Determinants of farmers’ choice of fodder market outlets in Laikipia County, Kenya

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Commercial fodder farming is rapidly expanding in Laikipia County, Kenya and there is an emerging market formation involving different market actors. Several market outlets are at the farmers’ disposal for channelling their fodder to consumers. The purpose of this study was therefore, to determine the factors which influence choices of fodder market outlets in Laikipia County. Using data from 204 fodder farmers, the Multivariate Probit model was used to estimate the determinants of farmers’ choice of fodder market outlets. Findings revealed that, the choice of local livestock farmers, local traders and buyers from other counties’ outlets was significantly influenced by age, experience, commercialization index, fodder quality, marketing costs, market agreements, market distance, market information, proactivity and price in varied directions and intensities. Therefore, collective action is recommended for easy access to market information, better prices, reduced marketing costs and proactive uptake of fodder business by fodder farmers. Policy interventions should focus on improving fodder quality and strengthening market linkages through contract farming and promoting access to fodder markets. To improve fodder productivity while simultaneously augmenting the amount of fodder offered for sale at various fodder outlets, stakeholders should take advantage of farmers’ experience and entrepreneurial orientation to guide their investments.

Key words: Fodder, fodder farmers, multivariate probit model, determinants, market outlets, choice.

INTRODUCTION

Globally, feed and fodder account for up to 70% of total cost of livestock production. As such there is high domestic, regional and international demand for fodder (IGAD, 2017). According to Kilimo Trust (2017), animal feeds demand in East Africa amounted to 6 million MT against production of 1.7 million MT. Consequently, feed deficit in East Africa was 8 and 5.3 MT in 2013 and 2014, respectively. Forage deficit in Kenya was 5.5 billion bales representing 70% of annual fodder requirements (Mureithi, 2018). Napier grass, Boma Rhodes, Lucerne, and natural pastures are the main fodder types grown and traded in Kenya.

Eighty nine percent of Kenya’s land is classified as Arid and Semi-Arid Lands (ASAL) and is home to 70% of the

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national livestock herd (worth KES. 70 billion) and 14 million pastoralists (GoK, 2012b). The Kenyan livestock sub-sector contributes 12% of the national GDP, 42% of the agriculture GDP and employs above 50% of the agricultural labour force hence a key economic driver (GoK, 2019). The sector suffers fodder scarcity due to erratic rainfall and changing land use patterns thus ASAL communities producing fodder to avert massive livestock deaths as well as a source of incomes (Lugusa et al., 2016).

The growing demand for fodder has led to emergence of a commercial fodder sector where farmers are producing and selling fodder (Fekade, 2019). According to Ohmstedt et al. (2018) hay production and marketing is a promising business in the North Rift region of Kenya. As such, there were some 2151 fodder farmers in Laikipia County cultivating 23,380 acres of hay yielding 2,686,324 bales of hay valued at KES. 537, 264, 800 (KNBS, 2020). The County thus identified needs and planned initiatives to scale up fodder production by 5000 acres while stressing on range reseeding (CIDP, 2018).

In this study, it was recognized that fodder production was market oriented and provided dependable income to the farm households justifying the study. The growing demand for livestock products such as meat and milk in Kenya has led to an increased demand for fodder thus presenting viable business opportunities for fodder producers and sellers (agripreneurs) in the country. In order to satisfy the markets, commercial fodder farming is rapidly expanding and there is an emerging market formation involving different market actors. The market formation resulting from the huge quantities of fodder produced and demanded was the emergence of different market outlets from where producers can choose. Fodder farmers voluntarily chose the market outlets but what influenced their preference for different outlets was unknown.

Objectives of the study

The objective of this study was to explore the determinants of farmers’ choice of fodder market outlets. The scrutiny of these factors could help in providing solutions to constraints in fodder markets. It could inform fodder business decisions and development of sustainable policy framework for entrepreneurial growth ultimately contributing to the Sustainable Development Goal two on Zero Hunger.

MATERIALS AND METHODS

Study area

The study was conducted in Tigithi Ward, Laikipia County (Figure 1). The County lies between longitudes 36° 11’ and 37° 24'E and latitudes 0° 18'S and 0° 51'N. The County has five administrative sub counties which are Laikipia East, Laikipia North, Laikipia West, Laikipia Central and Nyahururu. It covers an area of 9,532.2 km² of which 20.5% is high and medium potential apt for crop farming while the rest is low potential, apt for livestock and wildlife. The human population in 2019 was 518,560 persons: 49.97% women and 73% youth (KNBS, 2020). The County’s labor-force was 291,837 persons (CIDP, 2018). Ranching, crop farming, dairy farming, tourism and trade are the main economic activities and the major soil types are loam, sand and clay. Average annual rainfall ranges from 400 to 750 mm on a bimodal pattern with the long rains falling between March and May and short rains in October and November.

Sampling and sampling procedure

Purposive sampling was used to select the study area from which the respondents were selected. First, Laikipia County was selected for its high potential for commercial fodder production. Secondly, Laikipia Central sub-county was selected since it had the highest entrepreneur participation in fodder production and marketing activities. Tigithi Ward with a total of 769 fodder farmers as per KNBS (2020) was then selected for its high concentration of fodder farmers compared to other wards in the sub-county. Lastly, simple random sampling was conducted based on a list of farmers provided by the ASDSP Laikipia to select 204 respondents.

The overall sample size was determined based on desired precision level using the probability proportionate to size sampling formula by Yamane (1967) as in Equation 1:

\[ n = \frac{N}{1 + Ne^2} \]  

(1)

where \( n \) was sample size, \( N \) was total population and \( e \) was desired precision level. In this study, a total population \( N = 769 \) fodder farmers and a precision level \( e = 0.06 \) were used giving a sample size of 204 fodder farmers as in Equation 2:

\[ n = \frac{769}{1 + 769(0.06)^2} = 204 \]  

(2)

Data collection

A semi-structured Open Data Kit (ODK) questionnaire with open and close-ended questions was used to collect data. Household, institutional, market and entrepreneurial orientation data were collected for the year 2020. To pre-test the questionnaire, 15 interviews were conducted to randomly selected fodder farmers in Nanyuki Ward after which revision and validation was done. Data collected was cleaned, coded and entered into STATA for analysis.

Analytical framework

Fodder farmer’s choice of market outlets involved deciding the buyer to sell to among the existing fodder market outlets, namely, local livestock farmers, local traders and buyers from other counties. When the choice consists of two options, binary econometric models are used for analysis. However, if the options are more than two, then the multinomial/multivariate models are used (Greene, 2018). In this study, there were three market outlet options; therefore, the Multivariate Probit model was used to estimate the determinants of farmers’ choice of fodder market outlets.
The Multivariate Probit model for the choice of market outlets

Fodder farmers had options to simultaneously choose from different fodder market outlets to dispose-off their product. These outlets included local livestock farmers, local traders and buyers from other counties. The empirical specification of choice decision over the three outlets can be modelled by multinomial or multivariate regression analysis. Multinomial models assume that error terms of the choice equations are mutually exclusive (Greene, 2018). However, the choices among the outlets are not mutually exclusive as fodder farmers may concurrently sell their fodder to more than one market outlet and thus the random error components of the market outlets may be correlated. Therefore, a multivariate model which allows for the correlation of error terms and simultaneity in the choice of the three market outlets was chosen for this study.

Multivariate Probit model has been used in many studies (Tarekegn et al., 2017; Ngenoh et al., 2019). Tarekegn et al. (2017) used this model to analyze the factors that determine honey producer market outlet choice in Chencha District, southern Ethiopia. The framework is efficient in estimating cases of simultaneity of outlet choice. The Multivariate Probit model used for the jth fodder farmer is of the form in Equation 3.

\[
Y_{ij}^* = \beta_j' X_{ij} + \varepsilon_{ij} \quad (j = Y_1, Y_2, Y_3)
\]

This translates into the observed binary outcome equation for each choice as in Equation 4.

\[
Y_{ij} = \begin{cases} 1, & \text{if } Y_{ij}^* > 0 \\ 0, & \text{otherwise} \end{cases} \quad (j = Y_1, Y_2, Y_3)
\]

where \( Y_{ij}^* \) is the latent variable for choice of market outlet j. \( Y_i \) denotes the choice of the three fodder market outlets (local livestock farmers, traders and buyers from other counties), \( X_{ij} \) is a vector of explanatory variables of outlet choice decision, \( \beta_j \) is a vector parameter and \( \varepsilon_{ij} \) is the error term.

In choosing the three fodder market outlets, the error terms \( \varepsilon_{ij} \) jointly followed a multivariate normal distribution with zero conditional mean and variance normalized to unity and a symmetric covariance matrix \( \varepsilon \) as in Equation 5.

\[
\varepsilon = \begin{bmatrix} 1 & \rho_{12} & \rho_{13} \\ \rho_{21} & 1 & \rho_{23} \\ \rho_{31} & \rho_{32} & 1 \end{bmatrix}
\]

The correlation coefficient \( \rho \) between the stochastic components captured the influence of unobservable factors that are hardly measurable in the study such as self-control, motivation and preference.

The variables determining the choice of fodder market outlets are shown in Equation 6 and are described in Table 1.

\[
C^{MC} = \beta_0 + \beta_1 \text{Age} + \beta_2 \text{Expr} + \beta_3 \text{Crdt} + \beta_4 \text{Rlnfr} + \beta_5 \text{MDist} + \beta_6 \text{Minfo} + \beta_7 \text{Magree} + \beta_8 \text{MCost} + \\
\beta_9 \text{AProd} + \beta_{10} \text{Price} + \beta_{11} \text{CIndex} + \beta_{12} \text{Qlity} + \beta_{13} \text{Inno} + \beta_{14} \text{Proa} + \beta_{15} \text{Risk} + \varepsilon
\]

Prior to running the Multivariate Probit models, diagnostic test for multicollinearity was done using Variance Inflation Factor (VIF) to ascertain the fitness of the models. VIF values less than five (5) points to inexistence of multicollinearity among the predictor

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Figure 1. Map of Tigithi ward, Laikipia Central Sub-County.
Source: Geography Department Egerton University.
**Table 1. Description of variables used in the empirical model**

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Description</th>
<th>Unit of measurement</th>
<th>Expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C^{MC} )</td>
<td>Choice of market outlet</td>
<td>Dummies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Local livestock farmers</td>
<td>1 for livestock farmers, 0 otherwise</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Local traders</td>
<td>1 for traders, 0 otherwise</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Buyers from other counties</td>
<td>1 for other counties, 0 otherwise</td>
<td></td>
</tr>
</tbody>
</table>

**Independent variables**

| Age | Age of farmer | Years | +/- |
| Expr | Number of years in fodder business | Years | + |
| Crdt | Credit access | Dummy (1=Yes, 0=No) | + |
| Rlnfr | Road infrastructure | Dummy (1=Good, 0=Bad) | + |
| MDist | Distance to the market | Kilometers | - |
| Minfo | Access to market information | Dummy (1=Yes, 0=No) | + |
| MAgree | Market agreements | Dummy (1=Yes, 0=No) | + |
| MCost | Marketing costs | KShs | - |
| APod | Amount produced | Bales | + |
| CIndex | Commercialization index | Percentage | + |
| Qlity | Quality of fodder | 5 Likert=(SD - SA) | + |
| Inno | Farmer innovativeness | 5 Likert=(SD - SA) | +/- |
| Proa | Farmer proactivity | 5 Likert=(SD - SA) | +/- |
| Risk | Farmer risk taking | 5 Likert=(SD - SA) | +/- |
| Price | Price of a bale of fodder | KShs | + |

Source: Survey data (2020)

RESULTS AND DISCUSSION

Diagnostic test for multicollinearity

VIF values for the multicollinearity test of the explanatory variables test ranged between 1.11 and 3.11. These were significantly lower than the values 5 suggested by Akinwande et al. (2015) an indication of non-existence of multicollinearity.

Determinants of farmers’ choice of fodder market outlets

Table 2 presents the results from the Multivariate Probit regression for the choice of fodder market outlets.

The likelihood of choosing local livestock farmers’ outlet was 76.47% \((p<0.01)\) a value higher than those of choosing local traders outlet which is 38.24% \((p<0.01)\) and buyers from other counties at 20.59% \((p<0.01)\). This shows that fodder farmers were more likely to sell to local livestock farmers perhaps due to adequate demand and lower transaction costs despite the higher incentives offered by other market outlets.

The market outlet selection behavior varied among the farmers as reflected in the likelihood ratio statistics of estimated correlation matrix. The \( \rho \) values \((\rho_{ij})\) show the degree of correlation between each pair of market outlets. The findings revealed that the correlations between the choice for local traders and local livestock farmers’ outlets \((\rho_{21})\) and the choice for buyers from other counties and local traders’ outlets \((\rho_{32})\) were negative and statistically significant at 1% level. This implies that fodder farmers selling to local traders were less likely to sell to the local livestock farmers \((\rho_{21})\). Similarly, fodder farmers selling to buyers from other counties were less likely to sell to local traders \((\rho_{32})\). In contrast, the association between the choice of buyers from other counties and local livestock farmers’ outlets \((\rho_{31})\) was positive and significant at 1% level. This suggests that farmers selling fodder to buyers from other counties were more likely to sell to local livestock farmers also \((\rho_{31})\). This result points to high competitiveness among local traders and local livestock farmers’ outlets and between buyers from other counties and local traders’ outlets. Nonetheless, there was less business rivalry between buyers from other counties and local livestock farmers’ outlets.

Table 2 presents the factors that determine the choice of various fodder market outlets. Age was positive and significant for choice of buyers from other counties outlet at 5% level. A one-year increase in farmers’ age increased the probability of choosing buyers from other counties by 0.0087. Due to their market experience, resource endowment, access to credit and long-term relationships, older farmers are aware of outlets with relatively higher prices and profit incentives compared to
young fodder farmers. Accordingly, they are more likely to supply fodder through buyers from other counties offering relatively higher prices confirming related findings by Taye et al. (2018).

Fodder farmer experience was significant and positive for the choice of local traders’ outlet at 10% level. More experienced farmers were likely to supply their fodder through local traders by 0.0558. Experienced farmers were conceivably more networked to local traders’ outlet. This confirms Kgosikoma and Malope (2016) who opined that experienced fodder farmers are efficient and have strong social networks and links that assist in searching for the fodder market thereby increasing the chance of selling their marketable surplus through local traders’ outlet.

Notably, commercialization index (percent) was statistically positive and significantly associated with buyers from other counties outlet at 5% level. Increase in commercialization index by 1% resulted in increased fodder supply through buyers from other counties’ outlet by 0.0061. The higher the percentage of fodder offered for sale, the higher the commercialization and the higher the probability of choosing a market outlet. This implies that farmers intending to sell a greater proportion of their sellable fodder output are likely to sell to buyers from other counties who prefer buying fodder in large volumes. This finding is consistent with past studies (Muthini et al., 2017; Tarekegn et al., 2017) establishing that farmers selling large quantities of produce prefer to sell to market outlets that have capacity to buy in large quantities at reasonably better prices.

The improvement in quality of fodder unexpectedly decreased the amount of fodder supplied to buyers from other counties by 0.1167 at 10% significance level. The higher the fodder quality, the higher the value and the higher the price which depresses the market demand. This implies that fodder trade in Tigithi is predominantly quantity-based rather than quality-based and that the market prefers larger amounts of fodder as opposed to high quality of fodder. The increase in fodder quality results in increase in its price reducing the amount demanded by customers. On the contrary, Lu and Dudensing (2015) opined that improved product quality augments value and customer appeal as well as facilitating lucrative market access. The outcome also contradicts Heuzé et al. (2016) reorientation of fodder trade from the quantity-based to the quality-based trade. Buyers from other counties buy fodder in large volumes at a cheaper price with the aim of selling to less quality-conscious customers at a relatively higher price.
The effect of marketing costs on the choice of buyers from other counties is positive and statistically significant at 1% level. An increase in marketing costs by one-shilling results in 0.0001 increase in supply of fodder to buyers from other counties. It can be argued that farmers who proactively incurred an extra coin in search of and delivery to distant fodder customers were likely to supply more fodder to buyers from other counties. This result corroborates the findings of Opondo (2018) who pointed to a positive relationship between marketing costs and market entry.

Market agreement positively and significantly influenced choice of local livestock farmers and buyers from other counties at 1% and 10% levels respectively. A one unit increase in market agreements increased supply of fodder to local livestock farmers and buyers from other counties by 0.5659 and 0.2275 respectively. Formal and informal market agreements between farmers and the buyers created strong ties between them that guaranteed farmers with ready market, assured sale, better terms and better prices increasing trade between them. Geoffrey et al. (2014) argued that ready market reduced the costs of market search and transport for pineapples in Kericho. Kangile et al. (2020) also opined that contracts vividly determined access to lucrative markets for staple food commodities in Dodoma and Morogoro, Tanzania.

The likelihood of selecting buyers from other counties is significantly and negatively influenced by distance to the nearest market. An increase in market distance by a kilometre is likely to discourage the sale of fodder to buyers from other counties by 0.0226 due to high transport costs. The farther the fodder market, the higher the transportation cost and the lower the market margin. The fear of low market margins demotivates fodder farmers from choosing the said outlet hence the negative effect. This finding is consistent to Taye et al. (2018) findings that onion farmers residing far from the nearest market were likely to sell to wholesalers than assemblers and retailers.

Access to and use of fodder market information was positive and significant for deliverance of fodder to buyers from other counties at 5% significance level. Enhancing access to market information by one unit amplified supply to buyers from other counties by 0.4875. Access to market information plausibly helped fodder farmers to analyse the potential prices across all market outlets settling on buyers from other counties with relatively higher fodder prices. This result conforms to Bezabih et al. (2015) positive outcome for selection of potato retailer channel and contradicts to Tarekegn et al. (2017) negative effect on choice of collector outlet.

Proactivity was significant and negative for the choice of local traders’ outlet but positively significant in choosing buyers from other counties outlet both at 5% level. As such, raising proactivity by one unit by reduced the likelihood of supplying fodder to local traders by 0.2599 while increasing supply to buyers from other counties by 0.1559. Fodder farmers are believably quick to seize the high price-driven opportunity typical of buyers from other counties over local traders who offered relatively low prices for low volumes of fodder. Satisfied by the price and volume offered by the buyers from other counties’ outlet, farmers move fast to deliver their fodder thus the positive outcome. This confirms Manzano et al. (2020) revelation on the role of proactive orientation in business ventures.

Effective fodder prices offered by buyers from other counties are positively significant at 1% level. Evidently, a shilling rise in fodder prices increased the amount of fodder sold to buyers from other counties outlet by 0.0077. Higher prices offered by buyers from other counties outlet believably increased the fodder market margin and profitability. Large fodder producers enjoying high bargaining power and transaction cost advantage were thus likely to sell fodder through this outlet in large quantities and at better prices. This finding agrees with Mutura et al. (2015) opinion that large dairy producers incentivized by price, preferred selling large volumes of milk through cooperative societies.

**CONCLUSIONS AND RECOMMENDATIONS**

The objective of this study was to establish the determinants of farmers’ choice of fodder market outlets in Laikipia County. It was established that, age, farmer experience, commercialization index, quality, marketing costs, market agreements, distance to the nearest market, market information, proactivity and price significantly influenced the choice of different market outlets in varied directions and intensities. Therefore, fodder farmers should work in groups for easy access to credit and market information, better prices and proactive uptake of fodder business elicited by demand from different market outlets. Interventions should focus on improving fodder quality and strengthening market linkages through contract farming and shortening of market distances to enhance marketability of fodder. In order to improve fodder productivity while simultaneously augmenting the amount of fodder offered for sale at different market outlets, stakeholders should take advantage of farmers’ experience and entrepreneurial orientation to guide their investments. Future research could focus on analysing the effect of fodder commercialization on the farming household incomes as well as the effect of fodder improvement technologies on performance of fodder enterprises in order to provide vital insights in improving fodder competitiveness.

**CONFLICT OF INTERESTS**

The authors have not declared any conflict of interests.
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