CATTLE AS ASSETS: ASSESSMENT OF NON-MARKET BENEFITS FROM CATTLE IN SMALLHOLDER KENYAN CROP-LIVESTOCK SYSTEMS

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ABSTRACT

This paper uses data from a survey of two hundred and fifty cattle keeping households in three cattle keeping systems; intensive, semi – intensive and extensive systems to estimate the value of non – market, socio – economic benefits of cattle in Kenya. These benefits of cattle keeping are of special importance in developing countries, where financial markets function poorly and opportunities for risk management through formal insurance generally absent. However, when estimating the total contribution of livestock, these non - market functions are often ignored since they are difficult to value, yet they may contribute to a better understanding of livestock production systems. The use of contingent valuation method is employed in this study to elicit these non – market values. Econometric estimations are then used to assess the factors influencing the non - market benefits function. The results indicate that these benefits are highly valued by cattle keepers and comprise approximately 20% of the animal's total value across the three systems. They are influenced by various production system and household related factors. Implications for policy are drawn.

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INTRODUCTION

A livestock revolution is taking place in global agriculture that has profound implications for livelihoods and environment. Population growth, urbanization, and income growth in developing countries are fueling a massive global increase in demand for food of animal origin. The resulting demand provides income growth opportunities for many smallholders. One key to smallholder competitiveness is their ability to capture non-market benefits, however not well measured to date. The roles livestock play in smallholder systems are manifold. Livestock feature as living "savings" that can be converted into cash when need arises and as security assets influencing access to informal credits and loans. They are closely linked to the social and cultural values of millions of resource poor farmers. These values vary from society to society and largely determine the strategies, interventions, and demand and development opportunities for livestock. Owning livestock gives social status (leadership) and economic status (access to informal credits and loans) to the households. They are also considered a common means of demonstrating wealth, cementing relationships through bride price payments and as social links, important in crises. These socio – economic functions of livestock are often ignored when estimating the total contribution of livestock. Since they are difficult to value, emphasis is mainly placed on the physical marketed production.

Livestock assets are savings for future planned expected needs and perform financing roles in a context where banking is not developed or households are not fully integrated into credit markets, they also perform insurance roles because the capital invested in the flock forms a guarantee for meeting future unexpected requirements. Financing involves conversion of part of the flock into disposable income (and vice versa) to enable households meet lumpy expenditure needs, such as school fees payment. Insurance involves the maintenance of a capital stock embodied in livestock as a guarantee for offsetting shortfalls in earnings and unforeseen expenses in the future. These benefits of livestock keeping are of special importance in developing countries, where financial markets function poorly and opportunities for risk management through formal insurance are generally absent (Moll et. al, 2001).

Alternative forms of financing such as credit are limited and inaccessible especially for small-scale producers. The difference in the credit conditions faced by small and large farmers is the existence of a fixed cost of each lending and borrowing transaction, which is invariant with respect to the loan size. This makes it rather costly for small borrowers due to the larger transaction costs of small loans or in some cases an increased interest rate. The absence or ill functioning of markets for finance and insurance in developing countries, especially in rural areas, has been widely documented by for example, Binswanger and Rosenzweig (1986). The consequence of the restricted presence or absence of finance and insurance institutions is that to cope with the vagaries of life, people in rural areas search for alternatives such as assets within their sphere of command. Livestock provide a relatively suitable means for financing and insurance for smallholders, compared to other assets as they can be kept safely without losing value and its value can increase overtime (Slingerland, 2000).

Whereas production and income from livestock raising has been extensively studied, quantified and modeled, so far very little has been done to get a conceptually better underpinned and more quantitative grasp of the importance of the socio – economic functions, that would explain why livestock keepers are willing to keep low productive animals in the herd as perceived by the technical staff. In their recent study, Moll et. al, (2001) and Bosman (1995) quantify these functions on the basis of foregone costs, perceived as benefits that can be added to the production value of livestock. However, foregone costs are real, since farmers take them into account in the decision process and hence do not entail attainable income as noted by Slingerland (2000). This requires a method that takes livestock keepers' perceptions into consideration. Extensive reviews of benefit cost analysis studies of the livestock enterprise in developing countries (Moll et. al, 2001; Bosman, 1995; Slingerland, 2000), does not indicate any other work that has attempted to quantify these benefits and their effect on the survival of smallholder livestock systems, yet this may contribute much more to the understanding of livestock production systems than production of meat, milk, traction and provision of farm inputs. The paucity of empirical economic studies on this issue justifies further investigation. The objective of this paper is to estimate the value of the non – market, socio – economic functions of cattle in extensive, semi – intensive and intensive small-scale crop – livestock cattle production systems in western Kenya using the contingent valuation method. This is aimed at contributing to a better understanding of "appropriate" public and private policies benefiting producers, technical staff, researchers and policy makers.

A brief description of the small – scale crop-livestock production systems examined in this paper is briefly discussed below. The distinction between extensive and intensive agriculture refers to the amount and type of productive factors used in a given agroclimate (McIntire et. al., 1992). In the intensive small – scale cattle production system, crops and livestock are closely integrated and market factors have been crucial to development. High population growth has resulted in reduction in land – holding sizes. Farmers have developed a dairy enterprise (mainly upgraded dairy breeds), which is closely integrated into multi – objective farming system, also relying on cash crops. Cattle are confined in one place where they are stall – fed with fodder. Manufactured feeds are widely used especially at milking. Milk offtake is relatively high compared to the other systems. The semi – intensive system is characterised by a lower human population density compared to the intensive systems, the dairy animals rely mainly on grazing which is usually supplemented with cultivated fodder in a cut and carry system of feeding. The breeds are the same as those in the intensive areas though with a higher local zebu content: The main purpose of cattle keeping in the two systems is milk and manure production as well as its security role. In the extensive systems, more land and less labour is used per unit of output. Livestock mainly rely on grazing and are predominantly local zebus. There is little use of purchased inputs and land sizes are also relatively large. The important feature in this system includes the use of cattle for draught power, dowry payment, display of status, store of wealth, and security in addition to manure and milk production for subsistence needs.

Data for the study is collected from a sample of two hundred and fifty cattle keeping households in Kisii and Rachuonyo districts in western Kenya, in which open grazing, semi – zero grazing and zero grazing cattle systems are practised. Extensive grazing is mainly practised in the lakeshore lowlands of Rachuonyo district while semi – intensive and zero grazing is largely practised in Kisii district. Zero grazing is also practised in the upper midland zones of Rachuonyo district. The rest of the paper is divided into three sections. Section 2 describes the methods used, while section 3 discusses the empirical results. Section 4 presents conclusions and implications of the results for policy makers.

VALUATION METHODOLOGY

Contingent valuation (CV) is a survey method primarily used to place monetary values on products and services for which market prices do not exist or do not reflect their social value. Respondents to a contingent valuation survey are presented with a realistic but hypothetical scenario and asked questions about the maximum amount of money they would be willing to pay (WTP) for amelioration from the status quo, or the minimum amount they would be willing to accept (WTA) for the deterioration from the status quo. The elicitation of the values can be "closed" or "open" ended. The assessment of WTP through CV has a sound theoretical basis in welfare economics (Mitchell and Carson, 1989). There are two key assumptions of positive economics upon which welfare economics theory is based. The first one is that economic agents when confronted with a possible choice between two or more bundles of goods have preferences for one bundle over another. Secondly, through its actions and choices, an economic agent attempts to maximise its overall level of satisfaction or utility. Both assumptions have important implications for the contingent valuation (CV) approach. In discrete choice CV questions, the respondent is offered two choices, the "*status quo*" and the "change in the *status quo*". From the utility function, the probability that the respondent will answer "yes" is the probability that their utility with the proposed change (alternative 1) is greater than their utility without the proposed change (Alternative 0). Thus;

$$P_{1i} = \Pr[\overline{U}_{i1} + \varepsilon_{i1} \geq \overline{U}_{i0} + \varepsilon_{i0}]$$

$$= \Pr[\varepsilon_{i0} - \varepsilon_{i1} \leq \overline{U}_{i1} - \overline{U}_{i0}] \quad (1)$$

Where P_{1i} is the probability that the *i*th respondent will answer, "yes" to an offered price, u_{i0} is the respondent's total utility in the *status quo*; u_{i1} is the utility with the change. Contingent valuation was developed in the environmental field to assess the value of "intangible" items. The initial applications of the CV method in developing countries were in the areas of water supply and sanitation, recreation, tourism and national parks. It has subsequently been used in a variety of situations to provide a guideline for setting a price for an intangible good or service.

WTP Question

To introduce the willingness to pay section of the questionnaire, respondents were asked to outline the objectives or reasons for keeping different categories of cattle. Next, they were asked to give their perceived value of the animal, this is not necessarily its market price. Subsequently, a hypothetical scenario was posed whereby they were to suppose that a new government policy was in place, restricting movement and sale of the animals. As a result, the farmer loses control of disposal of the animal through sales and dowry payment. Consequently, he loses the dowry payment, insurance and finance benefits, as he is unable to sell the animal to meet planned and unplanned needs. Next, using the original perceived value as the base the farmer was asked his "new" perceived value after this loss, using predetermined values. The difference between the "new" perceived value and the original perceived value gives the value of these socio – economic benefits.

Empirical model

The factors influencing the socio-economic benefits function are examined using the Tobit model. According to Maddala (1992), the standard Tobit model can be defined as:

$$Y_i = Y^*_i = \lambda X_i + \mu_i \text{ if } Y^*_i > 0$$

$$\text{Otherwise, } Y_i = 0 \text{ if } Y^*_i \leq 0 \quad (2)$$

The model assumes that the random error term μ_i, is normally and independently distributed with mean = 0 and constant variance σ^2. If the non-observed latent variable Y_i^* is greater than 0, the observed qualitative variable Y_i, which is indicative of the socio-economic, non – market WTP value, becomes a continuous function of the explanatory variables and X_i represents a vector of independent socio – economic and institutional variables. On the other hand, if Y_i^* is less than or equal to 0, Y_i becomes zero implying that there is no demand for socio-economic non – market product of cattle.

The socio-economic WTP function is synonymous to the demand function for the socio – economic product of cattle. This function has a censored distribution since the WTP value is zero for those not demanding for the socio – economic product. In cases like this (where the dependent variable is only observed in some range), the Tobit model can be used to analyse the factors affecting the probability and level of WTP (Amemiya, 1985). The application of Tobit analysis is preferred in such cases because it uses both, data at the limit as well as those above the limit to estimate regressions (McDonald and Moffit, 1980). The relationship between the expected value of all observations E (Y_i) and the expected conditional value above the limit E (Y_i^*) is given by;

$$E(Y_i) = f(Z)E(Y_i^*) \quad (3)$$

Where $E(Y_i^*)$ is the expected value of Y_i for those farmers that are already demanding for the socio – economic product of cattle, and f is the cumulative normal distribution function at z, where z is $X\beta/\sigma$. Consideration of the effect of the *i*th variable of X on Y_i leads to the decomposition as follows;

$$\partial E(Y_i)/\partial X_I = f(Z)[\partial E(Y_i^*)/\partial X_I] + E(Y_i^*)[\partial f(Z)/\partial X_I] \quad (4)$$

This equation suggests that the total change in elasticity can be disaggregated into (1) the change in the probability of the expected level of WTP for those farmers that already demand for the socio – economic product and (2) the change in the elasticity of the probability of demanding for the socio – economic product. Tobin (1958) show that consistent estimates of β and σ are obtained by using maximum likelihood techniques, where plim (b) = β and plim (s) = σ. The random effects Tobit model in this paper is estimated using STATA version 7. The dependent variable is the proportion of the socio – economic value of cattle (WTP amount) over the farmer's total perceived value of the animal (WTPSHARE) while the independent variables include socio – economic and institutional variables.

RESULTS

The variables included as explanatory variables include; cattle types, grazing systems, age of animal, herd size, land size, household dependency ratio, household size, sex of decision maker, education years of decision maker, access to credit, off – farm income, climate potential indicator (ppe) and market access indicators derived from better measures of location by Staal et al (2002), which includes GIS-derived variables. Table 1 shows the results of the Tobit estimation. The statistical significance of the model is examined by using a Wald test of the null hypothesis that all slope coefficients ($H_0 = \beta_j = 0$) are zero except the intercept term. The χ^2 statistic of 74.4 is statistically significant ($p<0.01$) indicating a rejection of the null hypothesis.

The analyses indicate that the cattle type, cattle feeding system, animal breed, dependency ratio, household size, sex of the household head and distance to the nearest informal milk collection centre have a significant influence on the probability of demand and the magnitude of the proportion of the socio – economic value of cattle. The coefficients on bulls/oxen and calves relative to cows have negative and significant ($p<0.01$) influence on the probability of demand and the magnitude of the share of socio – economic value of cattle keeping. This suggests that bulls/oxen and calves have a lower non – market value and demand. This has the implication that such cattle types are likely to be easily disposed off and thus have a more market integrating effect than other livestock types. Interactive variables between the animal breed class and the cattle feeding system are also introduced in the model as dummy variables. The base group includes indigenous breeds on open grazing systems. The coefficient on the indigenous breeds on semi - zero grazing systems is strongly positive and significant ($p<0.05$) in explaining the probability and level of demand. This implies that indigenous cattle breeds on semi - zero grazing systems are more likely to be valued higher relative to indigenous breeds under open grazing system. The coefficient on the upgraded breeds on zero and semi – intensive grazing is negative though not statistically significant.

Table 1. Parameter Estimates for Factors Influencing the Share of Non - Market Value of Cattle.

		Elasticity of	
	Coefficient	Probability of demand	Expected level of demand intensity
Heifer (1 = Yes 0 otherwise)	1.604 (1.415)	0.012	1.347
Bull/Oxen (1 = Yes 0 otherwise)	-5.407*** (1.426)	-0.040	-4.487
Calf (1 = Yes 0 otherwise)	-5.029*** (1.967)	-0.038	-4.220
Upgraded breed*zero/semi-zerograzing (1=Yes 0 otherwise	-0.054 (1.697)	-0.000	-0.045
Local breed*semi-zero grazing (1 = Yes 0 otherwise)	4.403** (2.227)	0.033	3.649
Animal age (years)	0.357 (0.541)	0.002	0.290
Animal age squared (years^2)	0.001 (0.035)	0.000	0.003
Herd size (Tropical Livestock Units)	-0.123 (0.169)	-0.001	-0.103
Land size (acres)	-0.054 (0.092)	0.000	-0.028
Dependency ratio	3.628*** (1.297)	0.027	3.001
Household size (adult equivalent)	0.573** (0.254)	0.005	0.531
Sex of decision maker (1=Male 0=Female)	-2.476* (1.410)	-0.019	-2.139
Number of education years	0.086 (0.126)	0.001	0.067
Access to credit (1=Yes 0 otherwise)	-0.675 (1.064)	-0.004	-0.478
Annual off-farm income (KSh)	0.000 (0.000)	0.000	0.000
Distance to informal milk collection centre on murram road	-0.112* (0.061)	-0.001	-0.093
Precipitation/potential evapo - transpiration (ppe)	2.911 (3.724)	0.021	2.311
Numbers in parentheses are robust standard errors; significance levels ***=0.01, **= 0.05, and *= 0.1. Log likelihood function = -2399.1 Number of observations = 637 $H_0 = \beta_i = 0$, Wald χ^2 (17) = 74.4 F(z) = 0.96, z = 1.75 f(z) = 0.0863 σ= 11.59			

Three household related characteristic variables are significant in explaining the probability of demand and the magnitude of the proportion of the socio – economic non – market value of cattle; dependency ratio, household size and sex of the decision maker. The household dependency ratio and household size have strongly positive and significant ($p<0.05$) influence on the probability of demand and share of the socio – economic value of cattle. This is expected as it is hypothesized that both the number of dependants and household size have a positive influence on the household risk probability, financial needs and obligations. The coefficient on gender is negative and statistically significant ($p<0.1$) implying that, relative to female - headed households, male headed households are likely place a lower value on the socio – economic non – market roles of cattle, *ceteris paribus*. This can be attributed to their limited alternative sources of income to buffer risks compared to their male counterparts.

Past studies (Kabutha, 1999) have also documented the low access by women to capital and financial assets. The coefficient on distance to the nearest informal milk collection centre has a negative and significant influence on the probability and magnitude of the share of the socio – economic non – market value of cattle ($p<0.1$). This variable is used as a proxy for market access. The further away a farmer is from an informal market, the lower will be the likelihood of demand for the socio – economic benefits. This result suggests that farmers far from market outlets are less likely to have high demand for the socio – economic roles of cattle due to lack of markets for disposing livestock and livestock products when need arises. Variables such as land size, credit use, ppe and annual off –farm income have no significance in explaining variations in WTPSHARE. However, the sign on land size and credit access is negative as expected. Land can be used as collateral for credit. Credit is an alternative way of financing expenditures, so for farmers with access to this capital, the financing and insurance roles of cattle diminishes. The estimated elasticities from Tobit show that the household dependency ratio, household size, animal breed, cattle type and gender of the decision maker are substantial in determining the level of the socio – economic demand of cattle. The predicted values of WTPSHARE indicate that the value of the non – market socio-economic functions of cattle comprise approximately 20% of the animal's total perceived value across the three systems. This is a large boost to smallholder cattle competitiveness.

CONCLUSIONS AND POLICY IMPLICATIONS

Socio – economic non – market benefits of cattle are crucial to the survival and competitiveness of smallholder cattle production systems. They play a significant role in meeting household needs, more so for resource poor farmers, especially women who do not have alternative avenues to meet these needs. Recognition of these roles of cattle is of importance in formulation of effective livestock policies aimed at improving livelihoods of cattle keepers. The alternative use of cattle though useful, is associated with risks such as market risks, theft and deaths incase of animal disease. Therefore in the long run, these households ought to be integrated into financial and insurance markets so as to improve their livelihoods.

Poor transport and infrastructure results into imperfect and inefficiently integrated markets. It reduces producer's margin as it results in high market transaction costs. The results suggest that poor road infrastructure constrain access to market outlets for livestock products. One policy imperative to ensure livestock and livestock product market integration is to invest in roads and transportation and removing institutions and policies impeding domestic trade (e.g. removing the restriction of once a week livestock market days). Formal market outlets could be set up within short distances over space to provide quick markets to farmers. One way of achieving this is to invite the private sector to establish processing factories and offering them incentives like tax rebates. Finally, consideration of these non – market benefits of cattle is important as it enables assessments closely from the viewpoint of the producers, as they consider proposed changes in the production system in the context of their circumstances.

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