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Impact of Poultry Feed Price and Price Variability on Commercial Poultry Production in Murang'a County, Kenya

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Abstract: *This article evaluates the impact of poultry feed prices and price variability on poultry production in rural Kenya. The study utilizes a cross sectional farm-household data collected in 2014 from a randomly selected sample of 134 farmers engaged in layers and broilers production. The authors applied Nerlovian and econometric models to estimate the causal impacts. The Nerlovian coefficient of adjustment was 0.394 for layers and 0.182 for broiler. This implies that the rate of adjustment was moderate for layer farmers and slow for broiler farmers. Thus poultry feed manufacturers should adjust prices of layer feeds moderately and the prices of broiler feeds slowly if these farmers were to remain in gainful production. Results of econometric model show that lagged prices of poultry feeds has a significant influence on layers and broilers population kept in the current period. Although there was significant poultry population growth, time and poultry population had a negative relationship implying that individual farmers were rearing less and less birds with time. This indicates that if the government develops measures aimed at reducing variability in feed prices and those that may enhance farmers ability to adjust to or cope with price changes, it would result in improved and sustained poultry production.*
Keywords: *Price variability; Poultry feeds; Impact, Poultry production, Kenya*

I. Introduction

According to recent study, world population has been growing as well as demanding more and different types of food. Increased incomes in many countries have increased consumer purchasing power. These factors have caused a shift in "food ways" toward higher-value food such as meat and milk resulting in increased demand for grains used to feed livestock (Armah and Phillips, 2009 and Banerjee, 2011).

Poultry farming is an important enterprise because of its close links with grain and feed sectors. Maize and wheat are the most widely traded cereals whose high annual exports are related to their use as livestock feed (Kaabia and Ameur, 2005: Zhou and Malcolm, 2008; Shiferaw and Banziger, 2011).

Feeds are an important determinant of egg output (Ajetomobi and Binuomote, 2006). Another study found that hens fed on layer feed laid eggs faster than wheat-fed hens (Horsted and Hermansen, 2007). And that, feed intake has a positive correlation coefficient with production which is consistent with a classical production theory that increase in feeds intake should be encouraged (Ezeh and Chukwu, 2012).

Chicken enterprise is also influenced by management factors. The cost of feed per unit output is significantly higher for crossbred chicken compared to indigenous ones which calls for reduction of feed cost and improved credit access to enhance the purchase of feeds and increase the flock size (Kato and Mugisha, 2008; Ajetomobi and Binuomote, 2006). However a study on the evolution of feed – producer price system in vertically integrated markets showed that positive shocks to the price spread generate a quicker adjustment of feed prices while they remain more rigid after negative shocks to the price spread (Kaabia and Ameur, 2005).

The strategies adopted by marketers aimed at maximum satisfaction revolve around key factors of marketing mix product, price, place and promotion. Price play an important role in the determination of the volume of inputs demanded and supplied in the market (Kotler, 1982). The cost-plus formula pricing generates less variable expected utility values than bargaining scenario. Actual feed prices differ from the feed price component in the cost-plus system. The average difference between realized and predetermined feed costs is zero implying negative impact on producers (Gervais and Romain, 2007). Thus, feed millers attach a high relative economic consideration in feed manufacturing. Use of lower ingredient costs often corresponds to low feed quality which violates regulatory specifications (Mutua and Kahi, 2010). It is recommended that feed millers should use local feed ingredients instead of importing which confirms that feed cost depends on ingredients cost while the choice of feed ingredients depends on the objective of formulation (Mosnier and Dourmad, 2011). Feed prices also depend on consignment size, delivery mileage, and product form and payment terms. Across products and firms, less than 70 per cent change in average variable costs is transmitted to price (Ness and Walker, 1995).

Vertical integration is an emerging strategy in Nigeria where most privateers are producing own feed rather than purchasing commercial packaged feed due to rising production costs. But it is advisable for farmers in broiler production to use commercial feed than privately produced feed as it is more productive and profitable (Bamiro and Shittu, 2009). About 40% of farmers compound their own feeds, 60 % purchase feeds from registered feed millers while more than two-thirds (71%) lack access to credit facilities (Ajetomobi and Binuomote, 2006)

Recently, the performance of the livestock industry in Nigeria has fallen below expectation due to high feed cost arising from; fluctuations in feed supplies, rising prices of ingredients, poor feed quality (adulterated feed) and inefficiency in production (Olatunji and Ifeanyi-obi; Ashagidigbi and Adesiyan, 2011)). These farmers experience high risk and uncertainty during periods of inflation whose effect is non-neutral impacting on price variability (Ukoha, 2007).

The role and importance of poultry in rural livelihoods has emerged as a critical issue after the recent outbreaks of poultry diseases in Africa and Asia (Baba, 2006; WPSA, 2007). Agriculture sector in Kenya contributes directly 26% of GDP and 60% of the export earnings. It contributes a further 27% of the country's GDP through links with other sectors. More so, about 80% of the population live in the rural areas and derive their livelihood largely from agriculture. The livestock sub - sector contributes about 12% of Kenya's GDP, 40% to agricultural GDP and Employs 50% of Agricultural labour force (GOK, 2014).

In Kenya population density is high and the area of agricultural land per household is only about half the average for the whole of Sub-Saharan Africa. More so, poultry production is relatively important as poultry meat production provides a cheap source of protein and is second to beef. The population of poultry grew by nearly 3% annually over the last 20 years, with very limited state support. However, all the commercial broilers are produced in Nairobi and Central Provinces, close to the capital city; while egg production is a little less centralized with significant numbers of layers in Coastal and Nyanza Province (FAO, 2000; GOK, 2001). Layers and broilers are estimated to make up 23 percent of the total Kenyan chicken population, where number of layers constitute 9.6% while broilers 13.4%. However, 93% of broilers are located in Nairobi and Central Provinces while over half the layers are raised within the same area (Upton, 2000).

The production systems for hybrids (broilers and layers) vary from large scale fully integrated systems (3000 – over 10,000 birds) to medium and small-scale systems (500 – 3000 birds). The poultry industry provides food, income, employment and contributes 1.6% to the agricultural GDP. Poultry population in Kenya is estimated to be 29 million chickens. However, the true value of the poultry industry contribution to the entire economy is unknown due to limited data on the linkages (Mwanzia, 2010; GOK, 2004).

Manufactured poultry feeds production vary with seasons due to the relative availability of raw materials, the low quality of feed ingredients and the high cost of imported ingredients such as; premixes, amino acids and vitamins (GOK, 2001). Approximately 70% of the feeds produced in Kenya are poultry feeds (Mwanzia, 2010). Manufacturing of animal feeds influences livestock productivity, farm business, economic growth and environmental management (Mutua and Kahi, 2010). Poultry feeds production trends in metric tons in Kenya increased from 116,888 in 1989 to 177,236 in 1997 (GOK, 2001). The high cost of ingredients and low quality of feeds has been a major impediment to profitability of commercial livestock production. And that, when birds are well-fed, marketing plan becomes easier (Ndegwa et al, 2012). However, price risk is one of the most important components of risk faced by rural households in particular but not solely in developing countries (FAO, 2010).

Since the advent of liberalization of the economy, farmers in Kenya continues to experience variations in retail feed prices which hinder their production capacity. The government role in price determination has remained regulatory; through issuance of licenses of poultry feed businesses. Through the Kenya National bureau of Standards (KEBS), the government regulates the quality of poultry feeds (GOK, various years). The government also imposes tax on feeds, where the current Value Added Tax (VAT) is 16% according to the VAT Act 2013 (GOK, 2013).

Poultry feed prices in Murang'a county have been observed to vary with the seasons where prices are inversely proportional to national grain production levels. The challenges of high feed costs and poor quality feed have been identified to affect the poultry business. Poultry farmers are scaling back chicken production as a result of the soaring costs of feed (DAO, 2012).Thus, farmers need to access affordable inputs to revitalize the agricultural sector in line with vision 2030 (GOK, 2001).

Although an extensive empirical literature exists on livestock feed prices and poultry production (e.g. FAO, 2000; Kailikia, 1992; Mutua and Kahi, 2010; Ndegwa et al, 2012), there still substantial information unknown about poultry feed prices and poultry production. Also, in spite of the observed poultry feed price variability and its impact on production and the potential of adopting measures to reduce it, there is lack of empirical evidence to support the propositions. Theoretically, adopting measures that enable poultry farmers to adjust to or cope appropriately to changing feed prices provides potential benefits for accessing affordable feeds and proper resource allocation. Measures taken to improve productivity will have spill-over benefits for other poultry producers and consumers of poultry products. Based on these effects, fluctuation in prices may have important implications for reasons of resource allocation as well as consumer and producer welfare. First, volatility may have a negative impact at the macroeconomic level of growth and poverty. Second, commodity price volatility may also impact household decisions, farmers and the government (Rodrik, 1999).

There exists limited empirical evidence to either confirm or refute the hypotheses that poultry feeds price variability confers negative effect on layers and broilers production. Incorporating these price volatility impacts in the analysis could help understand the actual impact of current feed price variability on smallholder poultry farmers. Therefore this article determines the (i) rate at which poultry farmers are adjust to changing feed prices and (ii) the impact of price variability on the population of layers and broilers reared by poultry farmers.

By addressing these objectives, the contribution of this article to the literature is twofold. First, there is limited empirical evidence to test the hypothesis that poultry feeds price variability confers negative impact on poultry production. While some past studies have analysed effect of feed quality, this study investigates the impact on production of feed price variability, lagged population and time. Second, in most of previous literature on use of feeds in poultry production (e.g. Ndegwa et al, 2012), the impact of price variability and the rate at which farmers adjust to the changes is not explicitly dealt with. The farmers' decision to engage in commercial poultry production and therefore use manufactured feeds is not a random event and depends on a number of observable and unobservable factors. This article uses instrumental variable econometric techniques and Nerlovian model. Third, the article uses a sample data set collected through a cross-section farm household survey which heavily relied on recall.

The remainder of the article is structured as follows; Section 2 presents the methodology and analytical techniques. Section 3 presents estimation of results and discussions and in section 4 conclusions are drawn and some further implications cited.

II. Methodology And Analytical Techniques

2.1 Survey Design and Data

Purposive sampling procedure was used to select districts and poultry farmers. Three out of eight districts in the county (namely Kandara, Murang'a South and Murang'a East) were purposively sampled due to the predominance of poultry farming and accessibility. List of all locations with layers and broiler farmers were supplied by the DLPOs of the three districts. From this target population, systematic random sampling technique was used to select 134 layer and broiler farmer households for interviews. Data collection took place during the month of January to April 2014.The data were collected by trained enumerators supervised by the first author using structured survey questionnaires. The questionnaire was first pretested for validation in Kigumo district before commencing the survey. The survey questionnaire covered information on household members' characteristics, incomes, populations of layers and broilers; poultry feeds prices and quantities used. However, while conducting the survey the feed price figures quoted were supplemented by those of retailers and records from the ministry of livestock and fisheries development and Kenya National Bureau of Statistics.

2.2 Empirical Models of Data Analysis

2.2.1 Nerlovian Adjustment Model

To determine the rate at which poultry farmers adjust to changing levels of price, a model of Nerlovian type (Nerlove, 1979) was adopted in its simplest form. The model is based on the stock adjustment principle. It is therefore assumed that the desired level of birds population in period t say (Y_t*) which depends on lagged price of feeds is given by the following long-run relationship**.**

$$\ln Y_t^* = a + b\ln P_{t-1} + u_t \qquad (1)$$

Where P denotes the price of layer feeds, t is time and ln is the natural logarithm. It is assumed that the actual poultry numbers does not change immediately to Y_t* as P changes, but it responds according to the following adjustment equation:

$$\ln Y_t - \ln Y_{t-1} = \partial\,(\ln Y_t^* - \ln Y_{t-1}) + \upsilon_t \qquad (2)$$

Where the speed of adjustment (∂), obeys $0 \leq \partial \leq 1$

Substituting $\ln Y_t^* = a + b\ln P_{t-1} + u_t$ into the adjustment equation adding time (t) to account for effects such as technology and policy changes in poultry and feed production the model can be expressed as:

$$\ln Y_t - \ln Y_{t-1} = \partial\,[(a + b\ln P_{t-1} + u_t) - \ln Y_{t-1}] + \ln t + \upsilon_t$$

Rearranging we find

$$\ln Y_t = (\partial a) + (\partial b)\ln P_{t-1} + (1-\partial)\ln Y_{t-1} + \ln t + (\upsilon_t + \partial u_t)$$

Thus, the total poultry production function estimated is

$lnY_t = A_0 + A_1 \, lnP_{t-1} + A_2 \, lnY_{t-1} + A_3 lnt + W_t$ (3)
Where,
$A_0 = \partial a$; $A_1 = \partial b$; $A_2 = (1-\partial)$ and $W_t = \upsilon_t + \partial u_t$

The coefficient ∂ is known as the Nerlovian coefficient of adjustment and is based on the Hick's price elasticity of expectations. It indicates how fast the farmers are adjusting to their production expectations. The value of ∂ indicates whether farmers are adjusting slowly or quickly to changes in feed prices and other factors (Barmon and Chaudhury, 2011). A_i's are parameters. With a log-linear specification like this, the parameters represent short-run elasticities with respect to that variable. Long-run elasticities were calculated as follows (Sadoulet and de Janvry, 1995):

$$\varepsilon_i = \frac{\varepsilon^{sr}}{1 - A_1}$$

ε^{sr} = short-run elasticity and A_1 is the coefficient for the lagged dependent variable.

2.2.1.1Test of Autocorrelation

In this partial adjustment model, the error term does not involve any autoregressive scheme in the u's. In the present model, the disturbance term has no direct connection with its own previous values, so that we may assume that the new error term ($\upsilon_t + \partial u_t$) is not autocorrelated (Greens 2008; Koutsoyiannis, 1988). The Durbin-Watson statistic (the d statistic) was used to test the assumption of independence of errors. The value of DW statistic ranges from 0 to 4. If d = 2, there is no autocorrelation. Thus if from the sample data $d^* \approx 2$ we accept there is no autocorrelation in the function. If d = 0 there is perfect positive autocorrelation. If d = 4 there is perfect negative autocorrelation. As a general rule of thumb, the residuals are not correlated if the D-W statistic range is 1.5 to 2.5. The Durbin-Watson statistic was 1.899 and 2.304 for layers and broilers equation respectively, the DW value for both the layers and broilers fell within the acceptable range. Thus, there was no autocorrelation.

2.2.2 Linear Regression Model

The regression model involves the estimation of determinants of poultry flock size. Flock size refer to the population of layers and broilers in numbers kept by individual farmers. The following functional forms of simple and multiple regression equations were considered:
$Y_t^* = f(P_{t-1})$ (4)
$Y_t = f(Y_{t-1}, Q_{t-1}, P_{t-1}, t)$ (5)
$Y_t = \beta_0 Y_{t-1}^{\beta 1} Q_{t-1}^{\beta 2} P_{t-1}^{\beta 3} t^{\beta 4} u$ (6)

In this model, the number of layers (Y_t) is the dependent variable while the lagged population (Y_{t-1}), price (P_{t-1}) and quantity of feed consumed (Q_{t-1}) were considered as the independent variables. However, the logarithmic model of the above function was run to estimate the coefficients of the regression equation as follows:
$lnY_t^* = a + blnP_{t-1} + u_t$ (7)
$lnY_t = \beta_0 + \beta_1 lnY_{t-1} + \beta_2 lnQ_{t-1} + \beta_3 lnP_{t-1} + \beta_4 lnt + u_t$ (8)
Where: Y_t^* is desired number of birds; u_t = is the stochastic random error term.

The regression model was estimated using ordinary least squares (OLS) using the computer software SPSS (version 20). In this stochastic log-linear model the slope coefficient β_n measures the elasticity of Y with respect to X, which is the percentage change in Y for a given (small/marginal) percent change in X. The model also assumes that the elasticity coefficient between Y and X, β_n, remains constant throughout, (Green, 2008 and Koutsoyiannis, 1991). The model is used in non-linear functions involving constant elasticities. The model allows the use of OLS for estimation. The estimates of β_1, β_2, β_3 and β_4 are unbiased. However, the model produces a biased but consistent estimate of β_0.

2.2.2.1Test for Multicollinearity

Multicollinearity is detected by examining the tolerance for each independent variable. Tolerance is the amount of variability in one independent variable that is not explained by the other independent variables. Tolerance values less than 0.10 indicate collinearity. Collinearity was discovered in the regression output for layers where tolerance levels for lagged layers population and lagged quantity of layers mash consumed was 0.089. After omitting the collinear variables one at a time and running the regression, the better-fitted model was obtained on omitting the lagged quantity of layers mash. In this model, there was no multicollinearity and R^2 was 0.394.

III. Results and Discussions

3.1 Poultry Production Response to Change in Poultry Feeds Price

Table 1 presents the regression estimates of the poultry population response. The estimated coefficients for lagged price of layers mash and broiler finisher mash (A_1) and population (A_2) have the correct signs and are plausible. The estimated coefficients of lagged poultry population and retail price for both layers and broiler finisher mash were significant at the 5% level. The goodness of fit for the estimated equations as measured by R^2 was fair. R^2 was 0.394 for layers and 0.393 for broilers. The rate of adjustment (∂) for layers was 0.376 and that of broilers was 0.181. Coefficients of determination (R^2) implied that the lagged poultry population and retail price for both layers mash and broiler finisher mash explained 39.4% of variance in the layers population and 39.3% in the broilers population. The speed or coefficient of adjustment (∂) for the variables in layers was 0.376, which was less than 0.5; the speed of adjustment was moderate. The speed of adjustment for broilers production was 0.184 and was less than 0.5, the speed of adjustment to broilers production was small or sluggish. If the speed of adjustment $\partial \geq 0.5$, it is said to be big (Olayemi, 1998). This meant that farmers adjusted their layers population levels at a faster rate compared to broilers' as a result of changes in retail feed prices. This was explained by the fact that layer farmers sometimes even sold their birds after a sudden change in poultry feed prices before they completed their laying period unlike for the broilers.

Table 1: Estimates of Regression Model on the Poultry Population Response (N=134)

Estimates	Constant (A_0)	ln $P_{t-1}(A_1)$	lnY_{t-1} (A_2)	Log time	R^2	∂	b	DW
Layers	3.638 **	-0.134**	0.624**	-0.115**	0.394	0.376	-0.356	1.964
	(0.176)	(0.031)	(0.038)	(0.063)				
Broilers	0.651**	0.024**	0.816**	0.046**	0.393	0.184	0.131	2.075
	(0.216)	(0.013)	(0.041)	(0.027)				

Source: Field Data Analysis, 2014

Notes: (i) ** indicate 5% level of significance (ii) D-W indicate Durbin Watson Statistic

4.2 Estimates of Price Elasticities of Demand for Poultry Feeds

Results in table 2 show that, the short-run price elasticity of demand for layers mash was -0.134; while the long-run (L/R) elasticity was -0.356. However, the short-run (S/R) price elasticity of demand for broiler finisher meal was 0.024 while the long-run (L/R) elasticity was 0.108.

Table 2: Estimates of Price Elasticities of Demand for Poultry Feeds (N=134)

	S/R	L/R	Differential
Layers Mash	-0.134	-0.356	-0.090
Broiler Finisher Mash	0.024	0.132	0.108

Source: Field Data Analysis, 2014

Results show that the short-run elasticity (S/R) of price for layers was -0.134, which indicated that an increase in the price of layers mash brought a small decrease in the number of layers kept. However, the long-run (L/R) elasticity of layers was -0.356; indicating that the retail price of layers mash increased rapidly in the long- run and sluggishly in the short-run resulting to a higher decrease in the number of layers kept. The estimate of short-run (S/R) elasticity of price of broiler finisher meal was 0.024. This result indicated that an increase in the price of broiler finisher mash brought a very small increase in the number of broilers reared. This is however inconsistence to the law of demand. The long-run (L/R) elasticity was 0.108 implying that the prices had increased rapidly in the long-run compared to short-run. The presence of low number of farmers keeping low stocks of broilers and the large number of farmers keeping varying number of layer birds in the study area may have explained the two scenarios.

3.3 Estimates of regression model

The multiple regression models included lagged poultry population (Y_{t-1}), lagged feeds price (P_{t-1}) and time trend as the independent variables, while poultry population was considered as dependent variable. The estimates of coefficients of lagged variables poultry population, feeds price and time trend on allocation of resources for poultry production are presented in Table 3.

3.3.1 Layers Production

The estimated layer production equation was:

ln (layers population) = 3.638 + 0.624*ln (lagged Layers Population) -0.134*ln (lagged retail price Layers Mash) -0.115*ln (time)

The coefficients of the model are β_1 = 0.624, $\beta2$ = -0.134, $\beta3$ = -0.115. We conclude that one percentage change in lagged layers population, lagged retail price of layers mash per 70kg bag and time results in $[(1.01)^{\beta1}-1]*100$, $[(1.01)^{\beta2}-1]*100$ and $[(1.01)^{\beta3}-1]*100$ percentage change in layers population (YL) or 0.623%, -0.133% and -0.114% change in layers population respectively. The coefficient of multiple determination (R^2) was 39.4%. This showed that more than 39 per cent of the total variation in layers production was explained by the changes in lagged layers population, lagged retail price of layers mash and time. The t-test and F-test were used to determine the significance level of R^2, which was found significant at 5 per cent level.

3.3.1.1 Lagged Layers Population

Layers production mainly depends on the feed price variability and feed quality. Fluctuations of prices reflect the imperfect conditions of marketing system. The ingredients and technology on the other hand, cause variability in feed quality. Results given in table 13 shows that all the coefficients in the regression model had the expected signs. The lagged layers population variable had significant effect on allocation of resources for layer production and all coefficients were statistically significant at 5% level. The layers population reared in any one period depends among others, the population reared in the previous periods due to resource endowment and habit formation process, which is a characteristic of human behaviour. That is the number of layers kept in the previous period positively influenced the layers population the farmer would keep in the current period. This implies that farmers in the county increased or decreased their poultry stocks in relation to the populations they had in the previous period.

3.3.1.2 Lagged Layers Mash Price

The results show that the retail price of layers mash had significant impacts on the allocation of resources for layers production .The price of layers mash in the previous period had a negative influence on the number of layers the farmer would actually keep in the current period. This meant that if prices of feeds in the previous period were high farmers had a tendency of lowering their layers population in the current period.

3.3.1.3 Time Trend

Time trend mainly represents the availability of suitable technology for poultry production. The coefficients of time trend in the regression models of layers had significant negative impacts on the allocation of resources for layers production. This indicated that the allocation of resources for layers production had decreased over the years. There is a negative relationship between time and layers population implying that the farmers are rearing less and less of layer birds with time.

Table 3: Estimates of Regression Coefficients of Poultry Population (N=134)

Estimates	Constant	$\ln Y_{t-1}$	$\ln Q_{t-1}$	$\ln P_{t-1}$	Log time	SE	R^2	DW
Layers	3.638**	0.624**		-0.134**	-0.115**	0.6075	0.394	1.964
	(0.176)	(0.038)		(0.031)	(0.063)			
Broilers	0.685 **	0.838**	-0.018**	0.013**	0.045**	0.3802	0.394	2.080
	(0.219)	(0.048)	(0.021)	(0.018)	(0.027)			

Source: Field Data Analysis, 2014

Notes (a) $Y_{t-1,}$ indicate lagged poultry population ; Q_{t-1} indicate lagged quantities of poultry feeds consumed and P_t-$_1$ indicate lagged prices of poultry feeds (b) ** indicate 5% level of significance

3.3.2 Broilers Production

The impact of lagged population, quantity of broiler finisher mash and time trend on the allocation of resources for broilers productions is presented in table 3. The results show that all the coefficients in the regression model had expected signs. R^2 for the model was 39.4% that indicated a better 'goodness of fit' of the regression plane to the sample observations. The estimated broilers production equation was:

Ln (Broilers population) = 0.685 + 0.838*ln (lagged Broilers Population) -0.018*ln (lagged Quantity of broiler finisher mash consumed) + 0.013*ln (lagged retail price Broiler finisher Mash) + 0.045*ln (time).

We conclude that one percentage change in lagged broilers population, lagged retail price of broiler finisher mash per 70kg bag , lagged retail quantity of broiler finisher mash in 70kg bags and time results in $[(1.01)^{\beta1}-1]*100$, $[(1.01)^{\beta2}-1]*100$, $[(1.01)^{\beta3}-1]*100$ and $[(1.01)^{\beta4}-1]*100$ percentage change in broilers population (YB). That is, 0.8373%, -0.0179%, 0.0129% and 0.0447% change in broilers population respectively. The lagged broilers population, lagged quantity of broiler finisher mash lagged price of broiler finisher mash and time had significant impacts on the allocation of resources for broilers production. The coefficient of lagged quantity of broiler finisher mash had a negative sign, which indicated an upward shift in the allocation of resources for broilers production. The main reason is that poultry farmers were always motivated to rear broilers if they were assured of stable feed prices, high quality feeds and availability of market for their products and feeds. Time had a significant positive influence on the number of broilers reared by farmers. The reason for this is that most farmers were found to keep an almost constant flock size across the periods. This is consistent with the farmers' claim that broilers are becoming cheaper to keep with time as they mature within 6 weeks.

IV. Conclusions

This study contributes to poultry production literature among smallholder farmers using the case of Kenyan layers and broiler producers. The primary aim of this article is to empirically determine whether poultry feeds price variability confers negative impact to production using econometric modelling.

The results show that the retail price of layers and broiler finisher mash had significant impacts on the allocation of resources for layers and broilers production. The coefficient of lagged prices of layers had a negative sign, which indicated downward shifts in the allocation of resources for the purchase of layers mash for layers production. The coefficient of broiler finisher mash had a positive sign indicating a slight upward shift in its use for broilers production. The main reason was that poultry farmers were always demotivated to rear layers and broilers due to feed price instability. The coefficients of trend variable time were negative for layers and positive for broilers. This showed a downward shift in the allocation of resources for layers production and a slight upward shift for broilers production over the period.

The Nerlovian coefficient of adjustment for layers less 0.376, which means that farmers engaged in layers production were adjusting moderately to the changing levels of price and price variability, feed quality and other factors. Thus, feed millers should adjust the price of layers mash moderately; considering that most farmers are small-scale layers producers, otherwise the farmers will divert their resources to other enterprises that will hinder eggs production in Murang'a County. The coefficient of adjustment for broilers was 0.184. This means that although broiler farmers were adjusting to the changing levels of feed prices, the adjustment was sluggish. Thus, it may be concluded that prices of broiler feeds should be adjusted rapidly along with the demands of broiler meat in the market. Alternatively, the farmers will shift to the production of other animals and deprive the market of broiler meat, whose supply is already low in the County.

The short-run and long-run retail feed price response elasticities for layers mash and broilers finisher mash was inelastic. It implies that a small change in feed prices results into a less than proportionate change in layers and broilers produced. The government and private sector can help farmers increase their poultry production to meet the demands of poultry products in the market. The policy options include public investment in increasing farmers' productivity and access to affordable feeds and products markets, the reduction of poultry feed price fluctuations, stabilizing feed prices and enhancing the farmers' ability to adjust to negative shocks of feed price changes could have major implications for translation of resources into production.

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