ranked least whereas that with the least sum of ranks was ranked first. The results of Kendall ranking are presented in Table 4. Results indicated that there was 42% level of agreement among the rankers which was significant at 99%. Thus the null hypothesis of no significance agreement among the rankers was rejected. Consumers were in agreement in ranking indigenous chicken eggs as the most important (Table 4). Exotic chicken eggs, quail eggs, turkey and guinea fowl eggs were ranked in the second, third, fourth and fifth positions respectivelly (Table 4). The popularity and preference for indigenous chicken eggs can be attributed to the perception by majority of consumers that IC eggs are highly nutritious, economical and easily available when needed (Matt *et al*., 2009). When compared to exotic chicken eggs, there is perception among consumers that IC eggs are organically produced with less chemical contaminants.

Table 2. Socio-economic characteristics of the consumers

Variable	Definition	Mean	Std Dev.	Minimum	Maximum
Age	years	35.8103	12.9986	17	85
Household	No.	4.2931	2.6293	1	20
Price	Ksh	17.9023	3.6488	10	35
Quantity	Number	14.1092	15.6343	1	60

SOURCE: Authors computation (2017)

Table 3. Household demographics

Variable	Definition	Frequency	Percent
Gender	Male	98	56.32
	Female	76	43.68
Education	Primary	38	21.84
	Secondary	84	48.28
	Tertiary	52	29.89
Income	1<10,000	66	37.93
	15,000-30,000	50	28.74
	>30,000	58	33.33

Table 4. Ranking of preference for egg types

Egg type	Rank	Sum of ranks
Indigenous chicken	1	284.5
Exotic chicken	2	522
Quail	3	646
Turkey	4	758.5
Guinea fowl	5	789
W	0.42***	
F	144.96	

Determinants of IC eggs demand

Table 5. Factors affecting demand for indigenous chicken eggs

Variable	Coefficient	Std Error	t-statistic	P-value
Constant	-5.3151	7.6705	-0.69	0.489
Gender	1.7391	2.3745	0.73	0.465
Age	0.1837*	0.0954	1.92	0.056
Education	4.9202***	1.7442	2.82	0.005
Household	0.7716*	0.4534	1.70	0.091
Income	1.4195	1.5010	0.95	0.346
Place of residence	-0.2489	0.3336	-0.75	0.457
R^2 10.00%				
F 3.09***				

Significant levels: * (10%), ** (5%), *** (1%)

Multiple regression model was employed to determine factors influencing demand for IC eggs in the study area. Socioeconomic variables were used as independent variables while quantity of eggs bought was the dependent variable upon which the effect of independent variables was evaluated. Table 5 above indicates the coefficients of variables, standard errors, t-statistics p-values which show the significance level and R^2 which indicates that 10% of the variation in IC eggs demanded is attributed to the variables in the model (Gujaratti, 1995).Results indicated that independent variables in the model significantly ($P<0.01$) influenced demand for IC eggs in the study area. According to the results, gender of the household head is positively but not significantly ($P>0.1$) related to demand for IC eggs. This implies that there is no difference in IC eggs consumption between males and females. These results are inconsistence to those of Kostakis (2013) who established that gender of the household head significantly influenced food expenditures. Age of the consumer significantly ($P<0.1$) influences the demand for IC eggs. Ceteris Paribus, an increase in age by one unit will result in a corresponding increase in demand for IC eggs by 0.1 units. These results imply that older consumers tend to demand more IC eggs than their young counterparts probably because of the perceived health and nutritional benefits. The findings corroborates with those of other studies. Kostakis (2013) found that income, age, gender, marital status and place of residence had an impact on household food expenditures. Mehmet *et al*. (2015) found that age of the respondent was a significant predictor for fish consumption frequency.

Education level of the household head significantly ($P<0.01$) influenced demand for IC eggs. Ceteris paribus, an increase in education level increases demand of IC eggs by one unit. The results indicate that educated consumers tend to demand more of IC eggs than the less educated ones. The probable reason for this is that education is correlated to acquisition of information on both health and nutritional aspects of IC eggs. Educated consumers are hence more empowered with this knowledge and tend to balance their demand levels with nutritional body requirements. These findings are consistence with those of Kostakis (2013).

Household size significantly ($P<0.1$) influences the demand for IC egg. The demand will increase by 0.7 units for a unit increase in household size holding other factors constant. The results connotes

that households with more family members will demand more IC eggs in order to satisfy the utility levels of additional members. Accordingly, fewer family members will have to content with fewer amounts of IC eggs. The findings corroborates those of other researchers; Moni (2014) reported that household size positively and significantly influenced the consumption of chicken, beef and pork in central Kenya while Toluwase *et al*. (2017) found that own price, household size, income and price of close substitutes were important determinants that influenced demand for chicken meat in Nigeria. Income level of the consumer did not significantly (P>0.1) influence demand for IC eggs but had the expected positive sign. Price of IC eggs did not significantly (P>0.1) influence its demand but had the expected negative sign. This is consistence with the economic theory of inverse relationship between price of a good and its demand in the market. The findings are in tandem with Oczkowski *et al*. (1998) who found that eggs prices did not influence the quantity of eggs demanded but contradicts studies by Issa *et al*. (2015) who established that taste and price were the main determinants of indigenous chicken consumption in ND'jamena.

Conclusion and implications

The results of this study can inform policy deliberations by public organizations. For instance, the need for extension to focus on promoting production of IC eggs and knowledge and awareness creation on the health benefits associated with IC eggs consumption in the region across consumers of different ages, gender, education level and income groups will enhance demand levels of IC eggs. Marketers of IC eggs on the other hand, can use the important socio demographic variables in formulating strategies that will enhance performance of the IC eggs value chain.

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