Economic analysis of small-scale poultry production in Kenyan medium-sized cities of Kisumu and Thika

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Key words: urban agriculture, poultry farming, profitability, Kenya, Kisumu, Thika

1. INTRODUCTION

Rapid population growth and uneven economic development in Kenya has rendered formal employment incapable of meeting job requirements of the population (KIPPRA, 2016). With widespread poverty of 53 percent (in 2013) and an annual urbanization rate of four percent, poverty and food insecurity have increasingly become a major problem in urban areas (Republic of Kenya, 2011, 2012a; KIPPRA, 2016). Urban households engage in different income generating activities in the formal and informal sectors, including businesses, urban agriculture, and petty trade (Omondi *et al*., 2017). The informal sector, which has been growing constantly, provides employment opportunities to a significant proportion of the population (KIPPRA, 2016).

Urban-based agriculture, that is, engagement of urban households in agriculture, either in rural or urban areas, is an important livelihood strategy for many households in Sub-Saharan Africa (SSA), including Kenya (Jayne *et al*., 2015; Ayerakwa, 2017a; Omondi *et al*., 2017). For instance, in Ghana, 43 percent of households in Techiman and Tamale practice farming in urban or rural areas (Ayerakwa, 2017a). The proportion of urban farmers is even higher in Thika and Kisumu, in Kenya (55%) and Copper Belt Province in Zambia (84%) (Smart *et al.*, 2015; Omondi *et al*., 2017). Urban agriculture plays an important role of food provision and livelihood strategies for household in all income groups (Owuor, 2006; Lee-Smith, 2010; Warren *et al*., 2015; Ayerakwa, 2017a). Income shares from urban agriculture in SSA range between 12 and 36 percent, thus contributing significantly to the household economy of the urban population (Zezza and Tasciotti, 2010; Ayerakwa, 2017a; Omondi *et al*., 2017).Therefore, given the high participation rates and significant income contribution, it is not surprising that development agencies, researchers, and (local) governments have

focused much attention on urban agriculture (Dongmo *et al*., 2010; Lee-Smith, 2010, 2013; Mougeot, 2011; Stewart *et al*., 2013; Warren *et al*., 2015).

The role played by urban agriculture in cushioning citizenry against world food price shocks and urbanization of poverty makes it an important policy issue (de Zeeuw and Dubbeling, 2009; Zezza and Tasciotti, 2010), particularly in countries where a significant proportion of the urban population practice agriculture. The unprecedented urban food demand caused by rapid urbanization, increase in urban population, and a dietary shift of increased consumption of animal products (Popkin, 2003; Pingali, 2006, 2010; Reardon, 2016), presents an opportunity for urban farming to enhance food security and poverty alleviation. Urban farmers engage in agriculture to cater for their household food needs, through direct consumption of their produce or by marketing part of the produce to earn an income (Ayerakwa, 2017a; Omondi *et al*., 2017). Whereas cereal staples produced in urban spaces are mainly for household consumption, vegetables and livestock products are mainly for income generation (Dongmo *et al*., 2010; Prain and Lee-Smith, 2010).

The decision to engage in urban livestock farming can therefore be assumed to be profit motivated, in addition to food provision and as a leisure activity. Urban poultry farmers can therefore be considered to be operating microenterprises, which combine factors of production and available technology to produce outputs. Such microenterprises, ranging from small-scale trading, service provision, and agro-microenterprises provide employment opportunities to a significant proportion of the population in developing countries, thereby contributing to poverty reduction and food security (Khaleda, 2013).

While a majority of studies analyze the role of urban agriculture for food security, through food security indicators (Zezza and Tasciotti, 2010; Warren *et al*., 2015; Ayerakwa., 2017a;

Omondi *et al*., 2017) or the availability of urban land for agriculture (Martellozo *et al*., 2014; Badami and Ramankutty, 2015), this study focuses on urban agriculture from an income and economic perspective. It analyses the economic feasibility of poultry farming and the factors that affect its profitability. This is important given that money earned from agricultural activities can be channeled to household food needs and other expenses (Chege *et al*., 2015).

Urban poultry farming presents an interesting case, which will continue to be important and feasible in the context of increased demand for food by rising urban populations, mounting land constraints for more extensive urban agricultural production, and the dietary shift towards white meat consumption (Delgado *et al*., 1999; Kearney, 2010; King'ori *et al.,* 2010). At the same time poultry production requires smaller space and less investment and gives faster returns than large livestock (Omiti and Okuthe, 2009). Additionally, the poultry enterprises provide farming households with both animal protein and income. Indeed, close to a quarter of households (24%) in six medium-sized cities in SSA engage in poultry farming[1]. The prevalence of poultry farming among households in these cities ranges from 31 percent in Mbale and Mbarara in Uganda, to 23 percent in Techiman and Tamale in Ghana, and to 21 percent in Kisumu and Thika in Kenya. Even though all nodes of the poultry value chain, from inputs acquisition, production, inputs and outputs transportation, value addition, and marketing present opportunities for microenterprises, this study focuses only on poultry production-oriented microenterprises.

In Kenya, several County governments, have been promoting agro-based microenterprises as an alternative to formal employment. For example, as a part of plans to ensure food security, Kisumu County provided urban farming households with poultry production inputs

such as Day Old Chicks (DOCs) and feed[2]. This implies that the County government considers urban poultry farming as a viable economic activity. To this end, the aim of the study is to investigate the economic benefit and feasibility of urban poultry production. This is achieved by answering two research questions; To what extent is poultry farming economically feasible? What factors determine profitability of poultry enterprises?

2. METHOD

a. Study sites and data

This case study is based on primary data collected during the months of July 2016 and October 2016, with a reference period of the previous six months. Data for the study were collected at the household level, in medium-sized Kenyan cities of Kisumu and Thika. Thika is located in the Central part of Kenya, only 50 km North of Nairobi and has a population of 151 thousand inhabitants (Omondi *et al*., 2017; Republic of Kenya, 2012b). Kisumu is in the Western part of Kenya, with a population of 383 thousand (UN-HABITAT, 2005; Republic of Kenya, 2012b).

Using an urban agriculture baseline survey of 2013[3], a list of all poultry producing households in Thika and Kisumu was used as the sampling frame. Households in the two cities were sampled randomly using MS-Excel random number generator, with the aim of interviewing about 300 poultry farming households from the list. However, because of relocations and migration, it was only possible to re-interview 45 households. The rest of the sample consists of poultry farming neighbors to those missing from the original sample resulting in a total of 312 respondents, 177 in Kisumu and 135 in Thika. The sample consisted of households producing broiler, layer, and indigenous chicken among other

poultry species. Indigenous chicken producers constituted the majority of sampled households, with 254 households producing indigenous chicken.

Data were collected on household demography, poultry production, management, and marketing. In addition to summary statistics, descriptive comparative analyses across the two cities on costs, revenues, and profitability were conducted. The study further applied multivariate regression analysis to analyze factors determining the performance (profitability) of indigenous chicken production. Some households had very few indigenous chickens, therefore, the sample was truncated based on the number of indigenous chicken kept and reason for keeping poultry, allowing a minimum of 20 birds produced for income generation. This reduced the sample of indigenous chicken producing households from 254 to 157 for regression analysis.

b. Conceptual framework: determinants of farm performance

Just like in other production activities, farmers are faced with decisions on what, how much, and how to produce agricultural commodities. Although urban farmers have varying objectives for farming, some consider it as a business, with an aim of making profit (Dongmo *et al*., 2010; Prain and Lee-Smith, 2010). Because of difficulties in measuring household utility, farm profit is often used as a proxy for welfare (Barrett *et al*., 2012). In this study, gross margin per bird has been used as a measure of farm performance (profitability).

The dependent variable is the natural log of gross margin per bird. Gross margin was specified as $GM = TR - TVC$ where GM is the gross margin in Ksh. per bird and TR is the total revenue in Ksh., derived from sales of chickens, eggs, and manure. TVC is a summation of variable costs in Ksh., including costs of DOCs, feed, drugs, and heating. Most of the

interviewed households used family labor for production of indigenous chicken. Labor was therefore excluded from calculation of gross margins. For multivariate analysis, gross margin was transformed to natural logarithm. For those households making losses, the loss was transformed by adding the absolute value of the highest loss plus one to make all values positive, after which they were transformed to natural logarithm (Bos and Koetter, 2011; Huang *et al*., 2017).

For the empirical model, a multivariate linear regression was fitted that relates gross margin to independent variables. The choice of explanatory variables was based on farm performance and agricultural marketing literature, discussed hereafter. The control variables included in the regression model include access to market information, marketing channel, household location, land ownership, poultry production system, and gender of poultry enterprise owner.

Access to market information is expected to have a positive effect on the level of farm performance. Different market channels offer different prices and as such, choice of market channel is expected to have effects on profitability (Chege *et al*., 2015). Recent literature on agricultural products marketing splits the market channels into conventional and high value markets (HVMs). Conventional markets are traditional spot markets, including open-air market, farm-gate marketing, and selling to wholesalers (Andersson *et al*., 2015). HVMs often involve contract arrangements between producers and firms or supermarkets (Chege *et al*., 2015). In the current context, HVMs for indigenous chicken include hotels and restaurants, schools, hospitals, supermarkets, and butcheries. Conventional or traditional markets on the other hand include farm-gate sales and selling to brokers and retailers.

Farmers linked to HVMs are expected to be more productive and earn higher farm incomes than those selling to traditional markets (Chege *et al,* 2015).

Distance to output markets guide the decision on the type of market to sell the outputs (chicken and eggs). Although distant markets may offer higher prices than nearby markets, they are often associated with high transportation and transaction costs (Alene *et al*., 2008; Fischer and Qaim, 2010). Using supermarkets as an example of a HVM involving contractual arrangements, studies point out that even though they offer higher and more stable prices than traditional markets, lack of transportation means and high opportunity cost of time tend to exclude some producers from such markets (Chege *et al*., 2015; Andersson *et al.,* 2015; Neven *et al*., 2009; Rao and Qaim, 2011).

Of interest to the study was to analyze the role played by location in indigenous chicken farm performance. The two surveyed cities vary in terms of size of poultry and egg market, number of different chicken producers, and access to and prices of production inputs. Thika is located close to Nairobi, the Capital, which provides a large market for agricultural outputs. In addition, apart from indigenous chicken production, Thika has a large number of layer and broiler producers (Okello *et al*., 2010). Kisumu is less centrally located and depends mostly on food imports from neighboring counties (UN-HABITAT, 2005). Furthermore, most of the input producing companies, especially feed companies are located in or close to Thika (Omiti and Okuthe, 2009).

Land is an important factor of production. In an urban agriculture context, farm land has been diminishing or converted to other uses such infrastructural development or real estate development (Ayerakwa, 2017b). It becomes even more important in the context of developing countries facing increased urbanization and landlessness (Briones, 2015).

Although it is hypothesized that access to land increases performance of agricultural enterprises (Alene *et al*., 2008), some types of agricultural production become more feasible and profitable under increasing land constraints, particularly in urban settings (Pribadi and Pauleit, 2015).

Different poultry production systems are in use in the surveyed cities. The main indigenous chicken production systems are free range, deep litter, and a combination of free range and deep litter systems. In free range system, birds are allowed to scavenge freely for food, such as insects, grains, and grass during the day and sheltered at night (King'ori *et al*., 2010; Okello *et al*., 2010). Occasionally, food supplements from household food waste are provided (King'ori *et al*., 2010). In deep litter, birds are often confined throughout the day and night and the system is highly dependent on purchased feed, while in combination of free range and deep litter, birds are housed during the day, provided with food and water, and sometimes allowed to scavenge for food.

3. RESULTS AND DISCUSSION

a. Household demographic and indigenous chicken production characteristics

Table 1 presents household demographic characteristics of indigenous chicken producers in Kisumu and Thika. A typical indigenous chicken farmer is in his or her mid-40s and has practiced poultry farming for close to seven years. However, poultry farmers in Thika are significantly older than their counterparts in Kisumu. An average farmer has 11 years of formal schooling, meaning that they started high school but did not finish. On average, the farm households have close to five members, with Kisumu households being slightly bigger. These figures are higher than the average household size for the country (3.9) and urban areas (3.2) (Republic of Kenya, 2015). This implies that urban farming households are

generally larger than the non-farming households (Lee-Smith, 2010). The relatively larger households than the non-farming households provide the family labor needed for poultry production.

Most of the households producing indigenous chicken enterprises earn low and middle incomes and poultry farms are located approximately two km away from output markets. A majority of poultry enterprises are co-owned between male and female household members (usually husband and wife). However, in Thika, most of the poultry enterprises are female owned. This is consistent with other urban agriculture studies which report that females tend to dominate poultry production while men produce large livestock like pigs, dairy (David *et al*., 2010; Dongmo *et al*., 2010). On average, each respondent own about 1.34 acres of land with households in Kisumu having significantly larger parcels than Thika (Table 1). Households that reported that they own land were about 78 percent of the sample.

Table 1: Summary statistics of indigenous chicken farming in Thika and Kisumu, 2016

	Variables	Kisumu (n=105)	Thika (n=52)	Whole sample (N=157)
Household demographic characteristics[1]	Gender of household head (1=male, 0=female)	0.78	0.78	0.78
	Age of household head (years)	42.7 (1.2)	50.2 (1.8)	45.2 (1.0)[c]
	Experience (years)	7.0 (0.5)	6.7 (0.7)	6.9 (0.4)
	Education of household head[2] (years)	11.0 (0.4)	10.9 (0.3)	10.9 (0.3)
	Household size (number)	5.1 (0.2)	4.3 (0.2)	4.8 (0.2)[b]
	Distance to output market (km)	2.6 (0.2)	0.9 (0.27)	2.0 (0.2)
Gender of owner	Female owned	25.7	44.2	31.9
	Male owned	18.1	23.1	19.7
	Both male and female owned	56.2	32.7	48.4
Household income status[3]	Low income	44.2	28.6	39.1
	Middle income	34.6	32.7	34.0
	High income	21.2	38.46	26.9
Production ,management, and marketing	Free range	46.7	23.1	38.9
	Deep litter	21.9	23.1	22.3
	Both free range and deep litter	31.4	53.8	38.9
	Supplementary feeding (1=yes, 0=otherwise)	0.90	0.92	0.91
	Bio-security (1=yes, 0=otherwise)	0.30	0.15	0.25[a]
	Keep records (1=yes, 0=otherwise)	0.18	0.17	0.18
	Access to market information (1=yes, 0=otherwise)	0.90	0.35	0.71[c]
	High value market	10.5	9.6	10.2
	Brokers/retailers	52.4	9.6	38.2
	Direct sales/neighbors	35.1	80.8	51.6
Land size	All households (acres)	1.4 (1.9)	0.2 (0.3)	1.0 (1.7)[c]
	Those with land only	1.9 (2.0)	0.3 (0.3)	1.3 (1.8)[c]

Note[1]: Age, experience, education, distance, number of birds, and gross margin represent the mean, the rest of the variables are proportions

Note[2]: During the time of the survey, education system in Kenya was as follows: Primary school education lasted eight years, secondary school education lasted four years while college/university lasted three or more years (Republic of Kenya, 2015)

Note[2]: Low income households earn less than Ksh. 15,000, medium income households earn between Ksh. 15,001 and 30,000, high income households earn above Ksh. 30,000 per month (1USD was equivalent to Ksh. 100 at the time of survey)

Note[4]: Figures in brackets are standard deviations, [a] Significant at 10%, [b] significant at 5%, [c] significant at 1%

Source: Author's survey, 2016

The most common production systems are free range system and a mix of free range and deep litter systems. Management, productivity, and biosecurity levels of the different production systems vary. Free range system is the most dominant system because it is less costly owing to reduced expenses on feed, while deep litter is highly dependent on purchased feed and has high management costs (King'ori *et al*., 2010; Okello *et al*., 2010). The main problem with free range system is disease outbreaks, mainly, New Castle Disease (NCD) which can wipe out the entire flock and high chick mortalities (Omiti and Okuthe, 2009; Okello *et al.,* 2010).

Most farmers provide supplementary feeding, but only one out of four maintain bio-security measures. This is because most indigenous chicken producers mainly seek veterinary services when there are disease outbreaks (Omiti and Okuthe, 2009; King'ori *et al*. 2010). In addition, only a small proportion of farmers (18%) keep poultry production and marketing records. Records are important for poultry farming in calculating returns from the enterprise (Ondwasy *et al*., 2006). Seven out of ten poultry farmers have access to market information. A majority of poultry producers sell their output in traditional markets, such as open air markets and to neighbors, retailers, or brokers, and only 10 percent are selling to HVMs, including hotels and restaurants, butcheries, and processors. The predominant market channel in Kisumu is brokers and retailers while in Thika, a majority of indigenous chicken producers sell directly in markets or neighbors (Table 1).

Indigenous chicken production system, marketing, and performance across different categories of farmers

The production systems and marketing with regards to profitability and variability in the two cities are summarized in Table 2. Simple comparison of means demonstrate that indigenous chicken farming is more profitable in Thika than Kisumu, and poultry enterprises co-owned by male and female household members appear to perform better than enterprises owned by males and females independently. Profitability also varies sharply across households based on their income status, particularly the middle income households who earn a significantly higher gross margin than the low and high income households.

Meanwhile, poultry farming under free range production system generates slightly higher gross margin than deep litter or a combination of free range and deep litter production system. This is because there is a reduction in feed expenses in free range system. Consequently, those who provide supplementary purchased feed earn slightly less profits than those who do not. Surprisingly, although not statistically significant, farmers who had access to market information seem to make less profit than those who had no access to market information. Lastly, the majority of farmers who sell their chicken or eggs directly to neighbors or in markets, earn considerably more profits than those selling to brokers and retailers, and slightly more than those selling to HVMs. Brokers often purchase poultry at the lowest price and later sell to other actors at a profit (Bett *et al.,* 2012).

Table 2: Performance of different categories of indigenous chicken farming in Kisumu and Thika, 2016

		Proportion (%)	Mean gross margin (Ksh./bird)
City	Kisumu	66.9	533
	Thika	33.1	1185[c]
Gender of owner	Female owned	31.9	598
	Male owned	19.7	693
	Co-owned by male and female	48.4	894
Income	Low income	39.0	561
	Middle income	34.0	1114
	High income	27.0	583
Production system	Free range	38.9	884
	Deep litter	22.2	652
	Both free range and deep litter	38.9	692
Supplementary purchased feed	Yes	91.1	740
	No	8.9	958
Access to market information	Yes	71.3	736
	No	28.7	805
Market channel	High value market	10.2	899
	Brokers and retailers	38.2	511
	Direct sales/neighbors	51.6	919

[a] Significant at 10%, [b] significant at 5%, [c] significant at 1%

Source: Author's survey, 2016

Indigenous chicken commercialization and economic performance

Indigenous chicken producers in Kisumu and Thika have on average 68 birds. Overall, 58 and 24 percent of chickens and eggs are sold, respectively in the two cities. On the other hand, households consume 32 percent of chickens and 37 percent of eggs they produce[4]. The consumption level of eggs is much lower in these two cities than the average for Kenya, at 50 percent (Omiti and Okuthe, 2009). This is an indication that urban poultry producers are more market oriented (Prain and Lee- Smith, 2010; David *et al.,* 2010). As shown in Figure 1, the proportion of eggs and birds consumed and marketed vary significantly across the two cities. In Kisumu, a significantly higher proportion of indigenous chickens are marketed than in Thika. In contrast, a significantly higher proportion of birds are consumed in Thika than in

Kisumu. Likewise, more eggs are sold in Thika than Kisumu, while a higher proportion of chickens are consumed in Kisumu than Thika. A plausible explanation is that Kiambu County, in which Thika is one of the sub-counties, is the main producer of eggs in Kenya (Omiti and Okuthe, 2009; Okello *et al.*, 2010). It is therefore easy for producers in Thika to market their eggs through the already established egg market in the County.

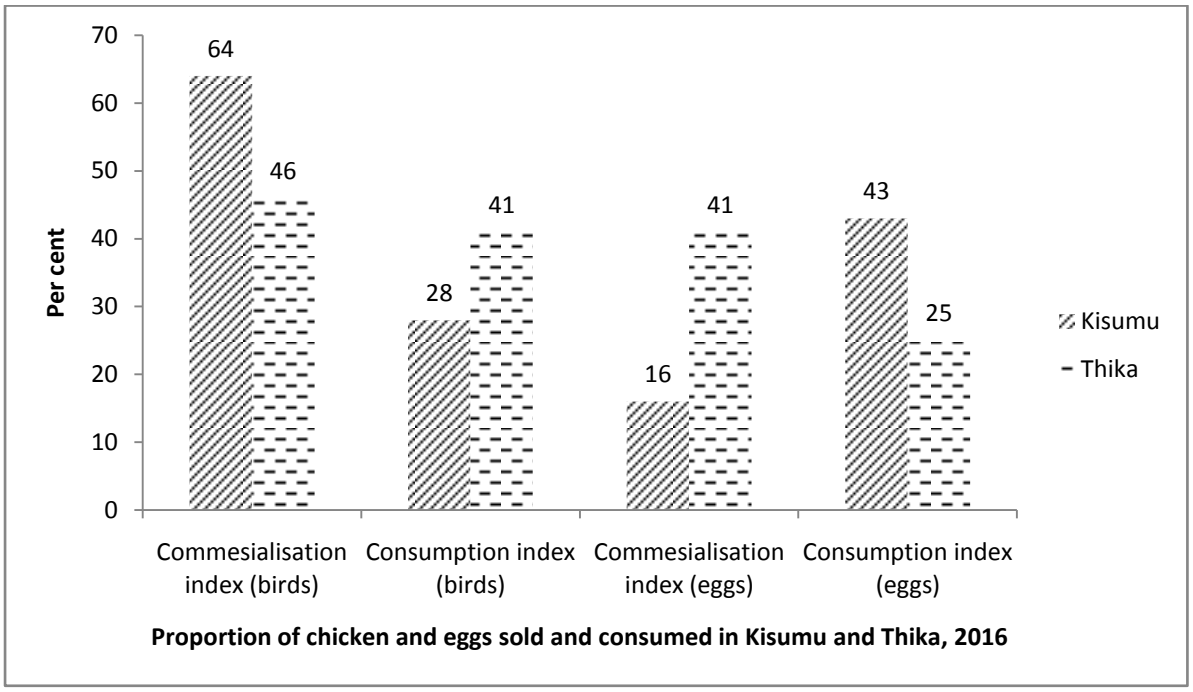

Figure 1: Proportion of chicken and eggs sold and consumed by poultry producing urban households in Kisumu and Thika, 2016

Source: Author's computation from 2016 survey

Costs and economic performance of indigenous chicken production

As indicated in Table 3, cost of feed constitutes the largest share of total production costs for indigenous chicken, accounting for close to three quarters of total costs. Indeed, some broiler and layer producers in Kenya have exited production because of high cost of feed (Okello *et al.,* 2010). The second largest cost is the purchase of DOCs or breeding stock.

Costs for drugs, including vaccines, antibiotics, and veterinary services constitute the third largest cost. The distribution of production costs do not vary significantly between the two cities, except for costs of drugs which are slightly higher in Kisumu than Thika. The high cost of drugs in Kisumu is because most farmers in Kisumu use the free range production system whose main constraint is disease outbreaks.

Table 3: Shares of different costs in indigenous chicken farming in Kisumu and Thika, 2016

	Share of cost (%)		
Item	Kisumu	Thika	Whole sample
Feed	70	76	73
DOCs	18	22	19
Drugs	10	1	7
Heat	2	1	1

Source: Author's computation, 2016

Comparison of revenues, costs, and gross margins of indigenous chicken farming in the two cities (Figure 2) show that they are all significantly higher in Thika than Kisumu. Revenues are derived from sale of eggs, chicken, and manure. On average, each indigenous chicken farmer generates Ksh. 756 from each bird. However, farmers in Thika earn gross margins of Ksh. 1,185 per bird, which is more than double that of their Kisumu counterparts.

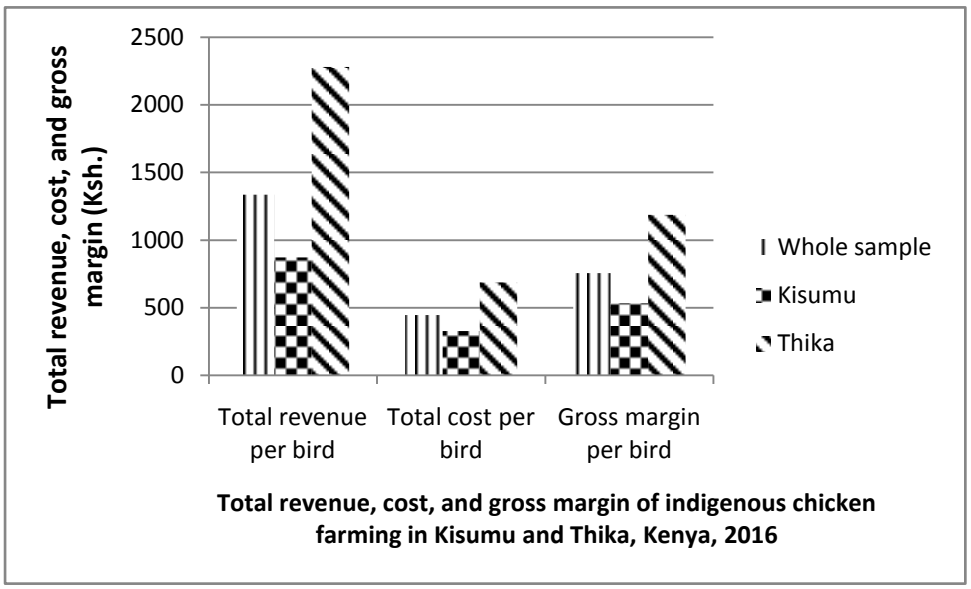

Figure 2: Total revenue, cost and gross margin of indigenous chicken production in Kisumu and Thika, 2016

Indigenous chicken production constraints

Poultry diseases are the most common constraint reported by indigenous chicken producers (Figure 3). New Castle Disease (NCD) is the most serious disease afflicting indigenous chicken poultry producers, particularly among those using free-range production systems (Omiti and Okuthe, 2009). Other important diseases include coccidiosis, fowl pox, and fowl typhoid. About a third of indigenous chicken farmers indicate that the high cost of inputs, especially feeds, is a major challenge. Lack of market, low market prices for eggs and chicken, and pest (fleas, lice, and mites) were reported as constraints by a minority of farmers. Poultry diseases can be abated through vaccination and maintenance of hygiene. However, in Kenya, the vaccine for NCD, the most fatal poultry disease, is sold in doses of 100 birds and requires refrigeration for storage (King'ori *et al*., 2010). This hinders farmers with less than 100 birds and who lack refrigeration facilities from buying the vaccine.

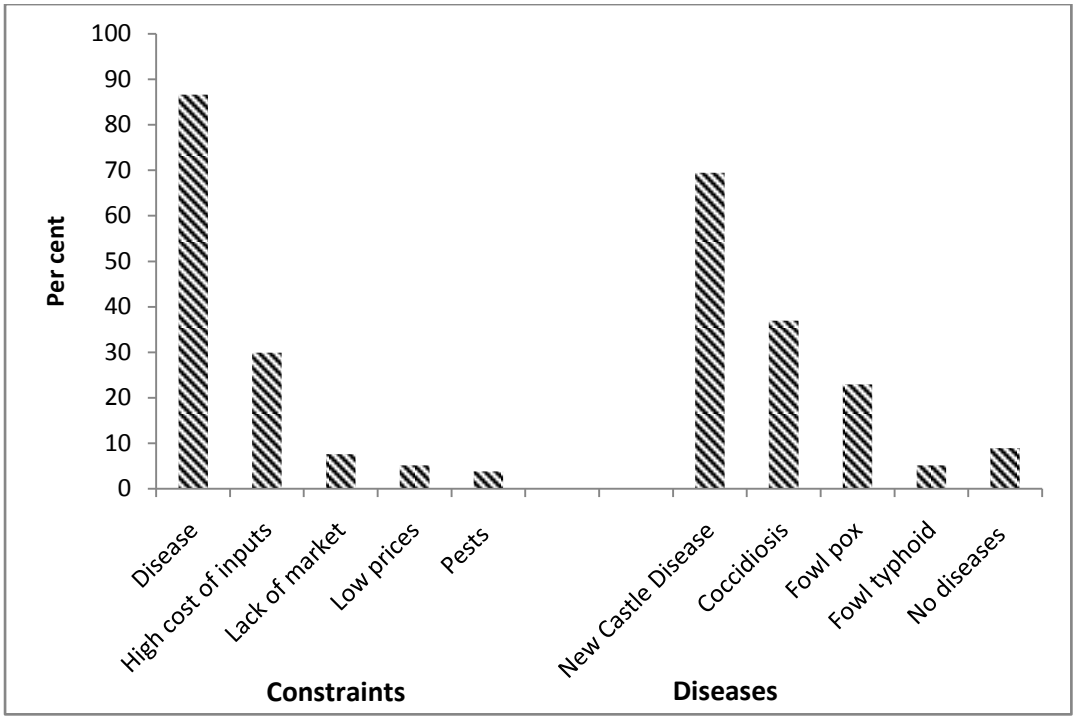

Figure 3: Constraints and diseases affecting indigenous chicken production in Kisumu and Thika as reported by sampled farmers, 2016

Note: Multiple responses allowed

Source: Author's computation from 2016 survey

b. Results for multivariate analysis

The result of multivariate regression that model the relationship between gross margin (natural log of gross margin per bird) and explanatory variables is presented in Table 4. Five out of six variables included in the regression model are significant in determining indigenous chicken gross margin. In addition, the F statistic demonstrates that all the variables included in the model, considered jointly, are significant factors, at one percent level of significance in determining the amount of gross margin earned.

Location of the farm and household income

The city where the farmer is located significantly influences the amount of gross margin generated. Holding all other factors constant, indigenous chicken farming in Thika increases the profitability of the enterprise. This could be attributed to higher output prices and lower input prices in Thika than Kisumu. There is a high concentration of feed millers in Thika, with slightly above one third of all poultry feed millers in Kenya located in Thika or Nairobi (Omiti and Okuthe, 2009). In addition, there is an already established egg market in Thika, which makes indigenous chicken producers in the region access the market easily (Nyaga, 2007; Omiti and Okuthe, 2009; Okello *et al.,* 2010). Middle income households earn significantly higher gross margins than high income households. This finding is consistent with summary statistics presented in Table 2. Poultry farming as an income diversification strategy appears to be more important to middle income households than high and low income households. Poultry farming is a viable part-time activity that diversifies household income (David *et al*., 2010; Molia *et al*., 2015.

Access to market information and HVMs

Access to market information provides an opportunity for farmers, given their budgetary constraints, to sell their outputs to the market with the best price. Having access to market information, *ceteris paribus*, significantly increases indigenous chicken farming profitability in the two cities. Access to market information reduces transaction costs of searching for information (Alene *et al*., 2008). Information asymmetry tends to affect production decisions because of uncertainty of market and prices (Bett *et al.,* 2012). Although poultry traders are one of the main sources of output price information for producers, they often tend to collude in setting prices, leaving producers at a disadvantage (Bett *et al.,* 2012).

All other factors held constant, selling to HVM significantly increases gross margin per bird. Such markets offer higher and more stable prices than conventional markets. For example, supermarkets in Kenya pay 10-20 percent higher and prices are more stable than traditional markets for vegetables. In addition, a majority of farmers selling horticultural products to supermarkets considered the channel to be convenient, in terms of planning, because quantity to be supplied and prices are known in advance. Furthermore, supermarkets demand higher volumes which reduce transaction costs (Neven, *et al.,* 2009). Access to market information and high expected prices provide incentives for smallholder farmers to enter commodity markets and increase supply (Olwande *et al*., 2015). However, most indigenous chicken producers do not have contractual arrangements with buyers, creating uncertainty during production (Bett *et al.,* 2012). Exclusion of smallholders from such markets could further lead to inequalities and marginalization (Balsevich *et al.,* 2003). Access to market information and low transportation costs are critical for smallholders to penetrate agricultural output markets (Olwande *et al*., 2015).

Production system

The type of production system a farmer utilizes affects their cost functions. The amount of feed, extent of diseases control and management, and time devoted to poultry farming affects the performance of the enterprise. Both deep litter and a combination of deep litter and free range systems significantly reduce profitability of indigenous chicken farming. This implies that producing indigenous chicken under free range production system is more profitable than both deep litter and a combination of deep litter and free range system. Cost of feed is, as already mentioned, significantly reduced in free range system as birds scavenge for food (Okello *et al*., 2010).

Table 4: Results of multivariate regressions of natural log of gross margin bird (Ksh./bird)

Variable	Coefficient	Robust std. error	*p>t*
City	0.957	0.481	0.049
Male owned	0.640	0.500	0.199
Co-ownership	0.583	0.425	0.173
Middle income	1.224	0.374	0.001
High income	-0.190	0.509	0.712
Access to market information	0.840	0.379	0.098
Selling to HVM	1.077	0.504	0.005
Deep litter system	-1.157	0.508	0.024
Deep litter and free range system	-0.914	0.376	0.016
Land size	0.121	0.419	0.772
Constant	4.466	0.682	0.000

Note: R^2=0.1218, F (10, 140) =2.51and p>F=0.0083, N=151
Source: Author's survey, 2016

4. CONCLUSION/IMPLICATIONS FOR POLICY

There has been conflicting research findings and conclusions about the contribution of urban agriculture to household welfare, particularly food security. While most studies find positive association between practicing urban agriculture and food security (Maxwell, 1995; Zezza and Tasciotti, 2010), others do not (Ellis and Sumberg, 1998; Frayne *et al.*, 2014). This study looks at the issue of urban agriculture from a different, yet important perspective. Rather than just looking at its food provision capacity, the study analyses the performance of urban indigenous chicken production and the specific factors that affect its profitability.

Rapid population growth and urbanization have increased land constraints for urban agriculture. Whilst agricultural enterprises that require large parcels of land are often displaced from the urban and peri-urban areas, those that are feasible and profitable on small parcels continue to persist in these areas (Pribadi and Pauleit, 2015). Poultry enterprises are among those that remain feasible and profitable under shrinking agricultural land sizes (Nyapendi *et al*., 2010; Khaleda, 2013). This is because of proximity to market for

the commodities (Ellis and Sumberg, 1998; Pribadi and Pauleit, 2015). Indeed, as mentioned earlier, about a quarter of urban households in medium-sized cities of Ghana, Kenya, and Uganda engage in poultry production. .

This study clearly points out that the type of agricultural activity and context matters when assessing the potential of urban agriculture. Unlike cereal crops, urban livestock production is mainly market-oriented and thus, most producers engage in urban livestock production with a profit motive (Dongmo *et al.,* 2010; Prain and Lee-Smith, 2010). Using the case of indigenous chicken farming in two medium-sized cities in Kenya, urban poultry production has been found to be a feasible and profitable venture. It contributes to the household food basket directly through consumption of chickens and eggs and indirectly through income generation. The findings of this study make a contribution to the urban agriculture debate by submitting that, rather than just ignoring the contribution of urban farming, efforts should be made to ascertain the contribution based on specific agricultural activities and their potential under available agricultural land and other resources. Clearly, poultry farming can be conducted in relatively smaller spaces than production of both cereal crops and large livestock (Omiti and Okuthe, 2009). This advantage can further be increased by, for example, construction of multi-storey cost effective poultry houses, which increases chicken holding capacity. Proximity to markets also reduces transportation cost and ensures timely supply of products (Nyapendi *et al.,* 2010).

The demand for indigenous chicken meat and eggs is rising in Africa (Molia *et al.,* 2015). Undeniably, meat and eggs from indigenous chicken are gaining popularity in Kenyan urban centers because of their low saturated fats and cholesterol and presumption that they are organically produced products (Omiti and Okuthe, 2009; King'ori *et al*., 2010). Chicken meat

fetches higher prices than other substitutes such as beef and pulses (Okello *et al*., 2010). Further, indigenous chicken meat costs higher than broiler meat (Okello et al., 2010; Bett *et al.,* 2012). Despite this growing market, the full production potential of indigenous chicken has not yet been achieved in Kenya because of low survival rates and productivity (Ondwasy *et al.,* 2006). Productivity of indigenous chicken in Kenya is low because of poor performing breeds, low feed conversion efficiency, poor disease management, and low uptake of new technologies by farmers (King'ori *et al*., 2010). Indeed, disease control through vaccination and maintenance of hygiene in the free range system could improve chicks' survival rate by 30 percent. Improved feeding, disease control, and proper housing would further improve survival rate to 80 percent (Ondwasy *et al*., 2006). Adoption of a full management package, comprising of feed supplementation, proper housing, proper brooding and chick rearing, and vaccination considerably increases productivity (Ochieng *et al*., 2010).

Rapid population growth, urbanization, improved welfare situations, and market liberalization have had profound effects on food system development (Mergenthaler *et al*., 2009; Schipmann and Qaim, 2011; Reardon and Timmer, 2014). Transformations in the food systems provide opportunities to smallholder farmers through increased income by selling to HVMs. Therefore, the findings of this study, support recommendations from other researchers, that in order to improve smallholders welfare, policies should be introduced to facilitate the linking of farmers to emerging HVMs (Neven *et al*., 2009; Chege *et al.,* 2015). Various smallholder agricultural development strategies aim at improving their performance through access to markets. Group marketing has been found to be effective in giving power to producers, by improving their bargaining power, and thereby getting better prices, especially in poultry marketing where traders collude to set prices (Neven *et al*., 2009;

Okello *et al.,* 2010). Development agencies such as NGOs also strive to encourage smallholders to form cooperatives (Neven *et al*., 2009) with the aim of reducing transaction costs in information search and marketing.

Supplying to HVMs is contingent on consistency in supply of quality products of enough quantity in a timely manner (Andersson *et al*., 2015; Ochieng *et al.*, 2017). Even though not statistically different, HVMs suppliers in the sample have 25 more birds than those selling to traditional markets. The problem of low volumes often excludes small producers from lucrative markets, but this problem can to some extent be solved through group marketing. However, reduction of transaction costs alone is not a sufficient condition for market participation. Provision of extension services, advising farmers on production and management practices and adoption of improved technologies and high yielding poultry breeds would increase marketable surpluses and capacity to access HVMs (Ochieng *et al*., 2012; Olwande *et al.,* 2015). Feed expenses constitute the largest share of costs in poultry production. In order to improve the performance of indigenous chicken production, cost of feed should be made more affordable. This could be achieved for example by County government agricultural and livestock departments training and supporting farmers on production of affordable poultry feed.

Demand and price of indigenous chicken vary with season. High demand and prices normally occur during holidays and festive seasons (Omiti and Okuthe, 2009; Bett *et al*., 2012). One limitation of the study is the use of cross-sectional data which provides information for only one point in time. Future research should be able to capture the seasonality of indigenous chicken production.

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[1] This statistic is from an urban agriculture baseline survey conducted in 2013 in Ghana and Kenya and 2015 in Uganda. For a comprehensive description of the sampling procedure in Ghana and Kenya, see Ayerakwa (2017a) and Omondi *et al.* (2017), respectively.

[2] This information is from interviews with agricultural and livestock officers in Kisumu in 2016.

[3] For a detailed description of the sampling procedure used in the baseline survey, see Omondi *et al*. (2017).

[4] It is important to note that the sum of proportions sold and consumed do not add up to unity because it is common practice for indigenous chicken farmers to retain some eggs and birds for reproduction (Okello *et al.,* 2010).