Resource use efficiency levels in poultry production in Bureti District, Kenya

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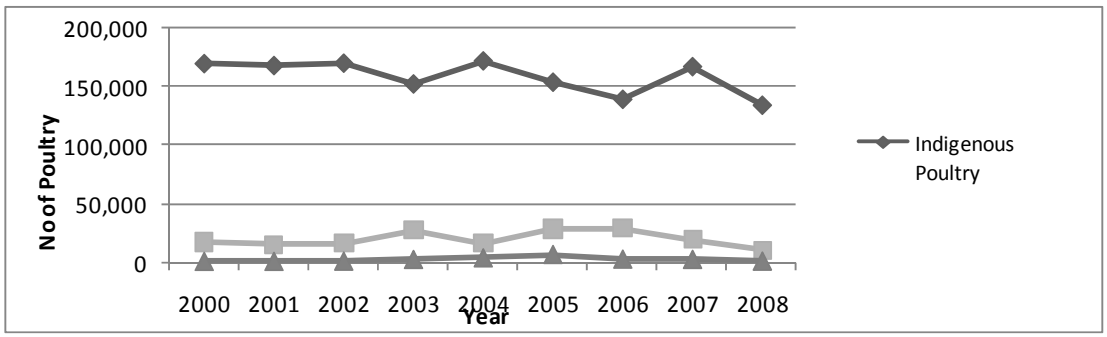
ABSTRACT: Poultry production is one of the most important economic activities to the small-holder farmers of Kenya. However, constraints are evident which have resulted in low production of poultry and poultry products to meet population demand and for socio-economic sustainability of the livelihoods. The objective of the study was to determine resource use efficiency, optimal production levels, production systems of small-scale poultry farmers in Bureti district, Kenya. Primary data were obtained using a set of structured questionnaires from 300 representative farmers drawn from the study area using cross-sectional sampling techniques. Data were analyzed by Cobb-Douglas production function. The results showed that the resources used in poultry production were underutilized while others were over utilized. The efficiency indicators for poultry feeds (0.0603) showed that poultry feeds were inefficiently used. Labour efficiency indicator (-0.091) showed that farmers were not only grossly inefficient in the use of the resource but also over utilized it while the efficiency indicator (60.86) for poultry equipment implied the resource was inefficiently utilized. It is recommended that farmers should use inputs more efficiently (particularly feeds which were being inefficiently utilized) by reducing their levels of employment.

Key words: resource use, efficiency levels, poultry, kenya

INTRODUCTION

Poultry production in Bureti district has been declining over the years despite livestock extension services being promoted by the government of Kenya. There is low poultry population (Figure 1) in the district. The figure shows that indigenous poultry breed population declined from about 170,000 in 2000 to about 130,000 in 2008 (20.8% decline). Commercial layers also declined from 17,000 in 2000 to 9,960 in 2008 (41% decline). There was a gradual increase in broiler production from 370 in 2000 to 6,300 in 2005 before a drastic decline to 600 in 2008 (90% decline).
Generally, the figures above clearly show a significant drop in poultry breed population from the year 2005 to 2008, which implies existence of a problem.



Source: D.L.P.O., 2008: Bureti district Livestock Production Report.

Figure 1: Poultry Population Trends, 2000 2008

Poultry products in the district, mainly eggs and broiler meat and meat from indigenous poultry have also been declining over the years (Figure 2 and Figure 3). Estimated total egg production

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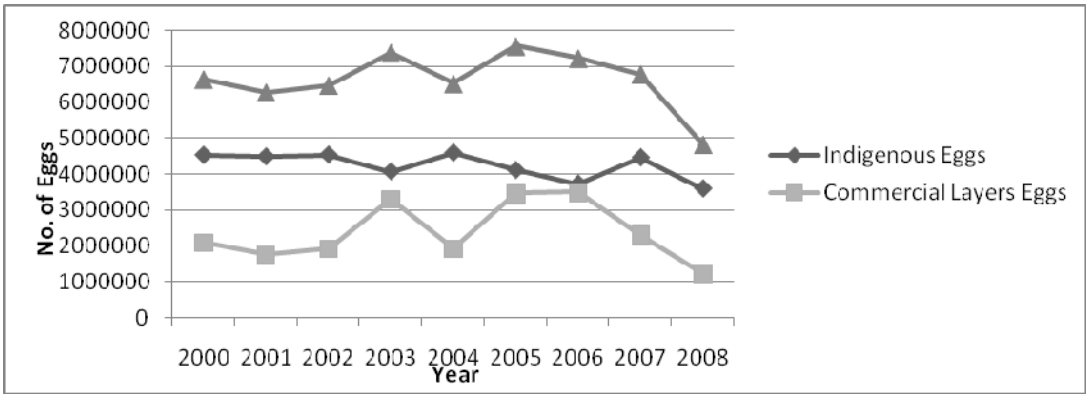
statistics in the district revealed a general decline. In 2000, about 6,640,000 eggs were produced followed by a decline to about 6,500,000 eggs in 2002. From 2005 to 2008, total egg production declined from 7,568,945 to 4,826,577 eggs (36% decline) respectively.

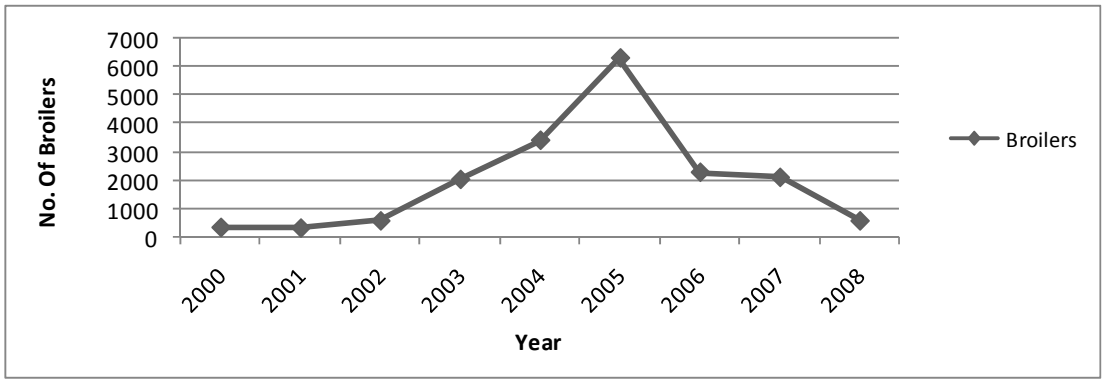
The estimated total egg production for indigenous chicken declined from about 4,500,000 in 2000 to about 3,600,000 in 2008 (20% decline). Estimated egg production for commercial layers has not also shown any significant improvement in tandem with population increases in this period. Egg production from these commercial layers increased from an estimated 2,100,000 in 2000 to about 3,500,000 in 2006 before declining to 1,200,000 in 2008 (66% decline).



Source: D.L.P.O., 2008: Bureti district Livestock Production Report

Figure 2. Egg Production Trend, 2000-2008

From figure 3 below, there was an increase in Broiler poultry production (broiler meat) in the district from year 2000 to 2005. Production then declined drastically from about 6,300 broilers in 2005 to 600 broilers in 2008 (90% decline).



Source: D.L.P.O., 2008: Bureti district Livestock Production Report

Figure 3. Broiler Production Trend, 2000-2008

The above decline in production trends led to deficit in supply to meet the rising population consumption demand, decreasing small-scale rural family farm incomes and hence reduced welfare. For example, on average, the estimated total egg production in the district in 2008 was 4,826,577 against the districts consumption demand of 72,358,460 eggs per year (*D.L.P.O., 2008*).

One of Kenya's food policy objectives is to have the country sustain her self-sufficiency in the supply of food products (poultry and poultry products included) (GOK, 2001). This policy is based on the fact that the analysis of projected demand of poultry products indicates a large and possible deficit over domestic supply (supply- demand gaps).

All these presented figures on poultry breed population, production of poultry eggs and poultry meat suggest the presence of constraints which result in low poultry production and poultry products to meet population demand that would improve the socio-economic sustainability of the rural livelihood. What then ails the poultry production systems in Bureti district? What are the constraints to the development of poultry production systems? and; is poultry production profitable?

MATERIALS AND METHODS

Choice of the Functional Form for Production Function

Production technology of farmers is assumed to be specified by the linearized stochastic production function representing Cobb-Douglas production technology (Henderson and Quant (1971)), which is specified as;

$$lnY = ln\beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \ldots\ldots\ldots + \beta_n lnX_n + \mu - U \quad \ldots 1$$

Where;- Y = Amount of poultry products (e.g. eggs, chicken, broilers or manure) sold/produced per annum) in Kshs, X_1 = Total number of birds purchased in Kshs, X_2 = Amount of labour measured in man days, X_3 = Cost of vaccines, drugs and Chemicals (Kshs), X_4 =Amount of feeds in bags/Kilograms purchased (Kshs), X_5= Years of experience in poultry production, X_6= Education level of household head, X_7= Cost of poultry Equipment in Kshs, X_8= Other cost (Miscellaneous cost) in Kshs, μ= Random error term, U= Technical inefficiency effects, $ß_0$= Constant term, $ß_{is}$= Slope parameters, β_0 represents the intercept while $\beta_1,\ldots..,\ \beta_n$ are the parameters which defined the transformation ratios when the Xs were at different magnitudes (quantities) and (e) was the natural exponent. The estimated parameters could then be used to evaluate the factors that influence the supply of poultry and poultry products of the sampled farmers in the district.

Resource Use Efficiency Index

In order to determine the economic efficiency of the resources used in poultry production, the marginal value product (MVP) of each resource was compared with its marginal factor cost (MFC) and the efficiency indicators computed. Economic efficiency is a combination of technical and allocative efficiency respectively. It aims at maximizing benefits while minimizing costs. According to Nicholson (1978), economic efficiency is the same as Pareto efficiency. An allocation of resources is Pareto efficient if no one individual (or activity) can be made better-off without making someone else (or another activity) worse-off. Hardwick *et al*. (1988) proposed that the concept of Pareto efficiency can be used to evaluate different ways of allocating resources.

The mean estimates (output returns and input costs) of the log-linearized Cobb-Douglas production function were used in the computation of MVPs of each of the resource (input) with its MFC. A statistically significant difference between a resource's MVP and MFC suggests sub-optimality in the utilization of that resource. The study adopted the method used by Oladeebo (2006), where the marginal value productivities (MVPs) for each resource is computed and compared with their respective acquisition cost (MFC).

The MVP of a particular resource is as:

$MVP = MPP_{x_i}.P_y$ ……..……..……2

Based on the functional form selected as lead equation for regression which is Cobb-Douglas production function which was double log-linearized, the MPP and the corresponding values of MVP were obtained as follows:

$MPP_{x_i}.P_y$ =MFC, ……..……..3

Where $MPP_{x_i}.P_y$ = MVP, But: MPP = $\beta_i.Y/X_i$; MVP = $\beta_i.Y/X_i$. P_y

MFC = $\beta_i.Y/X_i$. $W_{x_i}Y$ ……4

Where:-

β_i= regression coefficient per resource, Y = mean output (amount of revenue) of poultry products (Kshs) X_i = mean value of resource (Kshs.), $\partial Y/\partial X_i$ = derivative of total output (Y_i) with respect to

factor input(X_i), W_{xi} = cost of resource X_i per unit (Kshs.), P_{yi} = price of output i per unit (Kshs.), MFC = marginal factor cost,
Resource-use efficiency = MVP/MFC, ……5
P_{yi} = 284.46 (calculated output's average selling price (i.e. of eggs, broilers, live birds/culls and manure per year per farmer).
MFC (W_{xi}) = (Calculated average acquisition cost per resource per year per farmer).

(X_0) = Optimal level of resource use given by:
\$i Y/X_i. PY/ X_0 =\$i Y/X_i. W_{xi}Y(MFC)

Thus, when Resource-use efficiency RUE =1, resources are optimally utilized, When RUE < 1 resources are over utilized, When RUE > 1, resources are underutilized.

Sampling Procedures

Stratified random sampling was used in this study to categorize farmers into subgroups based on poultry management systems practiced by farmers from all the divisions to achieve desired representation. Stratification produced precision in the estimates of the characteristics of the whole population. By stratification into subgroups, the required number of farmers of each type (commercial layers, broiler and indigenous poultry farmers) could then be sampled. From the stratum size thus selected, systematic sampling method was used. For broiler production system, purposive sampling procedure was also employed. A systematic random sampling procedure for extensive traditional production system was used to identify farmer households to be interviewed. The households sampled were those selected after every 21st household within the sample frame.

Data Collection Methods

A structured questionnaire was used to elicit information from respondents identified. To complement information that were gathered by use of the questionnaire, a purposive target sampling procedure was used to identify key persons in the district. An interview to elicit information from these persons was then carried out by use of an interview schedule. Observation methods were also used in the farms.

RESULTS AND DISCUSSION

The Cobb-Douglas production function was used in the computation of Marginal Value Product (MVP) of the resources used in poultry production. The results of economic efficiency and optimal levels of resources are presented in table 1 below.

The results of resource use efficiency (Table 1) are presented based on the following criteria; when the Resource-use efficiency RUE =1, resources are optimally utilized, when RUE < 1, resources are over utilized and when RUE > 1, resources are underutilized.

The efficiency indicator (Table 1) for labour (RUE=-0.11), shows that poultry farmers are not only grossly inefficient in the use of labour but also over utilized the labour resource. Labour use in poultry production in Bureti district should thus be reduced considerably from approximately 10 man-hours to 1 man hour per day to attain efficiency. This reduction should be done only up to the level where RUE equals to one. According to Massel, (1967), an efficient farmer is one who allocates resources e.g. labour such that each marketed resource is used up to the point where its marginal value product (MVP) is equal to its price, and each resource that is shared among crops is allocated so as to equate its marginal value product in each use. He further stated that efficiency of resource use can be achieved by allocating resources among the uses more optimally.

This finding also conforms to the findings of Nzomoi, (2006) who identified that the amount of labour force employed by a producer significantly influences the amount of average output and profitability. Thus reduced family labour to an optimal level of one man hour per day not only leads to improved poultry output and profitability, but also reduces the problem of underemployment of labour

(i.e. the marginal product of labour is less than the average value of goods and services consumed by the family member). But according to Jenkins (1995), labour has an economic opportunity cost (EOCL)-the salary or wage they could make working similar hours in some set of other alternatives including the market and non-market activities. The economic opportunity cost of labour has the potential to impact on the family savings changes in the amount of income received by family labour. But these impacts can increase or decrease family savings because of market distortions which changes in economic welfare of families (*Ibid)*.

Table 1. Resource Use Efficiency Indicators and Optimal Levels.

Explanatory variable	MVP	MFC, Ksh/man hour/ unit/bag	MVP/MFC (Resource Use Efficiency)	Description of Efficiency Index	Optimal Level of Resource (X_i)
Labour	-9.61	87	-0.11	Grossly inefficient and Over utilized	1.05 man hrs.
Number of birds	68.38	132.9	0.51	Over utilized	2.6
Vaccines, drugs and chemicals	54.12	2.14	25.28	Underutilized	Kshs. 151.20
Amount of feeds	29.71	475.91	0.062	Over utilized	0.69 bags
Cost of poultry equipment	214.78	2.15	99.89	Underutilized	Kshs. 699.29
Other (miscellaneous) costs	1687.88	1.141	1480.59	Inefficiently used	Ksh. 991.13

Source: Computed from Survey Data, 2009

The efficiency indicator for total number of birds (proxy for farm size) (RUE =0.51), suggests that birds were being over utilized. Farmers are not reaping enough benefits from the large number of birds used.

Birds were thus not being used efficiently and therefore farmers should reduce the number of birds up to the level where the RUE equals unity. To realize profits, farmers in the study area can purchase as low as three birds and optimality in poultry production can be achieved.

The efficiency indicator (RUE=25.28) for veterinary services took a positive sign which shows that vaccines, drugs and chemicals were being underutilized. To use the veterinary services efficiency, the farmers need to increase expenditure on drugs, vaccines and chemicals from the current average expenditure of Ksh. 54 to an average of Ksh. 151.20 per flock cycle for optimality to be achieved i.e. to the level where $MVPx_3$ and $MFCx_3$ are equalized. This implies that veterinary services are thus important and have a significant effect on poultry output. Because poultry output and veterinary services relate positively, then to improve output and profitability of poultry products, farmers need more finances in form of credit facilities in order to efficiently utilize veterinary services. However, according to Brandy (2006), households have been found to be credit constrained, on average, both in the formal and informal sectors. Since credit facility is the major limiting factor in poultry production, particularly for utilization and acquisition of veterinary services, focus should be on other ways of increasing access to agricultural credits. Off-farm activities can be an important alternative source of cash income for poultry farmers which can potentially improve farm productivity if it is used to finance purchase of veterinary services (vaccines, drugs, chemicals, e.t.c.). Off-farm opportunities affect the motivation of a farmer to maximize the profits on his farm (Buigut, 2000).

The efficiency with which feeds are being used (RUE=0.062), shows that the amount of feeds are over utilized. This result is expected to influence household poultry production. Farmers engaged in poultry production and facing this feed cost constraint are less likely to engage in the enterprise. These findings are supported by similar findings by earlier researchers (such as Heady, 1952; Salam, 1985; Salasya *et al*, 1986; and Nandwa *et al*, 1997 among others) who also identified input costs as key determinants of enterprise selection or improvement. Economic efficiency and productivity could be achieved if a farmer uses poultry feeds more efficiently. This implies minimizing feed expenditure in their poultry enterprise. The savings can be re-invested to generate more profits for the farmer. The average amount of feed fed per farmer irrespective of the age of the birds and the poultry management

system used was 11.11 kilograms per day per flock. For optimal productivity and profitability, the amount of feed/bird/day is 64gms, 140gms and 116gms for layer chicks, layer bird and broilers respectively. Inappropriate utilization of technological information from extension agents could be the most probable reason why poultry farmers are over feeding their bird flocks. Appropriate use of information can improve poultry productivity and farmers can become more efficient in feed resource use.

The derivation for resource use efficiency for poultry equipment (water troughs, lamps, feed troughs, laying boxes and egg trays) implies that poultry farmers are not using poultry equipment for production efficiently. The equipment were being underutilized as RUE is greater than one (RUE=99.89). Poultry farmers in the district should increase the amount of money used in the purchase of equipment from approximately Ksh.100 to approximately Ksh. 700 in order to achieve optimality and efficiency and thus realize better output which results in profit maximization from the enterprise.

Other (miscellaneous) costs (charcoal, sawdust, paraffin, perches, *jikos*, gunny bags, disinfectants, e.t.c) were another variable of interest. The analysis of efficiency of the resource use suggests that these resources were being inefficiently used, with RUE equals to Ksh. 1479.30. Other costs were actually being underutilized in the production of poultry in the study area. To achieve efficiency, poultry farmers are supposed to reduce the employment of other costs to an optimal level of Kshs. 990 where resource use efficiency will be unitary. Profitability will also be realized when the resource's optimum level is achieved.

According to Todd, (1999) and Dolberg, (2001) smallholder poultry farmers are shifting from a no input/low output system to a small input/higher output system. The latter implies a risk both on high input costs and on investment which invariably leads to inefficiency in the use of resources. Likewise, with the liberalized economic framework, price variables have been left to be determined by the forces of demand and supply. This has led to increased costs of poultry inputs which negatively impacts on their use and the output realized from the enterprise. Asymmetry Information flow from formal sources such as research centers, extension agents and micro-credit institutions are minimal leading also to inefficiencies in resource use.

CONCLUSIONS

From the foregoing results of the study, it is clear that in general, all the resources used in production of poultry in Bureti District, Kenya were used inefficiently; either underutilized or over utilized. This means that the small-scale poultry producers are inefficient at their level of production and that their output and income can be improved if more of feeds, capital, vaccine and medicine are used efficiently and the adoption of relevant technologies for improved poultry management. However, farmers need to make input use more efficient by reducing the level of employment of inputs particularly feeds in order to improve profitability. Moreover, the study objectives can be achieved through government subsidizing feed and chick costs and provide funding for development and research; Livestock Research Centers and the Kenya Agricultural research institutes should develop genetically improved breeds of poultry which are efficient converters of feed; and extension agency should be financially supported to disseminate improved technologies that will stimulate small-scale poultry production. Capital can also be channeled to family poultry production through the provision of micro- credit and formation of cooperative societies in order to realize production and economic benefits from the enterprise.

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Abbreviation key: DLPO - District Livestock Production Officer, GOK - Government of Kenya, MFC - Marginal Factor Cost, MPP- Marginal Physical Product, MVP- Marginal Value Product, RUE - Resource-use efficiency