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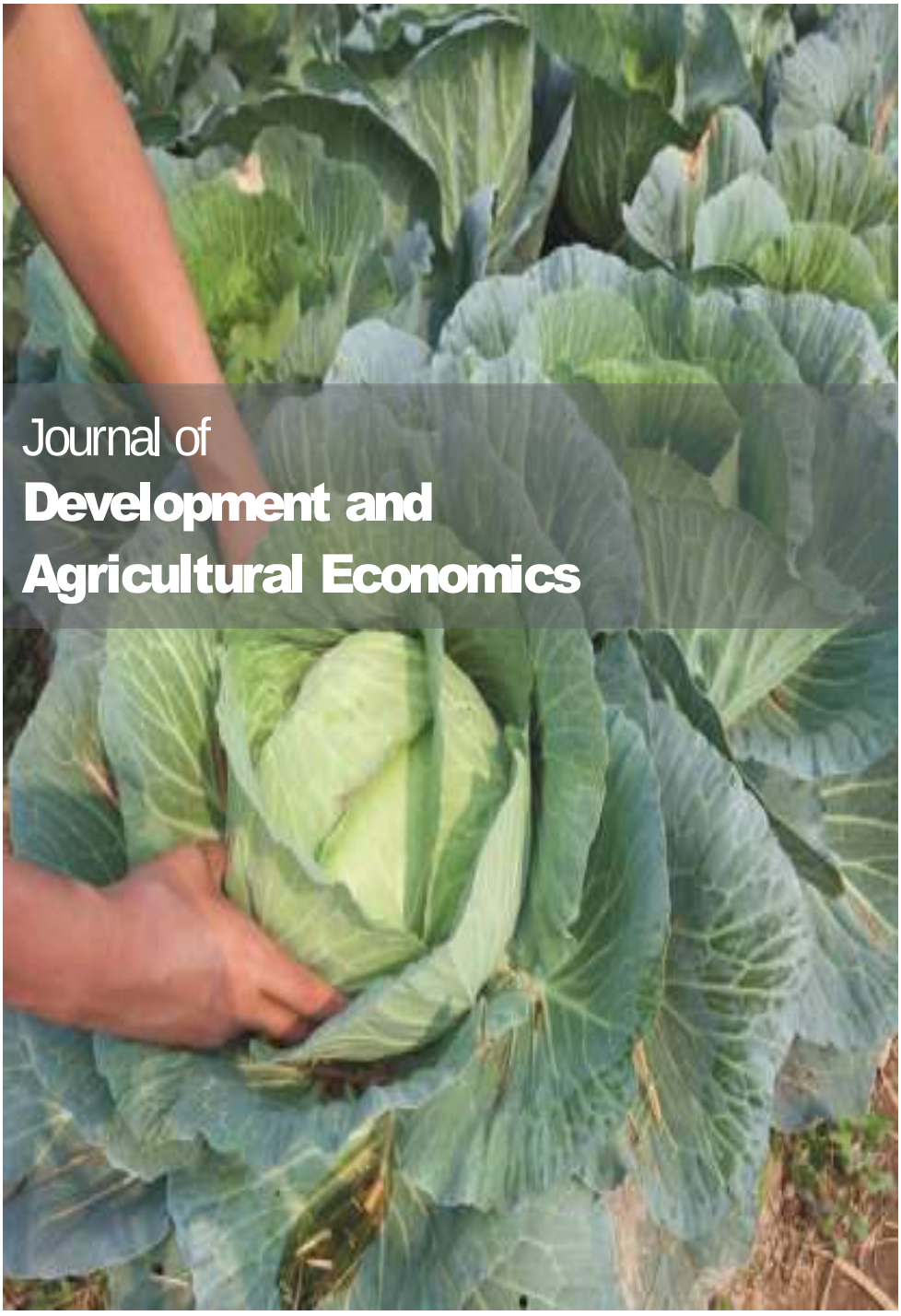

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Journal of Development and Agricultural Economics

Full Length Research Paper

Effects of marketing costs on gross margin: Evidence from guinea corn retailers in Wukari, Taraba State, Nigeria

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This study assessed the effects of marketing costs on the gross margin of guinea corn retailers in Wukari, Taraba State, Nigeria. The main aim of the study is not to only obtain precise costs and margins estimates for the conventional marketing functions of guinea corn, but rather to make the result of the analyses usable to devise a policy framework for an effective marketing strategy and improvement in the efficiency of guinea corn marketing and agricultural produce/products markets in Taraba State and Nigeria in general. Structured questionnaire was used to illicit response from forty guinea corn retail marketers across six local government areas of the state during the 2017 marketing season. Descriptive statistics were used to analyze the data collected, while Ordinary Least Squares Analytical Procedure was used to determine the parameter estimates of marketing costs. The average retailers' gross margin per 50 kg bag stood at ₦1,036.16, while price and transportation cost per 100 kg bag is ₦17,472.00 and ₦249.00, respectively. Storage cost for six months period stood at ₦163.00 per 100 kg bag. The results showed that retailers' selling price, transport cost, storage and cost due to perishability have significant effects on retailers' gross margin, at 8, 5, 10 and 9% levels, respectively. It is recommended that transportation facilities should be sustained by government, private individuals and corporate groups in addition to intensification of research into post-harvest storage and processing techniques. Again, funds and storage facilities should be made available to the marketers to enable them take advantage of bulk purchasing during harvesting seasons to ensure market expansion that will improve guinea corn marketing cum retailer gross margin like in the study area.

Key words: Guinea corn, marketing costs, marketing margin, retailers.

INTRODUCTION

Agriculture is an important sector in the Nigerian economy (Ivgababon, 2005). It contributes about 40 to 42.1% of the total GDP; employs about 70% of the labour force; accounts for 70% of the non-oil exports and perhaps most importantly provides over 80% of food needs of the country. During the post-independent era,

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agriculture was at subsistence, though self-sufficient level. However, a decade after opened the way for food shortages as a result of declining production. Food shortage is not peculiar to Nigeria, but is attracting global attention as millions particularly in developing countries do not have enough production to meet their basic food needs. Millions more are also experiencing hunger, malnutrition, growth retardation and sometimes death due to starvation. Idachaba (2004) opined that food insecurity could be caused by both supply-side factors and demand-side factors. One of the supply-side factors of food insecurity he identified is food-marketing problem.

Guinea corn (*Sorghum bicolor* (L) Moench) is an important food crop in Nigeria; being widely grown in the savanna regions of the country. This crop forms a staple food for most of the population, especially in areas adaptable for its production such as Wukari Local Government Area of Taraba State. Like other crops, guinea-corn is well distributed by the marketers-wholesalers and retailers. Due to some costs such as transport, storage and costs incurred due to perishability of the produce, poor pricing, returns cum margins prevail leading to the inability of the retailers to mark up for their efforts. This situation culminates to delay and difficulty in getting the produce to the consumers at the right time and place. However, in order to assess the effects of marketing costs on the gross margin of guinea-corn retailers in Wukari Local Government Area of Taraba State, the transportation costs, marketing infrastructure costs, storage costs, costs due to perishability and cost of capital of the retail marketers were examined among other factors that result in price changes and margins at point of retailing and their levels of influence on the gross margin of the retailers determined. On the average, guinea corn production in Nigeria between 2013 and 2016 stood at 6,485.5 metric tons per year, indicating an average annual growth rate of 2.51% (Agricultural Production Statistics by Country – IndexMundi, 2018).

The major problem is that prices of domestically produced guinea corn and the prices of labour involved as distributional process inputs used in getting the goods to the final consumers have risen faster than final consumer prices, leading to low margin (net income) of the retailers. The competitiveness of the market for the good is high since guinea corn is not sold exclusively through a limited set of retailers and is most likely to have a smaller gross margin. The socio-economic characteristics of the retailer itself can also matter, especially with retailers that operate with rapid turnover of stock typically applying smaller gross margins than others. Again, costs incurred in course of retail functions with prices paid at various channels have not been identified, so as to enable computation of margins and possible identification of major factors influencing retailer's income.

The broad objective of this study is to assess the performance of retailer guinea-corn marketers in Wukari Local Government Area of Taraba State, Nigeria, while the specific objectives include to: (i) examine the marketing costs of the retailer marketers in Wukari LGA; (ii) identify the marketing channels and prices at each point of the marketing chain; (iii) identify the costs militating against marketing of Guinea corn in the study area; (iv) evaluate the marketing margins at retail point of the marketing chain; (v) determine the effects of the marketing costs on the marketing margin of retailer respondents. The hypotheses tested are: H_O : Marketing costs of guinea corn retailers do not significantly influence their marketing margin. Against the alternative hypothesis: H_1 : Marketing costs of guinea corn retailers significantly influence their marketing margin.

The study is a documentation of the costs affecting the margin of guinea corn retailing in the study area. It creates awareness on the guinea-corn retail marketing issues among unemployed youths that could take up retailing of guinea corn as adjoin to trading on other agricultural products to obtain livelihood. Public in general will be aware of the reasons for the level of performance recorded by the guinea-corn retailers. Finally, it serves as encouragement to the guinea-corn marketers with respect to how to improve margins and net returns for a sound market performance in the area of study.

Literature review

In economics and marketing literatures, marketing margin refers to the difference between the price paid by the customers and the price paid to the farmer. Therefore, the criterion to determine the marketing margin is the difference between the prices of customers paying and farmers/producers receiving (Patrick et al., 2012). To investigate the marketing margin thoroughly and exactly, it is better to divide it into two smaller portions of wholesale margin and retailer margin. The wholesaler margin is the difference of the price at which retailers sell their product and the price which they pay to the farmers as they buy the product, and the retailer margin refers to the difference of the price at which the retailers sell the acquired products to the consumer and the price they pay to the wholesalers. In the export market; the total margin refers to the price at which the producer sell the item and the price at which the product is sold in the export market.

Guinea corn and its cultivation

Guinea corn is locally called Ikakporo or dawa. Plant scientists have described it as a major cereal of the world after wheat. Experts say that guinea corn is the most

widely cultivated cereal crop and accounts for 50% of the total cereal crops produced in Nigeria.

Study shows that about 8 million hectares of land is under guinea corn production with average yields of 1.7 t/ha and a total production of 9.3 million metric tons annually in Nigeria; making it the second largest producer of guinea corn coming next to USA and higher than India. Research shows that there is no shortage of indigenous varieties of guinea corn in Nigeria, but that there is a severe shortage of improved released varieties with good nutritional qualities to address the malnutrition in the population.

Guinea-corn is among the most important cereals in terms of nutrition, production and area planted. Roughly, 90% of the world's guinea corn area lie in the developing countries, mainly in Africa and Asia (FAO, 1996). These crops are primarily grown in poor areas subject to low rainfall and drought where other grains are unsuitable for production unless irrigation is available (Nyannor et al., 2007). Guinea-corn is widely grown both for food and as a feed grain and it constitute a major source of calories and protein for millions of people in Africa and Asia.

Nutritional value and economic importance of guinea-corn

Whole grains of guinea-corn contain approximately 89-90% dry matter (DM), 8.9-15% crude protein (CP), 2.8% ether extract (EE), 1.5-1.7% ash, 2.1-2.3% crude fibre (CF) and 71.7-72.3% nitrogen free extract (NFE) on fed basis (Ensminger and Olentine, 1978; Subramanian and Metta, 2000; FAO, 2012). The CP content of guinea-corn is higher than that of maize but almost equal to wheat. Protein content and composition varies due to genotype, water availability, temperature, soil fertility and environmental conditions during grain development. The protein content of guinea-corn is usually 11-13% but sometimes higher values are reported (David, 1995). Prolamins (kafirins) constitute the major protein fractions in guinea-corn, followed by glutelins. Grain protein is notoriously deficient in the essential amino acid lysine (Bohoua and Yelakan, 2007). Guinea corn is an important source of B vitamins except B12 and good source of tocopherols (FAO, 1995). Other B-complex vitamins present in guinea corn in significant amounts are vitamin B6 (0.5 mg per 100 g), folacin (0.02 mg/100 g), pantothenic acid (1.25 mg/100 g) and biotin (0.042 mg/100 g) (NRC, 1982). The B vitamins and minerals are concentrated in the aleurone layer and germ. Guinea corn grain contains about 1.5 ppm of total carotenoids. Anti-nutritional compounds (e.g. protease inhibitors, galacto-oligosaccharides, lectins, ureases, phytates, tannins, phenolics and saponins etc.) are plant constituents which play important role in biological functions of plants. Examples are the effect of these compounds on man and animal organisms are partly negative because they can reduce the digestibility of nutrients and the absorption of minerals (Derman et al., 1980). They may also inhibit growth as a result of their negative influence on the function of pancreases and the thyroid gland, and can cause pathological alterations in the liver. NRC (1996), FAOSTAT (2005); and FAO (2012) reported that guinea-corn play an important role in both the dietary needs and incomes of many rural households. Like other cereal grains, they are energy feeds valuable for their high caloric contents. The grains are used for poultry feeds. It is also considered a helpful famine crop as it is easily stored for lean years; the grain is readily digestible, highly nutritious and versatile, it can be cooked like rice, ground to make porridge or flour or used to make cakes (de Wet, 1978; FAO, 2012). Guinea corn is eaten in different forms that vary from region to region. In general, it is consumed as whole grain or processed into flour, from which traditional meals are prepared (Taylor et al., 2006; Liu et al., 2012). Furthermore, of major importance is that across Africa, guinea-corn is becoming the grain of choice for lager and stout beer brewing by major international companies (Taylor et al., 2006). This is because of its competitive price and availability as compared to barley and its intrinsic good brewing properties in terms of starch content and malting quality. In Africa, guinea corn and millets are also used to produce a very wide range of traditional foods and beverage products (Taylor and Emmambux, 2008). Some of these have been exploited commercially, most notably opaque beer which is brewed industrially on a large scale in several southern African countries (Daiber and Taylor, 1995). With the rapidly increasing urbanization in Africa and growth of the middle class, who demand convenient and healthy foods, there is much scope for commercialization of other traditional African guinea corn and millet products.

Tannins (condensed polyphenols) and phytic acid in guinea-corn

Tannins are secondary compounds present in plants and comprise polyphenols of great diversity (Hoste et al., 2006). The physical and chemical properties of tannins vary between plants, in different plant parts and between seasons. At high levels (above 50 g/kg DM), tannins in plant material can become an anti-nutritional factor and can result in reduced feed intake and digestibility in animals (Barry and McNabb, 1999). All guinea corn contains phenolic compounds, including phenolic acids and flavonoids. Yellow guinea corn variety was reported to have low levels of tannin (Gualitieni and Rappaccini, 1990). These compounds can affect colour, flavour and the nutritional quality of the grain and products prepared from it. Tannins confer a bitter taste and protect the grain

against insects and birds that can cause reduction in grains (Taylor, 2004). The tannin content of seeds inhibits the activity of some enzymes hence adversely influences protein digestibility and cellulose breakdown (Vinod et al., 2005). Phytic acid and/or phytates compete with essential dietary minerals such as calcium, zinc, iron and magnesium to make them biologically unavailable for absorption. Guinea corn bran contain the highest levels of phytates. Forty to fifty percent of the phytate and of total phosphorus can be removed by abrasive dehulling (Reichert and Youngs, 1977).

Processing of guinea-corn

At household level, processing involves post-harvest handling such as drying, threshing, winnowing, sorting and storing. Production is characterized by predominance of traditional practices that entail planting of farmers home-saved seeds. The mature panicles are harvested using thumb knives and sundried on bare ground, rocks, or mats (NRC, 1996; Ahmed et al., 2013). They are later threshed by beating the dried panicles with sticks, winnowed in flat trays and dehulled in mortar and pestle followed by narrow utilization based on value-added products in the form of thin or thick porridge and alcoholic beverages (NRC, 1996; Ahmed et al., 2013). It is processed at household level, by the millers who at times double deal as stockists and processors. The grains are hard-hulled and normally ground finely before being fed to animals (Calder, 1960; Raju et al., 2003). A very fine screen is used as some of the grains are extremely small and may escape grinding if a larger gauged sieve is used (Calder, 1960). Development of products like flour to produce porridge, *atap* (millet or guinea corn and cassava) and yeast with the exception of milling, can also be done manually (Rooney, 1992). Oniang'o (1996) reported that fermentation makes nutrients present in the grains more readily available to the body by reducing the tannin binding ability. Fortification is the process of supplementing minerals and protein contents.

Problems of guinea-corn marketing in Nigeria

Labaris et al. (2014) outlined the following as the basic costs of guinea-corn marketing in Nigeria.

Transportation costs

This is because transport facilities are grossly inadequate, especially in the rural areas where majority of the food is produced. Road or rail route linking outlying districts with a main system are lacking and where available, they are not motor able throughout the year or are laced with potholes, which make it difficult for vehicles to get to the farm sites and convey guinea-corn to the markets. The bad roads have increased guinea-corn post-harvest losses through damage to farm produce which affects the marketing of guinea-corn. This situation ends in available vehicle charging exorbitant fees to convey produce to market area. This has obvious implication on cost payable by consumers since transport cost will be built on the entire cost with a margin before market price is fixed.

Inadequate infrastructures

It is revealed that inadequate infrastructures are another problem constituting costs that affects guinea-corn marketing. Infrastructures such as storage and warehousing are lacking in most food markets. Insufficient storage facilities often lead to produce loss due to premature germination, fungal and bacterial attack, insects and rodents attack. This often led to increased marketing cost, resulting in high retail prices and reduced marketing margin and efficiency. Market information is also lacking. Sellers and buyers are not well informed about the sources of food supply, thereby reducing potential efficiency in the market. Other facilities such clean environment, communication facilities, health facilities, fire services, banking facilities, security facilities, water supply and good toilets are also lacking in most markets. These lead to reduction in income of marketers who pay extra fee to go to neighborhood to access these facilities. All these in addition to levies imposed and paid for the provision of the priority facilities weigh down the income of marketers.

Shortage of funds

Adequate fund is required in the area of bulk purchases, development of storage facilities, transport and processing facilities. Sometimes prospective guinea-corn marketers are often discouraged because of shortage of funds. Access to formal capital is predicated to collateral facilities and ownership of bank accounts among other requirements in spite of interest payment.

Seasonality and perishability of agricultural products

It was identified that seasonality and perishability are one of the costs of food marketing in the study area. The seasonal pattern of production and the perishable nature of food crops create a lot of costs. This is because the seasonal pattern creates surpluses during harvest which must be sold at low prices or stored (if storage facilities are available) for future sale at great costs. The costs is worsened by long chain of distributors, absence of uniform unit of measurement, small market size and high

risk of road accident and armed robbery in the study area. The quantity of these produce lost due to their perishable nature are as a result of poor storage and swells up the costs incurred by the marketer.

Marketing margin

Marketing margin is defined as the difference between the producer price and the consumer price and it can be affected by various factors. Marketing margin is an equilibrium entity that is a function of the difference between equilibrium retail and farm prices (Wohlgenant, 2001), or between export and farm prices (Carambas, 2005). Marketing margins provide neither a measure of farmers' well-being nor of marketing firms' performance. However, they give an indication of the performance of a particular industry (Tomek and Robinson, 1990), or an indication of the market's structure and efficiency. For instance, Gordon and Hazledine (1996) have argued and revealed in their study that the form of the market power is likely to manifest in larger marketing margins than would otherwise be the case. Marketing margins are the result of demand and supply factors, marketing costs and the degree of marketing channel competition (Marsh and Brester, 2004). Thus, margins reflect aggregate processing and retailing firm behavior which influence the level and variability of farm prices and may influence the farmer's share of the consumer food dollar (Gardner, 1975; Tomek and Robinson, 1990; Wohlgenant, 1989).

METHODOLOGY

The study was conducted in Wukari Local Government Area of Taraba State. Wukari Local Government has been the headquarters of the historically famous Kwararafa Confederacy which at the zenith of its powers extended to modern Niger, Plateau, Kogi, Nasarawa, Benue States and FCT in the north central geo-political zone, Edo and Cross River in the South-south zone, Kaduna, Kano and Katsina States in the north west zone and Bauchi, Gombe and Adamawa States in the north east zone (Taraba State at a Glance: tarabastate.gov.ng/about/, 2018). Wukari has over the years metamorphosed from a spiritual and cultural headquarters of the Jukun people to a political and administrative headquarters of former Wukari Federation which now consists of Wukari, Donga, Ibi, Takum, kurmi and Ussa Local Government Area of Taraba State (Taraba State at a Glance: tarabastate.gov.ng/about/, 2018). Wukari is a multi-ethnic area, predominated by the Jukun people who also call themselves Wapan, with the composition of other major ethnic groups as Ichen, Kpanzon, Chamba and Kuteb. Other ethnic groups that also live within the town and its environs that were considered as settlers are Tiv, Hausa, Fulani, Yoruba, Igbo and others. The Wukari people are predominantly farmers, hunters and partly fishermen, while some are civil servants. The dominant religion in the area is Christianity which is widely practiced; others are Islam and African traditional religion (Anyeze, 1983). Geographically, Wukari Local Government is situated in the southern part of Taraba state. It is bordered to the north by Ibi Local Government Area, east by Gassol Local Government Area, from the south by Donga Local Government Area of Taraba State, and to the west by Ukum Local Government Area of Benue State. The Local Government Area has a total area of 4,308 km^2 (1,663 square mile), located at 7°51′N 9°47′E. According to 2006 National population Census figures, Wukari has a population of 241,546 people (Taraba State at a Glance: tarabastate.gov.ng/about/, 2018), projected to 271,546 people in 2017. Wukari vegetation lies on the Guinea Savannah zones, which is marked by mainly forest and tall grass. The plain and fertile land, and the consistent annual flood of the rivers and streams within the area makes the land a conducive area for seasonal farming and grazing, and all seasons fishing (Taraba State at a Glance: tarabastate.gov.ng/about/, 2018). These activities informed the distribution of cultural and natural resources of the area, and also make Wukari a very rich agricultural land. The land is suitable for the cultivation of both arable and perennial crops such as yam, cassava, rice, guinea corn, maize, millet, groundnut, cowpea, beans, banana, coconut, fruit trees and vegetables, as well as animals such as cattle, sheep, goats and pig among others. It is also blessed with large volume of mineral deposits such as salt, lead, zinc, limestone and others all untapped (Taraba State at a Glance: tarabastate.gov.ng/about/, 2018).

Primary data only were gathered from retailers in Chonku, Kente, Puje, Rafin-Kada, Tsukundi, etc. This means that out of the population, a sample of 8 respondent retailers each were drawn from each of the five markets in the local government area, making a total of 40 retailers as representative sample used in the study. The data were generated through a well-structured questionnaire. The structured questionnaire modules consisted of coded questions aimed at gathering information on traders' socio-economic characteristics, marketing services and costs, selling prices of producers, wholesalers, retailers, as well as purchase prices by consumers. Others were information on transportation, storage as well as costs incurred due to infrastructure development and perishability. In addition to the coded questions, there were open-ended questions to allow respondents discuss freely any of the particular marketing issues of concern to them.

Data retrieved from completed questionnaire were analyzed using descriptive statistics, frequency distributions, percentages, pie charts and least squares statistical methods of estimations which provided the logical means for drawing inferences from the results. Objective (i) was achieved using frequency distribution and percentages; objectives (ii) and (iii) were achieved using descriptive statistics; objectives (iv) was achieved using gross margin analysis, while objective (v) was achieved using OLS analytical technique. The estimation procedures presented below shows the gross marketing margins for retail level distribution of Guinea Corn as calculated for each respondent and formed the dependent variable in the regression analysis which inferred the effects of the marketing costs on retailer margins as presented in chapter four.

$$GMM_R = \frac{\mathrm{Re}tailing\mathrm{Price} - Wholesale\mathrm{Price}}{\mathrm{Re}tailing\mathrm{Price} / Consumer\mathrm{Price}} \quad (1)$$

The mark-up pricing model designed by Waugh (1964) specifies that the consumer price is the determining factor in concluding the difference between the retail price and farm price. The price of food products, for example, at the level of farm price is simply the retail price minus the marketing agent cost, defining the marketing margin as a function of retail price and marketing cost: Implicitly the model is represented thus:

$$MM = f(RP; Z) \quad (2)$$

Where, MM = marketing margin; RP = retail price and Z = vector of marketing costs.

The effects of marketing costs on retailers' margin are modeled as:

RM = Retailers' marketing margin = f (Z) (3)

Where, Z_1 = transport cost, Z_2 = storage cost, Z_3 = cost incurred due to perishability, Z_4 = cost of capital, μ_i = error term.

RESULTS AND DISCUSSION

Table 1 shows the frequency distribution of guinea corn retailers according to age. The age range with the highest frequency is between 28 and 34. This indicates that the retail market is dominated by those within productive, active struggling age brackets. This finding is in line with result of Emokaro and Egbodion (2014), in a study on effect of marketing cost on marketing margin realizable from beef sales in Benin City, Nigeria, which showed that majority (87.5%) were within the age bracket of 30-39 years, that is, were in their active age of production and (85%) of the marketers were married. The results of the regression analysis indicated that marketing cost (packaging, handling, processing and transportation costs) explained about 91% of the systematic variation in the marketing margin realized from beef marketing in the study area. It was also shown that unavailability of credit facilities, high cost of transportation, high marketing charges and perishability of beef were the most serious constraints faced by the marketers. Besides, the findings of Lawrence and Sylvester (2014) on socio-economic characteristics, in their research titled "The Structural Performance of Artisanal Fish Marketing in Ondo State" revealed that the respondents with age range of 31-40 years had the highest frequency with 37.6%. This is followed by the respondents with age range of 21-30 years old with 27.2%. This implies that majority of the respondents between the ages of 21 and 40 years old are young and agile people involved in artisanal fish marketing in the study area, just as those within the same age limit are involved in marketing of Guinea Corn in Wukari Local Government area of Taraba State. Hitherto, Kainga Ebiowei (2013) in their work, "Marketing margin and determinants of net return of watermelon marketing in Yenagoa metropolis of Bayelsa State, Nigeria" showed that 70.0% of the respondents were within the age of 21-40 years. This is also consistent with the active age limit of respondents engaged in marketing activities. This means that the young and the energetic individuals, with an ambition to excel by earning higher incomes through marketing of their goods tend to expand investments or engage in different activities by being more active in terms of saving costs to improve margin. And in this way, the clientele within active age may accumulate much capital to plough back into the business, as against older marketers of the same goods. However, Lichtenthal and Tellefsen (2001) is at variance since he argued that the age of the buyers of a product has a lot to do with level of retail sales. In order words, it is not only important to identify the age of retailers, but also the age of buyers.

The number of years spent in school as presented in Table 2 shows only two categories out of which 55% had first school leaving certificate, which agrees with the findings of Lawrence and Sylvester (2014) on socio-economic characteristics, in their research titled "The Structural Performance of Artisanal Fish Marketing in Ondo State**"** that about 41.6% of the respondents, who were involved in artisanal fish marketing, had primary education, while 24% had secondary education. Also, this finding agrees with the results of Emokaro and Egbodion (2014) that the retailer beef marketers studied were fairly educated.

Table 3 shows the frequency distribution of the respondents according to years of experience. The table reveals that 15 respondents, representing 37.5% have years of experience ranging between 6 and 10 years. This is closely followed by those with 11-15 years of experience and a frequency of 9 (Table 3). This finding collaborates that of Emokaro and Egbodion (2014) that beef retailers have good marketing experience. It also agrees with Ebinga's (2014) study on Impact of Business Education in Enhancing Sales Volumes of Retail Businesses in Ohaozara Local Government Area of Ebonyi State where it was found that business education helps to improve managerial competence of retailers in Ohaozara Local Government Area.

Family size is recognized as a major source of labour in small holder agricultural activity in most African countries. In this scenario, it comprises the labour input of all males and females in a household with respect to marketing activities they carry out in the course of retail business. The insignificant contribution of this parameter may not be unrelated to probable increase in costs arising from consumption and movement of a reasonable member of the family to the sales outlet and back. However, the social links of the members of the family may increase sales on the long run. The frequency distribution of the respondents according to family size is presented in Table 4. The table shows only two distinctive categories resenting 45% of the respondents' family sizes ranging between 1-4 and 5-8 members. Put differently, family size influence consumption and cost.

Marketing channels, margins and marketing costs

The existing key marketing channels in the distribution chain identified include: farm gate, rural assembling level, retail level and retailer level. The information on price obtained from these levels was from producers, retailer marketers and consumer responses. The retailer level gross margin was calculated as indicated in the estimation procedure in the methodology. And the array

Table 1. Frequency distribution of retailers according to their age.

Age range	Frequency	Percent
28-34	14	35
35-41	7	17.5
42-48	8	20
49-55	8	20
56-62	3	7.5
Total	40	100

Source: Field Survey (2017).

Table 2. Frequency distribution of retailers according to the number of years spent in school.

Number of years in school	Frequency	Percent
6	22	55
12	18	45
Total	40	100

Source: Field Survey (2017).

Table 3. Frequency distribution of retailers according to the number of years of experience.

Years of experience	Frequency	Percent
1-5	4	10
6-10	15	37.5
11-15	9	30
16-20	6	15
21-25	7	7.5
Total	40	100

Source: Field Survey (2017).

Table 4. Frequency distribution of retailers according to family size

Family size	Frequency	Percent
1-4	18	45
5-8	18	45
9-12	4	10
Total	40	100

Source: Field Survey (2017).

of the gross margins so calculated formed the set of independent variable used in regressing the marketing costs identified. The identified marketing costs include transportation cost, storage cost, cost incurred as a result of the perishability nature of products, and infrastructure development costs.

Effects of marketing costs on retailers gross margin

The determinants of guinea corn retailers' gross margin as presented in the model gave an average R-square 0.9665, which implies that all the explanatory variables included in the model explained up to 97% of the variations in the retailers marketing gross margins in the study area (Table 5).

The variables found to positively and significantly influence the retailers' gross margin included, retailers sales price, initial capital and transport cost. Storage and costs due to perishability have negative and significant effects on retailers' gross margin, with cost due to perishability accounting for less. The positive effect of initial capital is not significant.

As shown in Table 6, the coefficient of retailers' selling price is 0.033 which is significant at 8% level of significance; showing a direct relationship with retailers' gross margin. This implies that a unit increase in retailers' sales price will increase the retailers' margin by 0.033 unit, all things being equal. This is in agreement with the findings of Wohlgenant and Mullen (1987), that marketing margin is influenced by factors such as shifts in retail demand, farm supply and marketing input prices; in addition to other important factors, including time lags in supply and demand, market power, risk, technical change, quality and spatial considerations.

Transport cost has a coefficient of 0.037 which is significant at 5% level of significance. This implies that there is a direct relationship between transport cost and Guinea Corn retailers' gross margin in the study area, implying that an increase in the transport cost would lead to an increase in the gross margin of the retailers. It is evident that the retailers pay commensurate transport costs that does not affect margin negatively, hence the more goods transported and sold, the more the margin made from sales. Additional information provided confirmed that total cost of goods includes overall production, transportation, distribution, warehousing and marketing costs (Hamlett, 2018), implying that determining a product's markup involves a company use of the product's selling price and total cost, while in determining gross margin/profit, a company takes its total revenue and subtracts cost of goods sold.

The coefficient of storage cost is -0.006 and presumably significant at 10% level of significance; showing an inverse relationship with retailers gross margin. This implies that a unit decrease in in storage cost will increase the retailers' margin by 0.006 units all things being equal. Storage cost is here interchangeably used as cost of warehousing of retail products (Table 6).

The coefficient of cost due to perishability is -0.037

Table 5. Model summary.

Model	R	R Square[b]	Adjusted R square	Std. error of the estimate
1	0.984[a]	0.969	0.964	18.48341

[a]Predictors: Cost due to perishability, transport cost, initial capital, storage cost, retailers' price.

Table 6. Effects of marketing costs on retailers gross margin.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Retailers' price	0.033	0.012	5.833	2.797	0.008
	Initial capital	0.000	0.000	0.378	2.170	0.037
	Transport cost	0.037	0.006	1.003	5.848	0.000
	Storage cost	-0.006	0.002	-0.617	-2.589	0.014
	Cost due to perishability	-0.037	0.013	-5.620	-2.759	0.009

[a]Dependent variable: Total gross margin per retailer.

Table 7. Model summary.

Model		Sum of squares	Df	Mean square	F	Sig.
1	Regression	371853.941	5	74370.788	217.690	0.000[c]
	Residual	11957.272	35	341.636		
	Total	383811.213[d]	40			

[a]Dependent variable: Total gross margin per retailer. [b]Predictors: Cost due to perishability, transport cost, initial capital, storage cost, retailers' price

which is negative and significant at 9% level. This is an inverse relationship, implying that for each unit decrease in cost due to perishability, gross margin increases by 0.037 units. This is in agreement with the findings of Muhammad et al. (2005) in their study on "An Assessment of Marketing Margins and Physical Losses at Different Stages of Marketing Channels for Selected Vegetable Crops of Peshawar Valley", where they stated that it is difficult to assess whether the large marketing markups reported in the case of different vegetable crops are necessarily exploitative. However, it is plausible to note that as margin increases, costs incurred due to perishability decreases.

Conclusion

From Table 7, it can be deduced that since the model p = 0.0001, the model is significant, implying that not all $b's$ are zero. Therefore, the null hypothesis "H_O: Marketing costs of Guinea corn retailers do not significantly influence their marketing margin", is rejected; more so, F*Cal = 217.96 > F*Tab 2.45, while retailers' selling price, transport cost, storage and cost due to perishability are all significant at 10% level presumably. It is concluded that marketing costs influence the gross margin of guinea corn marketers in Wukari Local Government Area of Taraba State, Nigeria.

RECOMMENDATIONS

Based on the findings, the following recommendations are proffered:

1. The negative significant effect of marketing cost incurred due to perishability, requires that retailers who purchase unprocessed Guinea corn should embark on post-harvest in addition to storage measures to overcome cost due to perishability and improve on their net margin.
2. Based on the negative significant effect of storage cost, it is recommended that retailers that store the produce longer should embark on spoilage reducing measures to reduce spoilage of stored produce to improve net margin.
3. Given a high positive significant effect of transportation cost on gross margin of guinea corn marketers, it is recommended that the understanding between retailers and transporters of the goods be sustained and

maintained to improve margin of marketers.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Estimating pastoralists' willingness to pay for artificial insemination in arid and semi-arid lands of Kenya

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Effective promotion of artificial insemination (AI) by private providers in pastoral areas requires stakeholders' opinion in shaping the direction of their adoption. A structured questionnaire was administered to 384 pastoralists in Kajiado and Narok counties, Kenya to elicit data on willingness to pay for AI services. Double bounded contingent valuation methodology was adapted in computing their willingness to pay for AI services. Results revealed that 90% of farmers were aware of AI of which 51.7 and 50.5% were willing to pay for the services in Kajiado and Narok counties respectively, for an average of Kenya Shillings 1, 853, reflecting a premium of 23.6% placed on AI by pastoralists with reference to the base price of Kenya Shillings (KES) 1,500 offered for exotic breeds in Kenyan highlands. Awareness, herd size and access to extension services significantly increase farmers' willingness to pay unlike farm income. The study recommends utilization of existing extension networks of community animal health workers to ensure relevant information about AI is disseminated among pastoralists and perform free AI trials on lead pastoralists' animals to earn others' confidence.

Key words: Artificial insemination, willingness to pay, pastoralists, adoption, contingency valuation, awareness, Maasai.

INTRODUCTION

In Kenya livestock sub-sector is an integral part of the agricultural sector contributing about 4% of the national Gross Domestic Product (GDP) mainly from the production of milk, meat, eggs, hides, skins and wool (KNBS, 2018). The bulk of the livestock are found in arid and semi-arid lands (ASALs), comprising 84% of Kenya's total land mass. These areas are characterized by low, unreliable and poorly distributed rainfall, supports a quarter of the country's total human population of 40.5 million (Ojigo and Dabom, 2013; World Bank, 2010) as well as 60% of the livestock population and most of the country's wildlife (Ngugi and Nyariki, 2005). Most of Kenya's small-scale farmers occupy mainly this region, pursuing traditional livestock production with traditional technologies. These farmers are unlikely to meet the growing demand for food from an increasing population (Leisinger and Schmitt, 1995; GoK, 2012).

Pastoralism is the dominant production system in

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Kenya's arid and semi-arid lands (ASALs), but over time, it has been confronted by limited access to better farm technologies, requisite skills and market services (Otieno et al., 2012). Further, weak linkages between research-extension service providers and farmers have hampered adoption of technologies by pastoralists. Until recently, pastoral areas were viewed as net consumers of national wealth, offering poor prospects of return on investment. As a result, productivity and growth have remained relatively low; despite the fact that the sub-sector is expected to play an important role in the development of these areas (Mugunieri and Omiti, 2007; Oluoch-Kosura, 2010).

Over the years the government was the sole provider of animal health services in the country. Empirical evidence however show high-potential areas and market-oriented livestock systems were better served (Oruko and Ndung'u, 2009), while marginal ASALs lacked adequate access to animal health services (Oruko et al., 2000). In mid-1980s, the country implemented the Structural Adjustment Programs (SAPs) which were characterized by market liberalization in the veterinary sector resulting in the gradual reduction of government involvement in the provision of AI services (Richter et al., 1990; De Haan and Bekure, 1991). Liberalization of animal health services started in 1992 with liberation of the pricing policy of milk and milk products followed by privatization and reduced involvement of government in animal breeding and artificial insemination (AI) services; input and veterinary drugs supplies; animal health care and dipping services; de-regulation of the processing and marketing of milk (Mudavadi et al., 2001). To bridge the gap, private sector providers were promoted as an alternative to state provision and as a means to reduce the government financial burden and improve efficiency of AI delivery (Tambi et al., 1999). Privatization of AI services increasingly became a necessity as government funding to veterinary dwindled, with the transfer of activities, functions, responsibilities and property from the public to the private providers.

In the context of AI services, privatization is viewed as a process of refocusing public sector by decentralising responsibilities, not merely as a means of reducing government expenditure, but also as an approach to increase its adoption by farmers in marginal areas, which require knowledge about the current and future demand, disease epidemiology, changing livestock systems, and socioeconomic changes (Kebede et al., 2014). The structural reforms led to reduction of the government and financial burden in the delivery of AI services but witnessed the reduction of farmers demanding the service. Consistent with the reforms, as much as 95% inseminations are now conducted by private AI service providers and cooperatives (Makoni et al., 2014). However, progress has remained slow and livestock production continue experiencing ineffective extension services and low adoption of AI. This is attributed by a myriad of factors among them low demand for AI, vastness of the area, harsh terrain and hostile environment, poor road network infrastructure, which exacerbate the problems posed by the long distances between frontline personnel and pastoralists (GoK, 2010).

The demand response, influenced by the farmers' attitude towards the AI, determines the involvement and efficient delivery of the service in ASALs areas (Tambi et al., 1999). Scholars have argued that the problem of technology adoption by farmers are not only associated with the technology per se but also by socio-economic disparities and environmental challenges (Croppenstedt et al., 2011). From an economic perspective, the benefits of adoption of AI should create sufficient motivation to farmers to adopt the technology since the economic nature of the AI is expected to drive farmers who enjoyed these services to be willing to pay for them (Kartamulia et al., 1995). It has been shown that AI adoption involves decision on investment, transaction and opportunity costs (Ferraro and Simpson, 2002), and its benefits should at least compensate farmers for the associated costs.

Successfully participation of private sector in the AI delivery require preparedness of all actors to engage in open processes and foster the self-confidence and local leadership necessary for their own lessons and capacities to bring about desired outcomes (Kebede et al., 2014). As argued by Rivera et al. (2009), privatization of AI services will depend on farmers' willing to pay for these services and where extension services have previously been provided free of charge, assessment should be made to understand commercial demand for agricultural information.

So far studies have shown that farmers often make decisions regarding uptake of new or improved agricultural technology with enhanced efficiency in delivery, and its adoption depends on awareness about the technology and willingness to pay for it. Establishing the opinion of stakeholders is thus crucial before introduction of a technology since it shapes the direction of their adoption and diffusion (Kimenju and De Groote, 2008). Promoting AI requires determination of the "price" which will not lead to inefficiencies and ineffective outcomes (OECD, 2010; Wunder, 2007). Quantification of these costs is often constrained by lack of information on the factors that a farmer includes in the decision-making process as well as information asymmetries that allows providers to overestimate the opportunity cost of AI delivery. Thus, contingency valuation methods are increasingly being used to estimate the willingness to pay (WTP) on the side of the buyer. Studies evaluating farmer's willingness to pay for AI services among pastoral farmers in Kenya are very rare, thus a knowledge gap. It's on this basis that the study sought to understand pastoralist's willingness to pay for AI and empirically determine farmer's socio-economic characteristics which make them more or less likely towards paying for AI

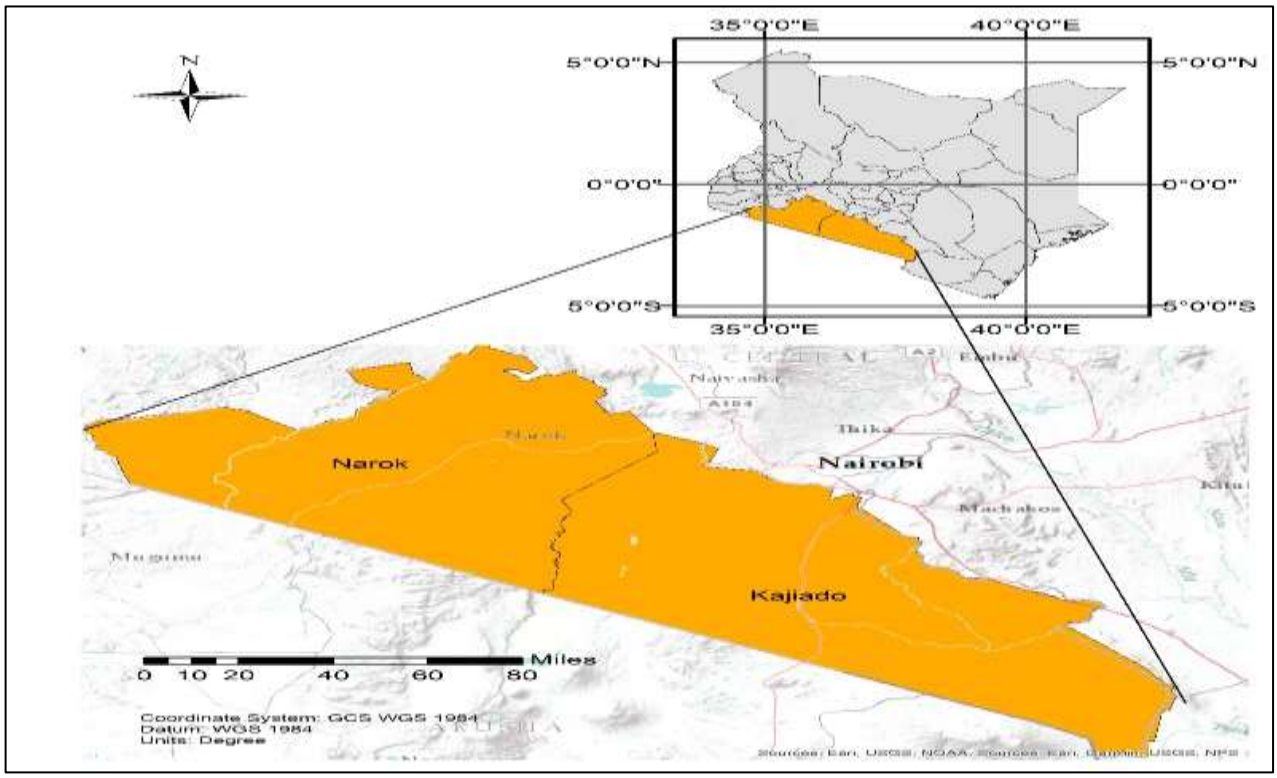

Figure 1. Location of the study area.

services. This information is very important for both County governments and private service providers participating in the provision of AI services in arid and semi-arid lands (ASALs).

MATERIALS AND METHODS

Study area

Data for this study was collected between November 2016 and January 2017 from Narok and Kajiado counties located in southern Kenya (Figure 1). Narok County lies between latitudes 0° 50´ and 1°50´ South and longitude 35°28´ and 36°25´ East covering an area of 17,933 km^2. In 2012, the population of the county was 979,770 and 169,220 households. The county is home to the famous Maasai Mara Game Reserve, one of the most popular tourism destinations in Kenya. The rangelands surrounding the Maasai Mara National Reserve can be divided into three range units based on bio-geographic and climatic differences. The western unit consists mainly of grasslands and comprises the Maasai Mara National Reserve. The Loita Plains stretch out in the North eastern part of the study area and are covered by dwarf shrub and whistling thorn (Acacia drepanolobium) grasslands. The eastern area, with the Siana Hills and Plains, supports Croton dichogamus bush and several other woody species interspersed with grasslands (Stelfox et al., 1986).

The dominant vegetation in the county includes forest land in the Mau area and grasslands and shrubs in the lowland areas of Suswa, in Narok North, Osupuko and Loita divisions in Narok South as well as the Mara sections in Transmara. These areas are suitable for livestock rearing and irrigation. Rainfalls amounts are influenced by the passage of inter tropical convergence zones giving rise to bi-modal rainfall pattern. Long rains are experienced between the months of February and June while the short rains are experienced between August and November. Rainfall ranges from 2,500 mm in wet season to 500 mm during the dry season. In 2017, the population of Narok county was projected to be 1,239,320 (Narok County Government, 2013).

Kajiado county on the other hand is bounded between latitudes 10° 0' and 30° 0' South and longitudes 36° 5' and 37° 5' East with an area of 21,900 km^2. In 2012, the population of the county was 804,796 distributed in 173,464 households (Kajiado County Government, 2013). The main physical features in the County are plains, valleys and occasional volcanic hills ranging from an altitude of 500 m above sea level at Lake Magadi to 2500 m above sea level in Ngong Hills. The county is divided into three different areas namely; Rift Valley, Athi Kapiti plains and Central Broken Ground. Vegetation type in the county is determined by altitude, soil type and rainfall. The county has a bi-modal rainfall pattern, with the short rains fall between October and December while the long rains fall between March and May. The rainfall amount ranges from as low as 300 mm in the Amboseli basin to as high as 1250 mm in the Ngong hills and the slopes of Mt. Kilimanjaro. Temperatures vary both with altitude and season (Amwata, 2013; Bobadoye et al., 2014).

The two counties are inhabited by the Maasai community who are mainly pastoralists, that is, at least 50% of their livelihoods depend on domestic livestock (Swift, 1988). Pastoralists differ from livestock rangers by their practice of taking herds to pasture and water, rather than having fodder grown or brought to them although purely nomadic in the past, many pastoralists are less mobile today (Fratkin and Roth, 2005). Pastoralism is the main source of livelihood to majority of rural households in the both counties. The most common livestock kept are dairy and beef cattle, goat and

sheep, with milk, meat, hide and skin, wool and mutton as the main products. Most families move between sedentary and mobile activities, while the larger part of a family, mainly women, children and elderly, have settled down pursuing small scale subsistence farming, some family members (often young men) still take the herds to pastures and water.

Sampling procedure

Multistage sampling technique was used. In the first stage, Keiyan, Kilgoris and Lolgorian divisions of Narok County and Namanga, Mashuru, Ngong and central divisions of Kajiado County were purposively selected because of their large concentrations of Sahiwal cattle populations. Moreover, these are high ranching zones suitable for Sahiwal production. In the second stage, pastoralist populations in these areas were divided into two strata based on their production systems, that is, Agro-pastoralists and Nomadic pastoralists using stratified random sampling technique. Third stage involved acquisition of lists of both nomadic and agro-pastoralists from District Livestock Development Officers (DLPO's) where systematic random sampling technique was applied to each list to obtain 205 agro-pastoralist and 179 nomadic pastoralists households for interview**.**

This sample size was calculated using the proportion sample size determination formula as given by Mugenda and Mugenda (1999).

$$n = \frac{z^2 pq}{d^2} = \frac{1.96^2(0.5)(0.5)}{0.05^2} = 384 \quad (1)$$

where *n* is the desired sample size of livestock farmers in Narok and Kajiado Counties, *z* is the standard normal deviate at the required confidence level, *p* is the proportion in the target population estimated to have characteristics of interest, *q* is 1- *p,* and *d* is the level of statistical significance set.

Analytical framework

Following the analytical framework of Hanemann et al. (1991), WTP for AI services by respondents was estimated using open-ended questions asking the respondents to declare the maximum amount they would be willing to pay, or close-ended, asking the respondents if they would be willing to pay a specific amount or not (dichotomous choice). In the current study, a closed-ended question approach was adopted given that most of the pastoralists were aware of the AI but could not arbitrarily attach a true value to the service. Moreover this approach is easier and more realistic since questions correspond more to a real market situation. On the other hand, the open-ended format is appropriate when the farmer is well informed about the new technology or product and its characteristics. However, literature indicates that such an approach would be misleading if the respondent lacks appropriate information and incentives to comprehensively determine the values to attach if a market were to exist (Boyle, 2017).

The use of contingent valuation (CV) methods to estimate farmers' valuation of non-market goods or new technologies as developed by social economists is not common, but it is widely used in environmental studies, wildlife conservation and natural resource economics (Hanemann et al., 1991). The technique is appropriate in imploring producers' WTP for a product that is not yet on the market, such as AI. Applicability of this approach demands that the researcher crafts a hypothetical market for non-market good, requests a set of subjects to operate in that market, and records the outcomes. The values generated through this hypothetical market are treated as estimates of the value of the non-market good or service (Mitchell and Carson, 1989).

In many transactions, farmers are offered a technology at a given price such that after considering his ability to buy, the decision is then reached on whether to buy or not. Estimating WTP using single-bounded method, the individual only responds to one bid which is incentive-compatible; it is in the respondent's strategic interest to say ''yes" if his WTP is greater or equal to the price asked, and ''no" otherwise (Mitchell and Carson, 1989). Utility maximization implies that a farmer will then only answer ''yes" to the offered bid if his maximum WTP is greater than the bid. However, the single-bounded method requires a large sample size and is statistically inefficient (Hanemann et al., 1991). In order to ensure efficiency of the estimates, double bounded method was adapted by offering the respondent a second bid, higher or lower depending on the first response. This approach includes more information about the respondents WTP and, therefore, provides more efficient estimates and tighter confidence intervals (ibid). Table 1 presents the definition of variables included in the model used.

The respondent was asked if he/she was willing to pay an amount B_i, for the provision of AI services on his farm per animal. If the farmer answers no then it can be assumed that $0 \leq WTP < B_i$, if he answers yes then $B_i \leq WTP < \infty$. More explicitly, the respondents will fall within one of the following categories: The farmer answers yes to the first question and no to the second question, then $B_i^u > B_i$ thus it can be inferred that $B_i \leq WTP < B_i^u$. The individual answers yes to the first question and yes to the second question, then $B_i^u \leq WTP < \infty$. The individual answers no to the first question and yes to the second question, then $B_i^d < B_i$, thus conclude that $B_i^d \leq WTP < B_i$,. The individual answers no the first and second questions, then we have $0 < WTP < B_i^d$.

Adapting the modelling framework of Hanemann et al. (1991), the likelihoods of these outcomes are π^{yy}, π^{nn}, π^{yn}, π^{ny}, respectively. Under the assumption of utility-maximizing farmer, the formulas for these likelihoods are as shown below. In the first case where the respondent accepts the initial and second higher bid, we have $B_i^u > B_i$;

$$\pi^{yy}(B_{i,}B_i^u = \Pr\{B \leq \max WTP and\ B_i^u \leq \max WTP\}$$
$$= \Pr\{B_i \leq \max WTP \mid B_i^u \leq \max WTP\}\Pr\{B_i^u \leq \max WTP\}$$
$$= \Pr\{B_i^u \leq \max WTP\} \quad (2)$$

In the second case where the respondent rejects the initial bid and second lower bid, we have $B_i^d < B_i$;

$$\pi^{nn}(B_i, B_i^d) = \Pr\{B_i > \max WTP\ and\ B_i^d > \max WTP\} \quad (3)$$

Third case is where the respondent accepts the initial bid and rejects the second bid, we have $B_i^u > B_i$;

$$\pi^{yn}(B_i, B_i^u) = \Pr\{B_i \leq \max WTP \leq B_i^{u}\} \quad (4)$$

The last case is where the respondents rejects the initial bid and accepts the second bid, we have $B_i^d < B_i$;

$$\pi^{ny}(B_i, B_i^d) = \Pr\{B_i \geq \max WTP \geq B_i^d\} \quad (5)$$

Computing the mean willingness to pay, a logistic curve was specified, fitted on the data and estimated. The log-likelihood function was then defined as follows and estimated:

$$\ln^{D}(\theta) = \sum_{i=1}^{N}\{d_i^{yy}\ln\pi^{yy}(B_i, B_i^u) + d_i^{nn}\ln\pi^{nn}(B_i, B_i^d) + d_i^{yn}\ln\pi^{yn}(B_i, B_i^u) + d_i^{ny}\ln\pi^{ny}(B_i, B_i^d) \quad (6)$$

where $d_i^{yy}, d_i^{nn}, d_i^{yn}$ and d_i^{ny} are binary-valued indicator variables.

The final step was to specify and estimate a WTP regression model to determine factors influencing WTP. The regression method allows inclusion of other factors in the analysis, in particular socioeconomic characteristics of the respondents to explain the bidding behaviour. However, WTP can be computed with or without inclusion of covariates in the modelling strategy as illustrated by Lopez-Feldman (2012).

RESULTS AND DISCUSSION

Farmers' awareness and willingness to accept AI services

Prior to establishing the extent to which farmers would be willing to pay for AI, it is imperative that we determine if they are aware of this technology. To illustrate this, descriptive analysis was carried out and the results presented in Figure 1. It was evident that 89.9 and 90.3% of farmers in Kajiado and Narok Counties respectively knew about the existence of AI services. This provides much needed background upon which sensitization needs to be built in order to achieve maximum diffusion of the technology. However, awareness of AI does not guarantee its uptake as noted by Chinese consumers towards biotech rice. Lin et al. (2006) found that consumers who were aware of biotech foods were less inclined to purchase biotech rice than those who had no or little awareness. Moreover, the impact of the awareness variable was not statistically significant in the case of biotech soybean oil (ibid).

Despite high levels of awareness, most farmers still use the natural service method as the major breeding method. This could be attributed to the fact that accessibility of the services is still a major challenge due to infrastructural constraints, faith in the technique and the communities' preference for bull service as reported by Janssen-Tapken et al. (2006). Inadequacy in number of AI technicians and accompanying inputs would hamper farmers' access to and adoption AI technology (Kassa and Wuletaw, 2018). Despite AI as a technology being technically beneficial, lack of appropriate delivery system, its adoption and effectiveness in pastoral areas is declining. The consequence of this fall is undesirable because the genetic potential and productivity of the dairy herd in ASALs is bound to decline very rapidly.The inadequate incentives for both public and private breeders to practice in ASALs have been a major hindrance to the spread of AI services across from the highlands to the ASALs.

The long distances that must be covered by a service provider between one household to another in ASALs and to the nearest markets and the cost incurred outweigh the revenues that are likely to be generated from such business. This therefore necessitates deliberate government intervention in deploying public AI service providers and facilitates their movements within these areas (ibid).

The decision to pay for a particular technology depends solely on the prior response on the willingness to accept it. This underscores the importance of qualitative studies on perceptions of both producers and consumers of services and goods before introducing them in the market. The question of amount is only relevant if the farmer is willing to accept AI otherwise a hypothetical scenario has to be created to entice him to reveal his willingness to accept (Boyle, 2017). This is based on the assumption that there are underlying constraints to access AI (accessibility, cost and success rate) such that if they are addressed then they may be willing to value the technology. Figure 2 indicates that among farmers who were aware of AI (89.9% in Kajiado and 90.3% in Narok), 38.8% from Kajiado were willing to accept and adopt compared to their counterparts (23.3%) in Narok County. This implies that farmers have reservations about the adoption of AI despite wide spread knowledge about AI. Current study findings are inconsistent with the findings of Dehinenet et al. (2014) who found awareness of diary technologies through livestock training to have increased farmer's probability of adopting and owning the improved technologies.

Monetary valuation for artificial insemination in pastoral areas

To ensure sustainability of the technology in pastoral areas, farmers were presented with different bids to establish amount they were willing to pay for AI. On average, 51.7% of the sampled farmers in Kajiado were willing to pay the initial bid proposed to them. Table 2 illustrates farmers bidding behavior with respect to different bids that were given.

The results also indicates that as the bid increases from KES 600 to KES 3000, the number of farmers affirming their ability to incur that cost declines. This is rational of farmers because as the cost of a new technology increases, given their cost outlay, they pursue a minimization objective and keep their production goals intact. The second bid is contingent on the response and amount indicated by the farmer in the initial bidding (Hanemann et al., 1991; Boyle, 2017). It is evident from Table 3 that farmers were willing to pay a second bid 48.9 and 50.5% in Kajiado and Narok counties respectively. The second bid offered was either a discount to the first bid offered for those farmers who declined to pay initial bid or a premium on the initial bid

Table 1. Variable definition for contingent valuation.

Name of the variable	Definition
B_i	Initial bid in KES
B_i^u	Second higher bid in KES if answer to initial bid was yes
B_i^d	Second lower bid in KES if answer to initial bid was no
Nn	= 1 if the answer to the WTP questions was no, no
Ny	= 1 if the answer to the WTP questions was no, yes
Yn	= 1 if the answer to the WTP questions was yes, no
Yy	= 1 if the answer to the WTP questions was yes, yes
Awareness	=1 if the farmer has ever heard of AI in the last 5 years
Credit	=1 if the farmer had access to credit facilities in the last 12 months
Herd size	Current total number of cattle owned by farmer
Extension	=1 if farmer had access to extension services
Education	Number of years of schooling
Age	Number of years the farmer has been living
Household size	Number of household membership
Off-farm income	=1 if farmer earns some extra income from off-farm activities

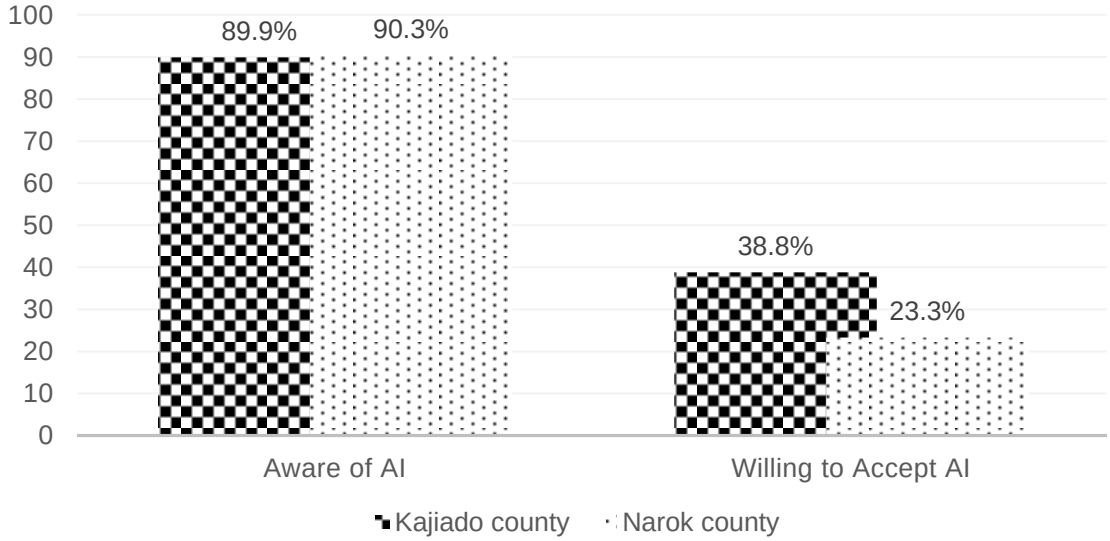

Figure 2. Distribution of farmers' awareness and willingness to accept artificial insemination services in the last 5 years.

Table 2. Bidding pattern for the initial bid.

County	WTP the first bid	The amount the farmer is willing to pay for artificial insemination						
		KES 600	KES 1200	KES 1800	KES 2400	KES 3000	Total	
Kajiado County	No	4	2	34	18	28	86	48.3%
	Yes	36	13	19	16	8	92	51.7%
	Sub-sample	40	15	53	34	36	178	100%
Narok County	No	5	7	42	16	32	102	49.5%
	Yes	33	12	40	6	13	104	50.5%
	Sub-sample	38	19	82	22	45	206	100%
Sample		78	34	135	56	81	384	

Table 3. Bidding pattern for the second bid.

County	WTP the first bid	The amount the farmer is willing to pay for artificial insemination							
		KES 400	KES 800	KES 1500	KES 2000	KES 2800	KES 3600	Total	
Kajiado County	No	0	9	23	24	30	5	91	51.1%
	Yes	4	29	24	13	14	3	87	48.9%
	Sub-sample	4	38	47	37	44	8	178	100%
Narok County	No	1	6	21	38	27	11	104	49.5%
	Yes	4	34	33	18	11	2	102	50.5%
	Sub-sample	5	40	54	56	38	13	206	100%
Sample		9	78	101	93	82	21	384	

Table 4. Double bounded contingent valuation without covariates.

Variable	Coefficient	Standard err	Z	P value
Beta constant	1881.25	50.79	37.04	0.00
Sigma constant	844.13	43.28	19.50	0.00
Number of observations		384		

for the farmer who were willing to pay initial bid as the true price for getting AI. The bidding behaviour of farmers towards the second bid was similar such that as the amount increases, then few are willing to incur such cost as can be seen when bid rises from KES 400 to KES 3600 as shown in Table 3.

Table 4 shows results of a double bounded contingent valuation approach without including covariates. The results revealed an average of KES 1881.25 as the mean WTP for AI by pastoralists in ASALs of Kajiado and Narok Counties. This reflects a premium of 25.4% placed on AI by pastoralists with reference to the base price of KES 1500 offered for exotic breeds in Kenyan highland.

However, the bidding decision by the farmer is informed by various factors including his awareness towards AI, access to credit facilities to finance new technologies, herd size, household size, age, education levels, access to extension services, and his off-farm income. It's worth noting that in expressing the amount they are willing to pay for the provision of the service, there is implied price comparison between the cost of the bid and the cost of acquiring the bull. Sahiwal bull at market price at that time was KES 120,000 if bought from KALRO – Naivasha and KES 80,000 if bought from the local markets. However, the survey revealed that most Sahiwal farmers interested in replacing the bull or acquiring an extra one would prefer getting it from KALRO. Inclusion of factors influencing the bidding behavior of the farmer, the Mean WTP for AI services reduces to KES 1853.19. This reflects a deviation of KES of 353.19 (23.5% of base price of KES 1500). As indicated in Table 5, awareness, herd size and access to extension had significant positive influence while farm income had significant negative effect on farmer's bidding process.

Knowledge about the existence of a good or technology by the farmer influences his decision to approve its uptake. In the current study, farmers awareness was found to positively influence his WTP for AI. Exposure to information on AI technology increases the probability of accepting a higher bid by 68.3%. These results corroborate findings of Ghosh et al. (2005) that have knowledge about AI, green fodder feeding, concentrate feeding and communication source directly and indirectly promotes the adoption of AI among dairy farmers of both co-operative and non-member co-operative societies. However, current study results are contradicted by study findings of Lin et al. (2006) who found consumers with exposure or awareness of biotech rice to be less inclined to purchase biotech rice than those who have no or little awareness. This implies that targeting the dissemination of information to farmers with the least exposure or no awareness would be a more effective strategy to achieve sustainability of AI technology in pastoral areas

Farmers herd size had a positive significant effect on farmer's WTP for AI. This could be attributed to the fact that farmers with large herd sizes found it economical to use AI than to procure the bull which is more expensive compared to the cost of AI. Moreover, repeated use of same bull leads to in-breeding. Inbreeding in pastoral areas is a reality given the fact that most farmers do not keep record as established from our survey and this explains low livestock productivity levels experienced by most pastoralists.

Effective extension services in ASALs could aid pastoralists in using AI in improving their herd's fertility

Table 5. Parameter estimates for WTP model for AI with covariates.

Variable	Coefficient	Standard err
Awareness	0. 683***	0.242
Credit	0.192	0.164
Herd size	0.001*	0.001
Extension	0.643***	0.147
Education	0.022	0.050
Age	-0.135	0.098
Household size	-0.01	0.013
Off-farm income	0.533***	193
Number of observations	384	
LR Chi2(8)	119	
Prob > Chi2	0.00	
Mean WTP	1853	

***, ** and * refers to statistically significant at 1, 5 and 10% respectively and the p values are in parenthesis.

through exchange of desired genetic materials thereby replacing less productive cattle breeds. However, lack of quality breeding services and perceived costs and risks has been their greatest hindrance in its adoption (Ericksen and Crane, 2018). Access to extension had positively significant effect in establishing farmer's WTP for AI. Availability of relevant information from credible sources has the effect of influencing farmer's preferences towards a new technology. Innovative approaches by promoters of a technology through extension officers and existing infrastructure have the probability to yield its sustainability upon their exit in agricultural subsector (Omondi et al., 2017).

Farmer's ability to purchase new technologies depends on his/her disposable income given existing production cost outlay. In this study, off-farm income had a positive significant effect in establishing farmer's WTP for AI services in pastoral areas. This could be attributed to the fact that pastoralists with extra income have the ability to buy more productive technologies to increase their output. These results confirm findings of Kimenju and De Groote (2008) who found consumers with higher income to have high WTP for fortified maize. Availability of off-farm income has a positive effect on technology adoption with little necessity to seek credit from lending facilities for most farmers in rural areas (Mwangi and Kariuki, 2015; Mmbando and Lloyd, 2017). This implies that farmers with off-farm income have higher propensity for new technologies.

CONCLUSIONS AND RECOMMENDATIONS

To ensure sustainability of the adopted technology, it is imperative that the beneficiaries be willing to financially and materially support its existence. In the current study, most farmers showed their willingness to accept AI technology despite challenges in accessing service providers. Existence of enabling market environment will motivate private service providers to operate in Kenyan pastoral areas. It was established that most farmers were WTP an average of KES 1853.2 for AI per cow. This reflects a premium of 23.6% placed on AI by pastoralists with reference to the base price of KES 1500 offered for exotic breeds in Kenyan highland. It is therefore recommended that both county governments and non-governmental organizations organize field days for pastoralists so that relevant information about AI is disseminated and free trials done on lead farmers. Moreover, government should consider ensuring high quality semen is distributed to pastoralist at subsidized rate till they gain confidence in the technology. This is because adoption of AI has the potential in easing the demand of the Sahiwal bull from an already limited supply.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Determinants of smallholder indigenous chicken farmers' market participation decisions and value of sales in Gulu district

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Indigenous chicken play an important role in the livelihoods of the rural poor in developing countries. They not only act as a source of nutrition but also supplement household incomes. Despite the tremendous market opportunities available for the farmers, there are still low levels of market participation for indigenous chicken farmers in Gulu district and other parts of Uganda. In light of this, a research study was motivated to ascertain the drivers of smallholder indigenous chicken farmers' market participation in Gulu district. Using cross-sectional data from households in selected sub counties in Gulu district, a two-stage Heckman model was used to model the decision of the smallholder farmers to participate in the market and then determine the factors affecting the value of sales thereafter. Results from the descriptive statistics showed that there were 126 market participants and 24 non-participants. Both flock size and non-farm incomes differed significantly (5%) between market participants and non-participants. The participants had a larger flock size while non-participants had more income. The results of the probit model further revealed that the first stage of market participation was significantly affected by distance of the household to the market (1%), flock size (10%), and ownership of a bicycle (1%). In the second stage (outcome model), the OLS results revealed that flock size, distance to the market and market price of indigenous chicken significantly (1%) affected the indigenous chicken farmer's value of sales. In conclusion, creation of effective marketing systems that would help reduce transaction costs of the indigenous chicken, provision of extension and veterinary services will not only increase the flock sizes kept by the smallholder farmers but also the value of sales of indigenous chicken for the farmers that participate in the market.

Key words: Heckman model, smallholder farmers, indigenous chicken, market participation, Gulu district.

INTRODUCTION

Livestock farming in sub Saharan Africa (SSA) is considered a strategic way of reducing rural poverty and achieving higher incomes (NRI, 2002). This is because indigenous livestock can withstand a number of shocks

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therefore, are used by households as a form of saving and insurance mechanisms against production, and price uncertainties. The poultry sub sector is particularly important for agricultural growth and improvement of people's nutritional status in Uganda. Despite the tremendous expansion of the commercial poultry sector since the 90s, scavenging poultry have not been given much attention on improvement of the breed though still account for more than 90% of the total poultry production. Of the estimated 45.9 million birds present in Uganda, rural scavenging chicken represented 39.6 million (about 86.4%) of the total in 2012 (UBOS, 2013). The poultry sub-sector is crucially important in the context of agricultural growth and improvement of diets of people in Uganda. The sub-sector is particularly important in that it is a significant part of the household's nutritional intake. It is an attractive economic activity as well, especially to women and the rural poor. However, the indigenous chicken's potential has not been exploited in Uganda, as much as has been done in other African countries. This therefore creates a gap in not only marketing but also production aspects if the indigenous chicken.

Generally, the indigenous chickens (IC) are raised at a subsistence level with free-range system being more predominant and this has been found to be more profitable than keeping indigenous chicken under confinement (Menge et al., 2005). However, these birds need extra feed to supplement that obtained from their scavenging activity (King'ori et al., 2007). Usually, these flocks are small and external inputs few (Okitoi et al., 2006), flock sizes vary between 17 and 22 birds which composed of cocks, hens, pullets, cockerels, and chicks (Illango et al., 2002). Owing to the scavenging nature of these birds, a key farm-level problem is periodic pest and disease attacks, which at times wipes out the flocks to uneconomical production levels.

Farmers' failure to participate in the market can be influenced by a number of factors as illustrated by a number of studies (Gausi et al., 2004; Williamson, 1975, 1981; de Janvry et al., 1991; Goetz, 1992; Abeykoon et al., 2013; Jagwe et al., 2010) which are embedded in the theory of transaction costs.

IFAD (2003) and World Bank (2008) show that the intensification of agricultural production systems and increased commercialization must be built upon the establishment of efficient and well-functioning markets and trade systems that keep transactions costs low, minimize risks and extend information to all actors, particularly those living in marginal areas of productivity and weak infrastructure.

Smallholder producers normally face two critical decisions; the quest to meet food security requirements and the need for marketable surpluses. These farmers are not only known for their subsistence level of production but are also characterized by weak links to information systems outside the communities in which they stay. In Northern Uganda particularly Gulu district, there are a number of market opportunities for indigenous chicken. This is due to increasing demand for chicken and chicken products locally, regionally and from neighboring South Sudan due to not only the increasing population but also the increasing consumer awareness of the health benefit of white meat. A number of studies have been carried out to characterize the poultry sector within and out of the country but with more emphasis on production, management, pests, and diseases. It is upon this background that this study establishes the factors that affect market participation decision and value of sales of indigenous chicken.

METHODOLOGY

Study area

The study was conducted in Gulu district located in Uganda. Specifically, the study took place in Laroo division, Unyama, and Bobi sub-counties. Gulu receives an annual rainfall of 10 to 250 mm (www.weather) and temperatures of 17 to 30°C with an average elevation of 1070 m above sea level. Agriculture in this region is predominantly rain fed with non-farm activities and livestock rearing contributing to the people's livelihoods.

Model specification

In this paper, the factors that affect the indigenous chicken farmer's decision to participate in the market as well as the value of sales were investigated using the two stage Heckman's procedure to correct for self-selection of households into market participants and non-participants. A probit model that generates the inverse Mills ratios (IMR) for market participants and non-market participants is used. The IMR was used as an additional regressor in the Ordinary Least Squares (OLS) regression that uses value of chicken sales as the dependent variable in the outcomes model.

The smallholder farmers' market participation issues as investigated in this study involved a two-stage decision problem for the households. The first is a discrete decision of whether or not to participate in the poultry market, while the second is a continuous decision of income earned from poultry sales and conditional on a positive first decision. If unobserved preferences and characteristics affect both the discrete and continuous decisions involved, the error terms in the two respective equations are correlated. Moreover, the variables affecting the two decisions may not be the same. In such situations, the Heckman's two-step model becomes appropriate (Heckman, 1979; Abeykoon et al., 2013), as it corrects for the self-selection problem.

In the Heckman's two step model, first the equation on the discrete decision was estimated and second, the equation on value of poultry sales was estimated with the inverse Mill's ratio (λe) obtained from the first estimation included as an additional independent variable. The following are the procedures.

Selection model

Whether or not to participate in poultry market (stage 1) is modeled as:

$$Y^* = Z^1 \propto +\varepsilon_1$$

Y=1 if $Y^* > 0$

Y=0 if $Y^* \leq 0$ (1)

where Y^* = 1 if a household participates in the poultry market and equals to zero otherwise. $\propto$ is a vector of parameters to be estimated which measures the effect of explanatory variables on households decision. Z is the vector of explanatory variables. ε_1 is the error term which is normally distributed with zero mean and standard deviation of 1, that is, e~N (0,1).

Since the probit parameter estimates does not show by how much a particular parameter increases or decreases the likelihood of participating in the indigenous chicken market, marginal effects were calculated by multiplying coefficient estimate $\propto$ by standard probability density function while holding other independent variables at their mean variables. The marginal effect of dummy independent variables were analyzed by comparing probabilities of that result when dummy variables take their two different values, while holding all other independent variables at their mean values (Wooldridge, 2002). Finally, log likelihood function was then maximized to obtain parameter estimates and corresponding marginal effects as:

$$\mathrm{LnL}\left[\frac{\propto}{Y}, Z\right] = \sum y = 1 \; In[\phi(\mathrm{Z}^1 \propto)] + \sum y = 0 \; In(1 - \Phi(\mathrm{Z}^1 \propto)) \quad (2)$$

A number of post estimation tests were carried out, for example, the goodness of fit test and the *estatclassif* command. The results of these tests were satisfactory as the model attained acceptable prediction power and had the desired goodness of fit (These results are available upon request).

The selection model that was used in the first stage is:

$$\Pr(\mathrm{Y_1}) = \mathrm{f}(\mathrm{x_1}, \; \mathrm{x_2}, \; _{\mathrm{elec}}\mathrm{x_{11}}, \mathrm{e}),$$

where Pr ($\mathrm{Y_1}$) is the probability of the farmer making a decision to sell poultry and poultry products in the market or not. $\mathrm{x_1} - \mathrm{x_{11}}$ are the variables affecting the decision of the farmer to participate in the market and e is the normally distributed error term.

Outcome model

Conditional on indigenous chicken market participation, variables affecting value of chicken and product sales were modeled in the second stage OLS (outcome model) regression as specified:

$$Z_i^* = W_i \propto + \varepsilon_2$$

where

$$Z_i = Z_1^* \text{ If } Z_i^* > 0$$
$$Z_i = 0 \text{ If } Z_i^* \leq 0 \quad (3)$$

Z_1^* is the latent variable representing the value of poultry and poultry products sold which is observed if $Z_1^* > 0$ and unobserved otherwise. Z_i is the value of poultry and poultry products sold. W_i is the vector of covariates for unit *i* for selection equation which is a subset of Z^*. $\propto$ is the vector of coefficients for selection equation. ε_2 is the random disturbance for unit of selection equation.

One problem with the two Equations (1 and 3) is that the second stage decision-making processes are not separable due to unmeasured household variables affecting both discrete and continuous decision thereby leading to correlation between errors of the equations. If the two errors are correlated, the estimated parameter values on variables affecting volume of sales are biased (Wooldridge, 2002). Thus, the model that corrects for selectivity bias while estimating factors affecting value of poultry sales has to be specified. For this purpose, in the first step the inverse mills ratio (IMR) was generated using predicted probability values obtained from the first stage probit regressions of factors affecting indigenous chicken market participation. Then in the second stage the IMR was included as one of the independent variables in the value of poultry and poultry products sales regression. Thus, the value of sales equation with correction of sample selection bias becomes:

$$V = w_i \propto + \lambda \left[\frac{\phi(w_i \propto)}{\Phi(w_i \propto)}\right] + e_3$$

where $\phi(.)/\Phi(.)$ is the mills ratio, λ is the coefficient on the mills ratio, ϕ denotes standard normal probability density function. ε_3 is not correlated with $\varepsilon_1 \text{and} \varepsilon_2$ and other independent variables. Under the null hypothesis of no sample selection bias λ was not significantly different from zero. V is the value of sales (UGX).

In the second stage of the Heckman model, OLS estimation was used to test the effect of the hypothesized factors on the level of participation. The model was stated as:

$$\mathrm{S_n} = \mathrm{f}(\mathrm{y_1}, \mathrm{y_{2,(e \bmod y_{13}}}, \mathrm{e})$$

where $\mathrm{S_n}$ is the value of indigenous chicken and indigenous chicken products sold annually in the market. $\mathrm{y_1} - \mathrm{y_{13}}$ are the variables that were hypothesized to affect the value of indigenous chicken and indigenous chicken products sold by the farmer in the market. While in this equation, e is the error term.

Sampling and data collection

A multi-stage sampling procedure was done at three levels, first a purposive selection of Laroo division, Unyama; Bobi sub-counties was done. Secondly, farmers engaged in the attachment program in Laroo division and Unyama sub-county were purposively selected because they received training and information from the university. Thirdly, random selection of farmers from the primary sampling unit (farmers in Laroo and Unyama involved in the farmer's attachment program) and those in Bobi farmers association was done. This association at the time had 6 groups. These groups were divided according to how far they were from the road and from this, two groups a sample that is representative of those that are near the main road and those far away were selected. The actual households interviewed were randomly selected.

The overall sample size was 150 households. This was calculated using Sloven's formula (Yamane, 1967) for determining

sample size for a finite population and with a confidence coefficient of 95%.

The data covered information necessary to make household level indices of social, economic, demographic, and institutional indicators comparable across different categories of households, thus continuous and discrete variables were identified based on economic theory and empirical studies.

RESULTS AND DISCUSSION

The market participants and non-market participants were characterized using a number of socio-economic factors shown in Table 1. Overall, 150 respondents participated in the study and by disaggregation, 126 respondents participated in marketing of indigenous chicken and chicken products, while 24 were non-market participants. Non-farm income and number of birds were significantly higher for indigenous chicken market participants than their non-participating counterparts (5%). This showed that farmers who were engaged in off-farm activities tended to have less time for farm activities, which could involve selling the indigenous chicken. Flock size significantly (5%) differed between market participants and non-participants.

The results of the probit model (Table 2) illustrated that age negatively affected the decision to participate by 10%. This could be due to its marginal diminishing effect on production as one's age rises, hence a confirmation to the lifecycle hypothesis (Randela et al., 2008; Enete and Igbokwe, 2009). The number of birds owned was found to be significant at 10% in influencing the farmers' decision to participate in the market. This is in line with Osmani and Hossain (2013). It was further observed that the probability of participating in the market increased by 19.1% for those who lived closer to the market. This finding is consistent with Gebremedhin et al. (2015) and Fletschner and Zepeda (2002) who reported that farmers with access to village market arrangements usually produce and sell more than their colleagues with no such opportunities to sell.

Ownership of a bicycle increased participation significantly at 1%. If a farmer owned bicycle, their probability of participating in the market was increased by 13.8%. The reason might have been the low transportation costs by the farmer in travelling to the market. This finding is consistent with the finding of Olwande and Mathenge (2010) who reported that ownership of transport equipment was significantly associated with agricultural market participation among poor rural households in Kenya.

Distance to the preferred marketing channel was negatively and significantly correlated to the probability of selling indigenous chicken. Hence, the partial effect of a unit increase in distance on the conditional probability of selling livestock was -0.02488. This means that with each unit increase (1 km) in distance, the probability to sell reduced by 19.1%. Thus, this finding suggested that households that are closer to market outlets are more likely to sell their indigenous chicken than those households living further away. The findings about the significant effect of distance to market in this study are in line with empirical findings of Bahta and Bauer (2007), Gebremedhin et al. (2015), and Fletschner and Zepeda (2002) who also observed that farmers with access to village market arrangements usually produce and sell more than their colleagues with no such opportunities to sell. In addition to this, the efficiency of both marketing and production of agricultural products can be improved by availability of physical sites like markets (Oppen et al., 1997).

The flock size was found to be significant ($P<0.1$) in influencing the farmers' decision to participate in the market. Output was expected to positively influence the probability and the intensity of market participation. The more the output the more the farmer is able to generate marketable surplus for participation. The result is consistent with the findings of Bellemare and Barret (2006) for the pastoral regions of Northern Kenya and Southern Ethiopia

Bobi dummy for sub-county was found to negatively and significantly affect participation (5%). Being in Bobi would reduce the farmers' probability of participating in the market by 14.5%.

Age was found to negatively affect the decision to participate (10%) due to its marginal diminishing effect on production as it rises hence giving a confirmation to the lifecycle hypothesis. An increase in age by one year reduced the probability of participating in the market by 3.9%. The older part of the population found it hard to move to the market due to the relatively long distances to the market place if these people did not have the means of transport so they would end up selling at the farm gate that offered very low prices and therefore this discouraged them. On the other hand, Enete and Igbokwe (2009) argued that younger heads were more dynamic with regards to adoption of innovations both in terms of those that would enhance their productivity and enhance their marketing at a reduced cost. Randela et al. (2008) also observed that younger farmers were expected to be progressive, more receptive to new ideas and to better understand the benefits of agricultural commercialization.

The results of the OLS regression (Table 3) shows that the price of indigenous chicken (hens, cocks and pullets) was found to positively and significantly (1%) affect the value of poultry sales. The results showed that a unit increase in the number of hens, cocks and pullets caused the value of sales to increase by 2.41, 4.18, and 4.35 UGX, respectively. In a related study, Enete and Igbokwe (2009) found that price had an important influence on the level of farmers' market participation in cassava markets which is supported by economic theory that price induces increased supply. Omiti et al. (2009) also asserted that better output price and market information were key incentives for increased sales in the market, while household size and non-farm income significantly reduced the sales of vegetables in the market.

Table 1. Comparison of characteristics between indigenous chicken market participants and non-participants in Gulu district.

Variable name	Mean		Mean difference	Pooled (N=150)
	Market participants (n=126)	Non-participants (n=24)		
Nonfarm income (UGX)	130,793.7 (15145.4)	49,541.67 (16620.50)	-81,251.9 (35523.94)**	117,793.30 (13206.92)
Distance off farm (KM)	11.51 (7.9)	2.33 (1.58)	-9.18 (18.21)	10.05 (6.66)
Flock size	12.01 (0.60)	8.25 (1.58)	-3.75 (1.73) **	11.41 (0.64)
Trading experience (Years)	7.07 (0.60)	7.14 (2.40)	0.07 (1.84)	7.09 (0.67)
Education household head (Years)	6.14 (0.03)	5.74 (0.56)	-0.42 (0.78)	6.10 (0.29)
Household-size	6.71 (0.20)	6.38 (0.44)	-0.33 (0.63)	6.65 (0.23)
Age household head (Years)	40.73 (1.10)	38.60 (1.15)	-2.06 (2.97)	40.40 (1.08)

Numbers in parentheses are standard errors; **Imply significance at 5%.

Table 2. Results of the probit model for both market participants and non-participants in Gulu district.

Variable name	Probit coefficients (N=150)	Marginal effects
Bicycle ownership	1.923 (0.711)***	0.138 (0.511)***
Car ownership	0.845 (0.992)	0.096 (0.112)
Motorcycle ownership	1.472 (0.963)*	0.121 (0.069)*
Indigenous chicken trading experience	0.046 (0.027)*	0.006 (0.003)*
Flock size	-0.104 (0.064)	-0.013 (0.008)
In distance to market	1.549 (0.396)***	0.191 (0.073)***
Log flock size	-15.536 (7.487)*	-1.914 (1.042)*
Dummy Laroo	0.162 (0.882)	0.018 (0.088)
Dummy Bobi	-0.952 (0.429)**	-0.145 (0.076)**
Age	-0.039 (0.019)*	-0.005 (0.002)*
HH _Size	0.004 (0.071)	0.0003 (0.007)
Education of HH	-0.091 (0.065)	-0.008 (0.006)
Nonfarm	3.65e-06 (2.20e-06)*	3.40e-07 (0.000)*
Constant	33.013 (19.547)**	-
Log likelihood	-29.43	-
Wald chi-square	261.74***	-
Pseudo R^2	0.55	-
Prob.>Chi^2	0.0000	-

Numbers in parentheses are standard errors; ***, **, *Imply significance at 1, 5 and 10%, respectively; Na: Not applicable.

Table 3. Results from the OLS regression of value of sales for indigenous chicken farmers in Gulu district.

Variable name	OLS-Regression	OLS-Regression (Robust standard errors)
Flock size	2290.6 (728.9)***	777.78
Laroo Dummy	-25934.6 (18759.9)	19607.28
Bobi Dummy	-37029.5 (20912.6)*	20736.91
HH_Female Dummy	-8042.4 (12470.5)	13127.76
Sources_market info(radio)	-17085.4 (14170.2)	14458.14
Sources_market info(peers)	20607.8 (12029.9)*	11555.77
Sources_market info(traders)	3734.0 (10900.9)	10455.77
Extension2	16942.1 (11716.3)	10749.17
Distance to the market L	67142.1 (22099.9)***	23138.02
HH_Size LL	-71194.3 (82597.5)	79911.88
Price_Hens	2.41 (0.89)***	0.7422
Price_Cocks	4.18 (0.68)***	0.7420
Price_Growers	4.35 (1.31)***	1.448
Trading log	70250.01 (221968.8)	168029.2
IC Trading experience log	158485.4 (221968.8)	255019.2
Age of HH	-858.6 (511.5)*	425.68
Education of HH	704.4 (1617.2)	1594.2
HH_Size	2609.1 (4619.8)	3520.59
Nonfarm Income	-0.06 (0.39)	0.048
Market_dues	-6.1 (9.81)	9.743
Invmills	22140.5 (15376.9)	9793.89
Constant	-657445 (1037476)	-

Numbers in parentheses are standard errors; ***, **, *Imply significance at 1, 5 and 10%, respectively.

Flock size just like distance to the market was found to positively and significantly (1%) affect the value of poultry sales. That is for every unit increase in the flock size, the value of poultry sales increased by 2290.6 UGX. It was also observed that, the closer the distance to the market where the farmers sold their indigenous chicken the less the transport costs they will have to pay and hence the value of poultry sales increased by 67142 UGX. Point of sale is dummied and used as a proxy for transaction costs. Key et al. (2000) and Makhura et al. (2001) found that distance to the market negatively influences both the decision to participate in markets and the proportion of output sold. Therefore, when the point of sale is far, it will be expected to negatively associate with the intensity of participation to households who sold in market centers.

Location in Bobi was found to negatively and significantly (10%) affect the value of indigenous chicken sales. The value of sales of indigenous chicken for farmers in this sub county was reduced by 37029.5 UGX. This is because of the long distance to the main Gulu town market for those farmers located in Bobi sub-county. This long distance increases the transport costs and thus reduces the value of indigenous chicken sales.

Receiving information from the peer farmers positively and significantly (10%) increase the value of poultry sales 20607 UGX. While receiving information from traders though had a positive coefficient, did not significantly affect the value of poultry sales. This showed that the information received from fellow farmers could have been more accurate than that from traders and the radio.

Education, household size, experience in trading and extension though not significant had a positive coefficient on the value of sales of indigenous chicken as predicted by the a priori expectations.

CONCLUSIONS AND RECOMMENDATIONS

Indigenous chicken production could be a significant livelihood activity for smallholder rural poor farmers in Gulu district. Traditional management systems were predominant with low productivity. Hence, this production system can be categorized under low-input low output production system.

The results also show that market participation of indigenous chicken farmers is high with more than 80% of the population participating in the market. However, indigenous chicken production still remains low with very low numbers of birds kept by farmers because most farmers are not yet aware of its profitability and as a result of this, the farmers give it less attention.

Age variable is also significant in determining the decision of households to participate in the market, but this shows a negative relationship with the participation

decision and thus indicating diminishing marginal returns to participation. This is consistent with the life cycle hypothesis because as producers grow older, they experience increasing returns to participation because they establish contacts, gain experience, and cut down on search costs. However, as they grow older, and get past their active productive life, production reduces and so does market participation

Household income considered as wealth has a positive significant effect on the decision of smallholder indigenous chicken farmers to participate in markets. Wealth helps farmers in breaking market entry barriers, as households must be above a minimum income threshold to participate in a market.

Results also revealed that once a smallholder farmer decides to enter the market to sell, household characteristics, and farmer endowments are the key factors that influence how much to be sold into the market. Factors such as distance to the market, flock size, price of birds, and information from peers affected significantly the value of sales. While age and sub-county turned out to significantly in a negative way, influence the level of market participation in form of how much to sell. Therefore, this study recommends that farmers be assisted to boost productivity of their indigenous chicken; and since this serves as a great determinant in the value of sales, it would be highly necessary to investigate level of commercialization of this sector in this region.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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