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Full Length Research Paper

The influence of livestock market structure conduct and performance on herd productivity among smallholder dairy farmers in Western Kenya

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Dairy farming in Kenya contributes about 4% of the country's GDP. The dairy sector contributes significantly to poverty alleviation by creating employment in rural Kenya. Increased activity in farming is driven mainly by the high demand for milk against insufficient supply. To gain from expanding market opportunities, smallholders in Western Kenya often purchase replacement cull cows or heifers from livestock markets which mainly obtain stock from neighbouring milk surplus Rift Valley. Market features such as lack of accurate information, high transaction costs and price inefficiency have likely led to low productivity of these dairy herds thus denying smallholders income. This paper provides an insight into the influence of livestock market features on herd replacement decisions and the resulting productivity. The study showed that dairy cows purchased in local livestock markets did not improve dairy productivity in Western Kenya. Lack of accurate information in the markets related negatively to productivity, while high transaction costs and price of cattle reflected insufficient supply of high potential dairy cows. The study recommends technical and institutional changes to improve dairy cow breeding strategies and marketing structure. Creating access to affordable credit to smallholder dairy farmers will improve their market participation and give them some market command.

Key words: Livestock markets, herd replacement, smallholder dairy farmers.

INTRODUCTION

The livestock sector accounts for about 18% of GDP in Sub Saharan Africa with milk contributing 20-25% of this output (Muriuki, 2003). Analysis by Delgado et al. (2001) provides clear evidence of an increase in demand of dairy products in Sub-Saharan Africa and other developing regions of the world as a result of rapid population growth, urbanization and increased disposable incomes (Muriuki, 2003). Milk production in the Common Market for Eastern and Southern Africa (COMESA) and the East African Community (EAC) is approximately twelve million metric tonnes against a demand of fourteen million metric tonnes per annum. Milk consumption in these trading blocs is expected to increase from the current *per capita* consumption of 36 L owing to increased disposable incomes and urbanization (ASARECA, 2004).

Kenya has the largest dairy subsector in eastern and southern Africa with a *per capita* production of approximately 90 L (Murage and Ilatsia, 2011). Over the years, the growth of Kenya's dairy sector has been steered greatly by supportive policy implemented in the country (Waithaka et al., 2002). Other factors include the favourable climate for dairy farming and the historical importance of milk in the diet of most Kenyan communities (Thorpe et al., 2000). Dairy production in Kenya is mainly practiced by smallholder dairy farmers keeping one to three cows who account for over 80% of domestic milk production (ILRI, 2008).

Dairying is an attractive livestock enterprise in Kenya for income generation and food security in addition to contributing to the sustainability of smallholder crop-dairy systems through nutrient cycling to fertilize soil, employment creation and provision of farm household nutrition. Dairying supports an estimated 625,000 smallholder producer households. Smallholders retain approximately 40% of milk produced mainly for

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household consumption (70%) and calf feeding (30%), while the rest is marketed via informal markets, cooperatives, self help groups and processors. It is estimated that from every 100 L of milk marketed by small scale producers, 1.2 jobs (formal and informal) are created along the dairy value chain (Murage and Ilatsia, 2011). These attributes have made dairying a preferred choice for addressing rural poverty.

Dairy farming in Western Kenya is predominantly subsistent in nature despite the good climate that favours the industry. The region has remained milk deficit (Waithaka et al., 2002). Dairy cattle breeds kept by farmers include Friesian, Ayrshire, Jersey, Guernsey and their crosses with local zebu. The local zebu is however popular in Western Kenya as a result of the socio-cultural practices (dowry payment and prestige), thus putting more emphasis on the number of cows other than the quality and quantity of the product (milk).

Livestock markets constitute the major source of replacement stock for smallholder farms in Western Kenya. Most of the cows offered for sale in these markets are frequently cull cows from dairy farms from neighbouring Rift Valley. There are also vibrant bi-weekly livestock sales conducted in various shopping centres. The market players are mainly intermediaries who have no knowledge in livestock health and have no performance records concerning the livestock they offer for sale (Muthui, 2013). Murage and Ilatsia (2011) showed that majority of smallholders are unlikely to raise replacements from their own farms owing to low calf survival rate and frequent culling to raise finances to address urgent needs. This situation leaves the smallholder dependent on livestock markets to obtain replacements. The setting up of bull schemes by the Livestock Development Project (LDP), Heifer Project International (HPI) and some Non-Governmental organisations have been instrumental in improving local breeds, however, progress has been very slow (Waithaka et al., 2002). They also showed that dairy farmers in Western Kenya are net buyers of breeding stock and that majority of stock available in livestock markets are often problem cull cows. These market features have likely impacted negatively on the quality of replacements and also on the productivity of dairy herds in Western Kenya. The objective of this study was therefore to inquire into the structure, conduct and performance of livestock markets and the implication on herd performance by focussing on the relationship between the productivity of progenies of purchased replacements and livestock market attributes.

METHODOLOGY

Study area and data collection

The study was conducted in Vihiga and Nandi Districts. The study areas were selected on priori information from literature and key informants. The choice of the two regions was also guided by the proximity to each other so as to minimise spatial influence on market price of replacement dams, insemination fees and farm-gate prices of milk. In Vihiga district, Tiriki East division which borders Rift valley was selected for household sampling. Vihiga district has two agro-ecological zones. There is the Upper Midland zone with well drained fertile soils supporting growing of tea, coffee, maize and beans. The Lower Midland Zone with red loamy soils from sediments and basement rocks is suitable for growing sugarcane, maize, beans and sorghum. The district is densely populated with an average of 978 persons per square kilometre which presents land pressure to dairy farming in a region where 60% of the population live below the poverty line (CBS, 2006).

In Nandi district, Aldai and Kaptumo divisions which border Vihiga district were selected for the study. The district has Upper midland agro-ecological zone with an annual rainfall of 1600 - 2000 mm and has a well developed supportive infrastructure including dairy hubs, processing plants and a number of dairy cooperatives. Dairying is based on natural pastures complemented with improved pastures of Rhodes grass and Nandi Setaria on large farm holdings unlike in Vihiga where fodder cut-and-carry feeding systems predominate in small holdings. Since the region has a relatively well developed supportive infrastructure for dairy development and serves as a source of dairy breeding stock and milk supply to Western Kenya, the region is labelled a milk surplus region.

A sample of 245 households was obtained through a cross sectional survey applying a stratified simple random sampling procedure. Two divisions were selected in each district and in each division two locations bordering Western and Rift valley regions were selected. A transect line was then drawn joining pairs of major landmarks such as schools and shopping centres along which every third household to the right and then to the left were sampled using the approach proposed by Bebe et al. (2002).

Data collection was through household interviews using a pretested structured questionnaire. Information captured in the questionnaires included the smallholders' demographic characteristics, ease of access to individual cow production and performance information during purchase of replacement stock, accuracy or effectiveness of available information, access to credit facilities to finance livestock purchase, market price of dairy cows and transaction costs associated with livestock markets. Data on herd management, performance of progenies of purchased replacements, sale and purchase of stock, cost of feeds and other inputs, cow maintenance costs, milk marketing costs and fixed costs were also captured.

Analytical technique

Descriptive statistics was used to analyse the smallholders' choice of replacement in terms of heifers or

cull cows, breed, parity, age and price of both cows sold and those purchased. To analyse productivity of heifer or cull cow progenies, discounted net margins were computed using the general profit function as described by Kahi et al. (2000) and Perez-Cabal and Alenda (2003) and presented as:

$$PROF_t = R_t - C_t. \quad (1)$$

In the study by Kahi et al. (2000), productive life (PL) is used in the profit function to compute the profit per day of PL per cow (PLD) discounted back to birth.

$$PDL = \frac{1}{PL}\left\{\frac{1}{(1+rd)^{AFC}}[R - C]\right\} \quad (2)$$

Where r = discount rate, defined as the inflation corrected savings account rate.
rd = daily discount rate defined as $(1 + r)^{1/365} - 1$, AFC = age at first calving in days, PL = productive life in days, C = cow lifetime costs, R = cow lifetime revenue.

The lifetime milk revenue (LMR) was based on the current fluid milk price and was expressed as:

LMR = Milk price per litre × Lifetime milk yield (LMY) in litres (3)

It was assumed that the cow costs and revenue were spread out evenly over each day of the productive life. The cow lifetime revenue was computed following this equation:

$$R = \frac{1-\frac{1}{(1+rd)^{PL}}}{rd \times PL}[(LMY \times Pm) + DV + (NC \times Pc)] \quad (4)$$

Where Pm = milk price in Ksh per Kg, DV = disposal or salvage value, NC = number of calves born alive, Pc = calf price.

The cow lifetime costs were computed as:

$$C = \frac{1-\frac{1}{(1+rd)^{PL}}}{rd \times PL}[FC + HC + CI + (LMY \times Mm) + MC + Ch + (Cdfc \times PL)] \quad (5)$$

Where FC = feed cost during productive life (Ksh), HC = health cost during productive life (Ksh), CI = insemination cost (either AI or bull service) during productive life (Ksh), Mm = milk marketing costs (Ksh per litre), Ch = cost of rearing heifer to first calving (Ksh), Cdfc = fixed costs per cow per day (Ksh), MC = marketing costs for disposed cows for slaughter or dairying.

Feed cost during productive life was estimated from data on feeding regimes. It was assumed that the feeding regime in the lactating period and the dry period was the same. This was a deviation from the study done by Kahi et al. (2000). The cost of insemination also took into account the cost of natural service where it was charged. For AI, the total cost including insemination fees and inseminators transport charges were considered. Milk marketing cost considered spoilage during marketing, spillage and opportunity cost of time spent to deliver milk. The heifer rearing cost took into account the value of the heifer, the heifer feeds, health and reproduction, labour and fixed costs. The underlying assumption in valuation of family labour was the opportunity cost for not working for the family farm. Likewise, valuation of pasture was based on the opportunity cost if the land was hired out for other agricultural activity. Fixed costs considered farm structures and equipments.

Linear regression was fitted to establish the relationship between the net margin estimates and the market features, that is, access to information, access to credit, perceived accuracy of available information, livestock market prices defined by the price spread and transaction costs. The model fitted was specified as:

$$Y(\text{Net margins}) = \beta_1 + \beta_2 INFOACC + \beta_3 INFOPERC + \beta_4 CREDIT + \beta_5 PRICE + \beta_6 TRANCOST + u_i \quad (6)$$

Where β_1 is the constant, β_2 _ β_6 are the coefficients for the explanatory variables. The Z- statistic was used to test the statistical significance of the coefficients.

RESULTS AND DISCUSSION

Livestock market features

The entire sample comprised 578 dairy cows, out of which 50.7% were bred from purchased replacement stock. Of the purchased stock, 73.4% were purchased as cull cow while 26.6% were purchased as heifers. The most preferred breeds purchased for replacement were dairy crosses (45.4%) followed by Friesian and Ayrshire (41.2%), similar to Kahi et al. (2000) who demonstrated that crossbreeds of Friesian or Ayrshire with Zebu were preferred in the tropical coastal lowland since they achieve good levels of milk yield under harsh conditions. These findings indicate that about half of smallholders are dependent on external sources for herd replacement. About three quarters of these replacements are purchased as cull cows. This definitely has implications on future productivity of these herds for a number of reasons, namely: the shorter productive herd life, likelihood of health complications and high veterinary costs. It also implies that livestock markets more frequently offered cull cows for purchase as compared to heifers.

The mean price of cows purchased in livestock markets in Nandi District was KSh 22110.30 ± 12131.90 and KSh 16074.60 ± 4424.20 for those purchases in Vihiga District. The difference in the means was statistically

significant; t(202) = 3.72, p<0.01. The mean age of purchased cows was 6.51 years ± 2.91 with a parity of 2.83 ± 1.79. The average milk production of these cows was 6.39 kg ± 4.49. Linear regression was computed to estimate the relationship between the market price of cows and their age, parity, source and milk production.

The age of dairy cows had a significant (1%) and negative relationship to the price of cows. An increase in age of cow by 1 year was related to a 53% decrease in price. Results also showed that an increase in purchases from markets in Vihiga by 1% was related to a 14% reduction in the mean price of cows. This can be explained by the difference in the mean price of cows in markets in the two locations.

Analysis of smallholders' access to cows' production information or records showed that only 16.9% accessed it. Majority of smallholders either never (44.8%) or just occasionally (38.3%) accessed any production information when purchasing cows. This finding indicated that either this information was not available from the vendors or that the intermediaries did not seek this information. Majority of smallholders rarely kept any records and therefore, it is likely that individual cow production information was rarely available to market players. Lack of adequate information is one of the features of imperfect markets. Among the major disadvantages is that this denies the buyer channel control leaving it to intermediaries. The other disadvantage is lack of product differentiation which is also an important component of perfect markets. For dairy cows, this can be achieved through description of the various production parameters, which is dependent on accurate production records. Breeding records would also facilitate grading of cattle thus facilitating differentiation.

Smallholders were asked to rate the accuracy of information they got from livestock markets based on the performance of the replacements they had purchased. Where the rating was "not a problem", it implied a good level of accuracy, while where there was a rating of "very common problem", it implied that the information was not reliable. Majority (74.8%) of smallholders said that inaccurate information was the most common problem associated with replacement livestock markets, while only 14% felt that it was not a serious problem. Among the factors that probably contributed to the poor rating is the dependence on non-technical intermediaries as the main source of cow information. The information these brokers gave was either inaccurate or false. Of particular importance is the fact that a majority of cows presented for sale were often cull cows which were problem cows, making availability of accurate individual cow information of critical importance to the buyer. The production and health risk implications for these purchases were therefore magnified by the high level of inaccuracy of available cow information.

In computation of discounted net margins (profit per day of productive life), the discount rate used was determined from 2 factors: (a) the average central bank interest rate and (b) the average inflation rate for the period of 12 months prior to data collection. The inflation corrected interest rate used for this study was 15.33%. The mean net margin for all cows in the sample was KSh 71.70 ± 66.80. There was insignificant difference in net margins of progenies of purchased cows (KSh 69.50 ± 4.22) and those from own farms (KSh 73.46 ± 3.80). This implies that purchased replacements did not improve productivity of dairy herds, contrary to the expectations from any dairy breeding programme.

Model empirical results

Linear regression was computed to estimate the relationship between market features, that is, the market price of cows, choice of replacement, access to information, accuracy of information and transaction costs to discounted net margin which was used as a proxy for productivity. The results revealed that the productivity of dairy cows related linearly and positively with their price, since more productive cows are expected to be more productive. The paradox here is that the market price of cows was a function of the market location and age of cows and not production. This however implies that cows in higher priced markets were likely more productive than those in lower priced markets. This finding collaborates that of Musalia et al. (2010) who observed that dairy breeding stocks were not easily available in Western Kenya and the few that were on sale were very expensive while some farmers did not know where to buy such animals.

The productivity of herds of smallholders who had access to credit during purchase of cows was 37% higher than if they had no access to credit, which was significant at 5% level. Access to credit increases the buyers' purchasing power thereby allowing him to purchase a bundle that offers higher utility. As observed, higher priced markets offered higher utility and therefore, higher productivity. Muriuki (2003) in a review of dairy development in Kenya cited low uptake of credit by smallholders to unavailability of suitable lenders, conditions and cost of credit and collateral requirements which have been linked to the slow growth of dairy farming, a scenario that is evident in this study.

Access to dairy cow market information had a 16% positive relationship to net margins significant at 5% level. This can be attributed to improved decision making thereby avoiding obvious error relating to purchase of unhealthy or unproductive replacement cows. This is important because many of the cows sold in livestock markets were often cull cows. This is emphasised by the finding that an increase by 1% of smallholders who rated available information as inaccurate was related to a 24% decrease in net margins, significant at 1% level. The findings were similar to those of Ogeto et al. (2012) who

showed that access to information improved productivity of smallholder sorghum farmers in Nakuru District, Kenya.

An increase in transaction costs by 1% was related to a 12% increase in net margins, significant at 5% level. The transaction costs considered included costs involved in search of the commodity such as telephone cost, transport cost, council levies, losses during transport and brokers' commissions. The results imply that the costs involved in obtaining more productive cows were high; however, they were not sufficiently high to offset profitability.

CONCLUSION AND RECOMMENDATION

It was concluded that the livestock market features that influenced herd productivity were access to accurate information and the smallholders' purchasing power. Higher market prices and transaction cost related positively to productivity therefore implying that the costs incurred in obtaining a good cow were significant. These findings reflected scarcity of high potential cows in livestock markets. Purchasing replacements in local livestock markets was also shown to be an ineffective strategy in improving dairy productivity in Western Kenya. These features in general are features of an inefficient market which is characterised by lack of information, inefficient pricing mechanisms, and poor flow of commodities.

To improve the market structure and conduct, the study recommends involvement of technical persons and institutions to shield dairy cattle buyers against eventual risks and lack of product differentiation posed by lack of or inaccurate strategies that would increase the population of superior genetics. This will improve the performance of dairy cow markets by improving the quality of the market commodity and eventually productivity. Access to affordable credit to smallholder dairy farmers will give them some level of market command other than have them remain price takers.

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