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ABSTRACT

Trypanosomosis is the single most important disease constraining the expansion of livestock in Kenya. Several technologies have been developed to ameliorate the effects of the disease. However, the delivery of these technologies to farmers has been undertaken on trial and error basis without a proper strategy. This has led to more failures than success and contributed to wastage of scarce resources. The main objective of this study was to estimate determinants of preferences for different trypanosomosis control technologies among smallholder cattle farmers in Busia County, Kenya. This study utilized a cross–sectional survey design based on a sample of 217 respondents. Data was collected by use of structured questionnaires and interview schedules. Data from the research instruments were analyzed using descriptive and inferential statistical analysis. Study results show that the most common mode of controlling tsetse fly was through spraying at home followed by communal spraying while the factors affecting the choice of trypanosomiasis control were: age, sex, education, expenditure, milk income, and experience. A high preference for home spraying was noted indicating the possibility sustainable household tsetse control. The study recommends that Farmers should be encouraged to integrate the existing control methods with cheaper ones like insecticide treated traps and zero grazing nets.

Key words: Communal spraying, trypanosomiasis, preference, zero and semi-zero grazing.

Introduction

Trypanosomiasis is a major constraint to the expansion and production of livestock and their products on approximately 10 million km^2 of land in Africa south of the Sahara (FAO, 2000). In Kenya, about 25% of the total land area (consistent with 60% of available rangeland) is infested with tsetse flies and therefore endemic for tsetse-transmitted trypanosomiasis. Trypanosomiasis interferes with people's livelihoods through loss of subsistence, particularly proteins, and incomes. It also limits agriculture through under-utilization of agricultural land and loss of traction and manure; as infected animals are too weak to be used in draught ploughing. Mochabo et al. (2005) and Mugalla (2000) have noted that trypanosomiasis is one of the most researched diseases in Africa, and this has led to development of an array of technologies to ameliorate the effects of the disease. These technologies include the use of chemotherapeutic

and chemoprophylactic drugs; tsetse control using targets, traps and insecticidal pour-ons/and or sprays; and the rearing of livestock resistant to trypanosomiasis.

Currently, the promotion of various technologies for adoption by farmers is being undertaken on *ad hoc* basis. This has raised questions with regard to sustainability of several trypanosomiasis control programs initiated in various parts of the country. The current study hypothesizes that the low success rate in uptake of trypanosomiasis control technologies is due to the lack of a clearly formulated strategy to promote uptake of appropriate technologies. There is limited information on farmers' particularly on determinants of small holder farmers' preferences for alternative trypanosomiasis control technologies in different livestock production systems in Kenya. This study aimed at estimating determinants of farmer preferences for different trypanosomosis control technologies.

Methodology

Study area

The study was conducted in Busia County which is located in Western Kenya. The County was purposively selected because it is a tsetse endemic zone and local communities have been engaged in education and tsetse and Trypanosomosis control programs including sensitization and promotion of the zero-grazing nets and community based crush pens for spraying cattle. The County falls in the sugarcane-belt, with maize and cotton production being important enterprises (Jaetzold and Schmidt, 1983). Cattle rearing is also undertaken with dairying gaining importance. Cattle breeds kept include local Zebu and improved dairy of various crosses (Friesian, Ayrshire, and Guernsey). The study area is located within the Lake Victoria basin tsetse belt. The highest points in this area are at about 1500m above sea level, located in Samia and Teso hills. This area receives between 1270 - 1790mm of rainfall annually with slight spatial variation (Jaetzold and Schmidt 1983). The rainfall amount generally decreases from north to south with a reliability of more than 66%. The maximum monthly rainfall falls between April and May.

This study employed a cross –sectional survey design based on a sample drawn from Busia, Nambale, Butula, and South Teso having different levels of trypanosomosis risk. This was preferred because it is efficient in collecting large amounts of information within a short time.

Sampling of respondents and data collection

Sampling of farmers was based on dairy production system. The main production systems considered in this study are zero grazing and semi-zero grazing. A list of all zero grazing farmers in Busia County was constructed with the assistance of Ministry of Livestock Development Staff

and local leaders. Based on this list, farmers were selected from each study locations using a random procedure. Overall, 106 households were selected for zero grazing. Selection of semi-zero grazing farmers was based on the communal spraying crush pens. A list of all the crush pens was obtained from the Veterinary Department. From this list provided by Veterinary Department, crush pens respondents were randomly selected. The selected crush pens were visited in an initial exploratory, the local Animal Health Assistants and crush pen leaders assisted by providing the list of all participating households in the study areas. This list was used as a sampling frame. The number of households sampled per crush pen was depends on their membership. Overall, 111 households were sampled. The main data collection instrument for the study was a questionnaire. The questionnaire formed the major source of primary data for the study. The questionnaire was used to survey the sampled households. The questionnaire included such details as personal characteristics of the household head (such as. age, sex, education), farm-specific characteristics (such as. number and class of livestock owned, major livestock diseases, types of crops grown and their acreage, among others) and the nature and sources of trypanosomosis control technologies in particular and veterinary services in general utilized in the area e.g. type of trypanosomosis control technologies, frequency of use of these technologies, preference for particular technologies.

Econometric approach

The consumer theory postulates that individuals derive satisfaction or utility from the consumption of goods and services (Varian, 1992). However, Lancaster (1966) argued that it is the attributes or characteristics of goods and services from which such utility is derived. Consumers will therefore make consumption decisions based on their perceptions of the degree of provision of those attributes by a good or service (Louviere, 1988; Reed et al., 1991). Due to observational deficiencies on the part of the analyst arising from unobserved attributes and measurement errors, the analysis of consumer choice is usually cast in a random utility framework (Maddala, 1983). This framework models the probability that a consumer will choose a particular good or service from the choice set as a function of differences in utilities among alternatives as well as the attributes of the consumer (Ben-Akiva and Lerman, 1985). Because the consumer is rational, s/he is assumed to choose the alternative that maximizes his/her utility (Greene, 1990). On this basis, the observed choice is deemed to be the option that confers the consumers the highest utility.

Following Maddala (1983), suppose that a consumer faces m alternative choices. Let U_i^* denote an underlying latent variable representing the indirect utility associated with the ith choice. The observed variables Y_i are defined as

$Y_i=1$ if $U_i^*=\text{Max}(U_1^*, U_2^*, \ldots, U_m^*)$ …… (1)

$Y_i=0$ otherwise

Assuming that there are no ties in the selection, the following random utility model can be specified:

$$U_i^* = V_i(X_i) + \varepsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

Where V_i is the deterministic component of the indirect utility function, X_i is the vector of attributes for the ith choice and ε_i is a vector of stochastic errors that captures unobserved variations in tastes and in the attributes of alternatives and other measurement errors. Assuming that the error term is independently and identically distributed with a Weibull distribution, the probability of choosing the ith alternative given the vector of attributes is given by the logit model (Maddala, 1983):

$$\Pr(Y_i = 1 \mid X) = \frac{e^{V_i}}{\sum_{j=1}^{m} e^{V_j}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}$$

The assumption of a Weibull distribution for the errors ensures independence from irrelevant alternatives (IIA). The validity of this assumption will be explicitly tested in this study.

In most cases we consider the effects of both alternative- and consumer-specific attributes on the choice probability. If U_{tj}^* is the level of indirect utility for the tth consumer making the jth choice and $Y_{tj} = 1$ if the tth consumer makes the jth choice and $Y_{tj} = 0$ otherwise, then

$$U_{tj}^* = \alpha_j' X_t + \beta' Z_{tj} + \varepsilon_{ij} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(4)}$$

where X_t are consumer-specific variables and Z_{tj} is the vector of the attributes of the jth choice as perceived by the tth consumer. The probability that the tth consumer selects the jth out of m alternatives is given by the following mixed multinomial logit:

$$P_{tj} = \Pr(Y_{tj} = 1) = \frac{\exp(\beta_j' X_t + \alpha' Z_{tj})}{\sum_{k=1}^{m} \exp(\beta_k' X_t + \alpha' Z_{tk})} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \text{(5)}$$

where $\beta_1, \ldots, \beta_m$ and $\alpha_1, \ldots, \alpha_m$ are alternative- and consumer-specific coefficients respectively.

Equation (5) was used to evaluate the impacts of both farmer and technology-specific attributes on the choice probability. A multinomial logit mode was fitted using computer software. The variables in the model are given in table 1.

Table 1: Description of variables in the empirical model

Variable	Description
CHOICE (TRYPSCTRLMETHOD)	Dependent variable representing farmer's preference for a particular technology. CHOICE=1 if the channel is chosen and 2 otherwise
AGE	Age (years) of the household head
SEX	Sex of the household head. Coded as a dummy variable: 0=female; 1=male
EDUC	Highest level of formal education attained by the household head. Coded as a categorical variable: 0=no formal education, 2=primary level, 3=post primary education
CATTLENO	Number of cattle owned
INCOMEHH	Household income in ksh
PERIODVIP1 (EXPERIENCE)	Experience of most important decision maker
INCOMEOFFARM	Amount of off-farm income (Kenya shillings)
PRESENTFARMSIZE	Total land size owned (acres)
INCOMEMILK	Income from milk in Ksh
PRESENTGRAZINGAREA	Area under pasture/fodder
DISTANCEINPUTS	Distance of the homestead to the nearest technology source (Km)
METHOEXPENDITURE	Amount of money spent on the technology in 12 months prior to the survey

Source: Author's Survey Data 2012

Results and Discussion

Regression results are presented in table 2 to table 5.

Table 2: Determinants of preference for home spraying among farmers who practice semi-zero grazing.

Variable	Coefficient	Std. Error	z value	Pr(>|z|)
AGE	-6.429e-02	2.508e-02	-2.563	0.0104 *
SEX1	4.151e+00	2.078e+00	1.998	0.0458 *
SEX2	4.078e+00	1.952e+00	2.089	0.0367 *
EDUC1	-5.495e+00	2.818e+00	-1.950	0.0512 .
EDUC2	-2.664e+00	1.447e+00	-1.841	0.0656 .
EDUC3	-2.253e+00	1.449e+00	-1.555	0.1200
EDUC4	-1.345e+00	1.469e+00	-0.916	0.3597
EDUC5	1.448e+01	1.774e+03	0.008	0.9935
CATTLENO	-9.750e-02	1.158e-01	-0.842	0.3997
INCOMEHH	-3.040e-05	2.453e-05	-1.239	0.2153
PERIODVIP1	9.208e-02	3.700e-02	2.488	0.0128 *
FARMSIZE	2.591e-02	1.111e-01	0.233	0.8157
INCOMEMILK	1.043e-04	4.811e-05	2.167	0.0302 *
GRAZINGAREA	1.412e-01	2.760e-01	0.511	0.6090
EXPENDITURE	3.306e-04	1.943e-04	1.702	0.0887 .

*Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 152.49 on 110 degrees of freedom

Residual deviance: 105.16 on 95 degrees of freedom

AIC: 135.16

Number of Fisher Scoring iterations: 16

Source: Author's Survey Data 2012

Results in **Table 2** show that at five per cent level of significance age, sex, experience, and milk income are important factors explaining preference for home spraying among semi –zero grazers.

There was a negative and significant relationship between home spraying and the age of the respondents. Age was significant at 5 percent level. An increment in age of respondents led to a decrease in log of odds in preference for home spraying. The negative relationship implies that older people were less likely to prefer home spraying than young people. This could be explained by the fact that home spraying is tedious and requires greater energy and is therefore less attractive to older people.

The relationship between milk income and preference for home spraying among smallholder cattle farmers in the study area was found to be positive and significant at the 5 percent level. An increase in income from milk would lead to an increase in the log of odds in favor of home spraying. The coefficient was positive implying that those small holder farmers with large income would take up the technology as opposed to those with low levels of income. This is true because home spraying is costly and it is only those endowed with income that can afford it.

Experience was significant and positive at 5 percent level. The results indicated that an increase in the number of years in dairy farming would lead to an increase in the likelihood of a farmer preferring home spraying. That implied that farmers who were more experienced were more likely to prefer home spraying.

Adult literacy and primary school education by households had a negative and significant relationship with home spraying at the 5 percent level. This is not expected to be the case.

Table 3: Regression results showing determinants of preference for home spraying among farmers who practice zero grazing.

Variable	Coefficient	Std. Error	z value	Pr(>|z|)
AGE	3.548e-02	2.605e-02	1.362	0.17327
SEX1	-1.807e+01	1.692e+03	-0.011	0.99148
SEX2	-1.735e+01	1.692e+03	-0.010	0.99182
EDUC1	1.648e+01	1.692e+03	0.010	0.99223
EDUC2	1.777e+01	1.692e+03	0.011	0.99162
EDUC3	1.816e+01	1.692e+03	0.011	0.99144
EDUC4	1.677e+01	1.692e+03	0.010	0.99210
EDUC5	1.750e+01	1.692e+03	0.010	0.99175
CATTLENO	6.490e-02	1.184e-01	0.548	0.58356
INCOMEHH	1.165e-05	7.812e-06	1.491	0.13599
PERIODVIP1	1.372e-01	4.487e-02	3.059	0.00222 **
PRESENTFARMSIZE	-8.499e-02	1.151e-01	-0.738	0.46041
INCOMEMILK	5.629e-05	3.269e-05	1.722	0.08512 .
GRAZINGAREA	-2.046e-01	3.059e-01	-0.669	0.50365
EXPENDITURE	-6.882e-04	2.245e-04	-3.065	0.00217 **

*---Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 140.02 on 101 degrees of freedom

Residual deviance: 105.57 on 86 degrees of freedom

AIC: 135.57

Number of Fisher Scoring iterations: 15

Source: Author's Survey Data 2012

Results in **Table 3** show, that at five per cent level of significance, experience and expenditure on spraying are important factors explaining preference for home spraying among zero grazers while milk income is significant at 10 % level of significance.

The relationship between milk income and preference for home spraying among smallholder cattle farmers in the study area was found to be positive and significant at the 5 percent. An increase in income from milk would lead to an increase in the log of odds in favor of home spraying. The coefficient was positive implying that those small holder farmers with large income would take up the technology as opposed to those with low levels of income. This is true because home spraying is costly and it is only those endowed with income that can afford it.

Experience was significant and positive at 5 percent. The results indicated that an increase in the number of years in dairy farming would lead to an increase in the likelihood of a farmer preferring home spraying. That implied that farmers who were more experienced were more likely to prefer home spraying.

Table 4: Determinants of preference for communal spraying among farmers who practice semi-zero grazing.

Variable	Coefficient	Std. Error	z value	Pr(>|z|)
AGE	7.796e-02	2.907e-02	2.682	0.00732 **
SEX1	-2.231e+01	3.014e+03	-0.007	0.99409
SEX2	-2.215e+01	3.014e+03	-0.007	0.99414
EDUC1	3.555e+00	4.900e+03	0.001	0.99942
EDUC2	2.035e+01	3.014e+03	0.007	0.99461
EDUC3	1.962e+01	3.014e+03	0.007	0.99481
EDUC4	1.826e+01	3.014e+03	0.006	0.99517
EDUC5	2.464e+00	4.080e+03	0.001	0.99952
CATTLENO	4.375e-02	1.237e-01	0.354	0.72355
INCOMEHH	3.824e-05	2.946e-05	1.298	0.19431
PERIODVIP1	-9.108e-02	4.048e-02	-2.250	0.02443 *
FARMSIZE	4.604e-02	1.181e-01	0.390	0.69677
INCOMEMILK	-1.238e-04	5.811e-05	-2.131	0.03307 *
GRAZINGAREA	-4.988e-01	4.075e-01	-1.224	0.22091
EXPENDITURE	-2.662e-04	2.102e-04	-1.267	0.20526

Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Null deviance: 152.49 on 110 degrees of freedom

Residual deviance: 86.53 on 95 degrees of freedom

AIC: 116.53

Number of Fisher Scoring iterations: 17

Source: Author's Survey Data 2012

Results in **Table 4** show that age, experience, and milk income are important factors explaining preference for communal spraying among semi –zero grazers.

There was a positive and significant relationship between communal spraying and the age of the respondents at 1 percent level. An increment in age of respondents led to an increase of log of odds in preference of home spraying. The positive relationship implies that older people were more likely to prefer communal spraying than young people. This could be explained by the fact that communal spraying is less tedious and requires less energy and is therefore more attractive to older people.

The relationship between milk income and preference for communal spraying among smallholder cattle farmers in the study area was found to be negative and significant at the 5 percent. An increase in income from milk would lead to a decrease in the log of odds in favor of communal spraying. The coefficient was negative implying that those small holder farmers with large income would not prefer communal spraying as opposed to those with low levels of income. This is true because those endowed with higher income that can afford other technologies such as home spraying.

Experience was significant and negative at 5 percent level. The results indicated that an increase in the number of years in dairy farming would lead to a decrease in the likelihood of a farmer preferring communal spraying. That implies that farmers who were more experienced were less likely to prefer communal spraying compared to other methods.

Table 5: Determinants of preference for communal spraying among farmers who practice zero grazing.

Variable	Coefficient	Std. Error	z value	Pr(>|z|)
AGE	-1.311e-01	1.080e-01	-1.214	0.2249
SEX1	-3.661e+00	7.870e+00	-0.465	0.6418
SEX2	-3.245e+00	7.404e+00	-0.438	0.6612
EDUC1	-1.945e+01	1.781e+04	-0.001	0.9991
EDUC2	-1.813e+00	4.200e+00	-0.432	0.6660
EDUC3	-3.354e+01	6.824e+03	-0.005	0.9961
EDUC4	-4.346e+01	3.968e+03	-0.011	0.9913
EDUC5	-3.415e+00	5.569e+00	-0.613	0.5398
CATTLENO	8.555e-01	9.275e-01	0.922	0.3563
INCOMEHH	-2.261e-04	1.563e-04	-1.447	0.1480
PERIODVIP1	- 5.281e-01	2.597e-01	- 2.033	0.0420 *
FARMSIZE	1.096e+00	6.167e-01	1.778	0.0755 .
INCOMEMILK	7.263e-04	3.926e-04	1.850	0.0643 .
GRAZINGAREA	-1.271e+00	1.022e+00	-1.244	0.2135
EXPENDITURE	-5.919e-03	2.934e-03	-2.017	0.0437 *

Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Null deviance: 140.016 on 101 degrees of freedom

Residual deviance: 18.274 on 86 degrees of freedom

AIC: 48.274

Number of Fisher Scoring iterations: 21

Source: Author's Survey Data 2012

Results in **Table 5** show that at five per cent level of significance, experience and expenditure on spraying are important factors explaining preference for communal spraying among zero grazers. Farm size and milk income are significant at 10 % level of significance.

The relationship between milk income and preference for home spraying among smallholder cattle farmers in the study area was found to be positive and significant at the 10 percent. An increase in income from milk would lead to an increase in the log of odds in favor of communal spraying. The coefficient was positive implying that those small holder farmers with large income would take up the technology as opposed to those with low levels of income. Experience was significant and negative at 5 percent. The results indicated that an increase in the number of years in dairy farming would lead to a decrease in the likelihood of a farmer preferring communal spraying. That implies that farmers who were more experienced were less likely to prefer communal spraying. Expenditure was significant and negative at 5 percent. The results indicated that an increase in the expenditure in communal spraying would lead to a decrease in the likelihood of a farmer preferring communal spraying. The relationship between farm size and preference for communal spraying among smallholder cattle farmers in the study area was found to be positive and significant at the 10 percent. An increase in farm size would lead to an increase in the log of odds in favor of communal spraying. The coefficient was positive implying that those small holder farmers with large farms would take up the technology as opposed to those with small farm sizes.

Conclusion

This study evaluated factors that determine farmers preference for communal spraying and home spraying. Farmer's age, sex, education, experience, expenditure on spraying and milk income had a significant influence on the likelihood of a farmer preferring either home or communal spraying. A high preference for home spraying was noted indicating the possibility sustainable household tsetse control.

Recommendations

In light of the findings and conclusions of this study, the study recommends that : Farmers should be encouraged to integrate the existing control methods with cheaper ones like insecticide treated traps and zero grazing nets. The community should work together to achieve total control of flies and eventually the disease (trypanosomiasis). The challenge for all those concerned with trypanosomosis control in Kenya is to develop methods which are sustainable, appropriate, and cost-effective and integrated with rural development. These can only be achieved through farmer motivation and education, improved delivery of tsetse control and veterinary services, commercial opportunities and cost recovery schemes, whilst at the same time encouraging the

pharmaceutical industry and the scientific community to search for new drugs and an effective vaccine against this most devastating of disease.

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