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Livestock Marketing Decisions Among Pastoral Communities: The Influence of Cattle Rustling in Baringo District, Kenya

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Abstract

The study sought to determine whether pastoralists have resorted to sale of livestock as a form of insurance against commercialization of cattle rustling in which well structured and managed cartels have organised more intense and frequent cattle raids on pastoralist, and how their decisions have affected their herd size. The study was conducted among the pastoral Baringo community of Kenya. A sample size of 110 households was selected using multi-stage sampling procedures and interviewed using a questionnaire. Binary Probit Model and Ordinary Least Squares were used in the analysis. Results indicated that cattle rustling, particularly in its predatory state significantly contributes to spontaneous sale of livestock even under very low prices that in themselves could be described as raiding. The results further indicated that the number of livestock lost through cattle rustling dominated livestock sale and hence reduced herd size and the numbers of livestock available for sale. The insecurity generated by cattle rustling, coupled with the poor marketing infrastructure make market inaccessible by both buyers and sellers, resulting to increased poverty and dependency amongst the pastoralists. Consequently, pastoralism has become a source of misery rather than source of livelihood.

Keywords:
Cattle rustling, Livestock Sale Decisions, Poverty, Livelihood Pastoralists.

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INTRODUCTION

Well over half of East Africa receives insufficient amounts of rainfall that is only suitable for extensive livestock production mainly based on grazing and browsing. Kenya, located on the east coast of the African continent covers an area of 582 646 square kilometres. It is bordered by Ethiopia and Sudan to the north, Uganda to the west, Somalia and Indian Ocean to the east, and Tanzania to the south. It has a population of more than 31 million people, of which more than half live in poverty (EBO, 2005). Only about 20% of its land is ideal for rain-fed agriculture while the rest is arid and semi arid lands mainly utilized for extensive livestock farming (FAO, 2005). Drought and famine are constant hazards in the ASALs. Only one in four years is likely to bring adequate rains (Hendrickson *et al.,* 1996).

The poor natural resource base of the Arid and Semi Arid Lands (ASALs) makes extensive livestock production the most suitable form of utilizing the land (Behnke and Scoones, 1993). Nomadic pastoralism is the major economic activity and the main source of livelihood for the inhabitants of these areas. Livestock production accounts for about 90% of employment and more than 95% of family incomes. However, these areas have the highest incidences of poverty (about 65%) and very low access to basic services (FAO 2004). A combination of various factors, that include variable rainfall, diseases, insecurity and overgrazing give herders a precarious living which in many cases is deteriorating over time (Raikes, 1981).

In the ASALs, livestock are the most important aspect influencing the pastoralists' social and economic life, including the environment in which they live. Cattle in particular hold the central value in many of the nomadic communities (Raikes, 1981; Lesorogol, 1998). They are the basis of association in a complex of social, political and religious institutions. For example, cattle contribute greatly to food security, are means of paying bride price, reflect wealth status, and are sometimes used in spiritual rituals and interventions. Because of the many roles played by livestock, Raikes (1981) notes that, some pastoralists accumulate livestock without regard to the economic benefit accruing from their sale. Indeed, whenever scarcity of pasture and water or disease depleted a community's livestock, it often sought to replenish numbers through raiding/rustling (Mkutu, 2000).

Traditionally cattle rustling while often involving some violence tended to be small scale and involved the theft of only a number of the best livestock, broadly reflecting the number that had been lost or which were seen as being needed by the raiding group. It was therefore seen as an important means of livestock accumulation. Loss of human lives was rare and when they occurred, extra cattle from the killers' family were given to compensate the victims (Mkutu, 2003). However in the recent past, particularly among the Baringo, Samburu, Turkana and Pokot tribesmen, large-scale cattle raiding between neighboring communities have been aggravated by the proliferation of small arms that has seen emergence of a new era of cattle theft that has lost the cultural meaning. Pastoral communities seem to be arming themselves for protection against being plundered by the hostile groups (Hendrickson *et al.,* 1996). The problem of arms has been made more complex by the commercialization of cattle rustling, whereby wealthy businessmen, politicians, traders or local people pursuing predominant economic objectives, fund raids among the pastoral communities. This commercialization of cattle rustling has interfered with the future, and assets of the pastoralists and the decisions they make on their herd such as migration and livestock sale. The combination of factors that limit sustainable

livestock production in the pastoral areas, including cattle rustling, and its devastating shocks, reduce the capacity of the poor to either maintain or accumulate livestock assets, thus limiting their ability to move out of poverty. This is made worse by lack of access to livestock markets due to bad infrastructure and insecurity.

In the current livestock market structures, death rates and theft still dominate sales rate, and restocking through markets is very significant (Mc peak, 2001). However, others restock through raiding. Livestock mortality and cattle theft affects the market performances through emergence of black markets. Moreover, livestock markets differ from grain markets in the sense that live animals are assets that produce a stream of goods and services, (besides they themselves being sold) while grain is just a good (Barret, 2001). Barret argues that even when the underlying prices of meat or milk remain stable, the price of an animal can vary sharply. Unlike in grain markets where shortage leads to an increase in price due to increased demand, livestock prices and mortality rate are negatively correlated. Since pastoralists hold most of their wealth in form of livestock, markets for animals exert considerable influence over their livelihoods, both by establishing the value of their assets and by affecting herd management decisions (Barrett, 2001). This study demonstrates the complex ways in which cattle rustling and its associated violence and threats interact with management decisions such as livestock sale among the pastoralists to influence the coping strategies of the herders.

MATERIALS AND METHODS

The study was carried out in the remote areas of Baringo District where the main occupation of the community is pastoralism. Baringo district is one of the arid and semi arid districts in the Rift Valley Province of Kenya where cattle rustling is very rampant. The district is located between latitudes 35'' 30' and 36'' 30' East and between latitudes 00 10' South and 140' North. It is cut across by the Equator at the southern tip. Many of the livestock management decisions in the area involve everyday direct-perceptible risks, which are managed instinctively and intuitively (Adams 1999). This is to say that there is no formal probabilistic assessment done before making a livestock sale decision by a herder, but the decision is based on chances and degree of belief of the herder. This represents Dempster-Shafer theory of evidence as one way of representing imprecise probabilities and partial information in a decision-theoretic context.

A total of 110 households were selected for interviews using Multi-stage sampling method. Purposive sampling was used to select the rustling prone divisions which were considered as clusters (first-stage cluster sampling). The second stage cluster sampling involved randomly selecting locations within the clustered divisions. In the third stage of cluster sampling, a simple random sample within each location was selected from which the interviews were conducted. Probit Model was used to explain factors that influence the probability of selling livestock as a way of taking insurance while Ordinary Least Square (OLS) for multiple regression was used to explain the factors that influence herd size including the probability of making a livestock sale decision.

To emphasize how livelihoods are undermined by cattle rustling and the insecurity generated by it, the effects of cattle rustling on livestock sale decision are separated from those of biophysical and social economic factors. Impacts of biophysical factors such as drought, disease and parasites/pests are more universal than those of cattle rustling in which some households may be lucky enough to avoid either by sheer luck or by management decision. Household

characteristics also influence the decision to sell livestock. A variety of other household characteristics may have been omitted in the conceptual framework

Figure 1 below shows the interaction of factors that influence the decision to sell livestock and herd size.

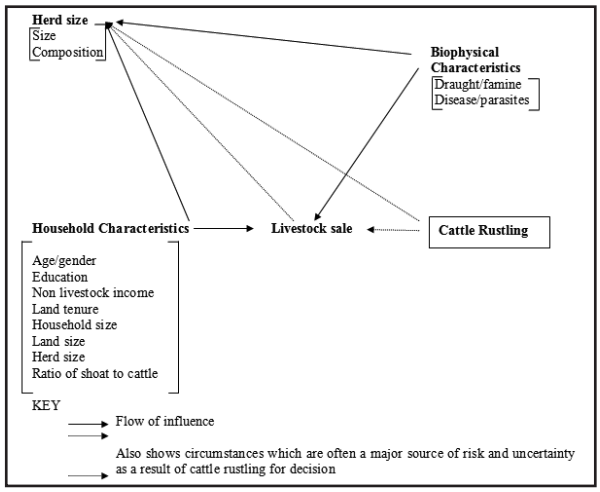

Figure 1. Factors influencing livestock sale decisions and herd size
Source: Modified from Moran *et al* (1998)

Empirical Model

Herders are faced with the problem of choosing the best action to take to protect their livestock from the uncertain environment of insecurities which include cattle rustling. Doss and McPeak (2004) cited that in the environments such as the arid and semi-arid lands, where the risk of drought, violence, and illness are quite high, individual household members may have different perceptions about the risks that they face. Subsequently, one can argue that depending on the "real intensity" and perception of cattle rustling by herders, different herders will prefer different methods of protection as way of taking insurance. The probability that a herder would make a livestock sale decision among other decisions available to avoid the risk posed by cattle rustling can be expressed as follows:

$$P_i = F\left(\beta_0 + \sum_{j=1}^{k} \beta_j X_{ij}\right) = \frac{e^{\beta_j X_{ij}}}{\sum^{k} e^{\beta_j X_{ij}}} \qquad (1)$$

Where: P_i is the probability of i^{th} herder choosing alternative j given X_i; X_i are the independent variables influencing migration; u_i is the error term; β_0 is a constant and β_j are vectors of coefficient to be estimated.

The decision to sell livestock as a way of avoiding risk is modelled as a discrete choice whose probability is a function of k attributes associated with it. The decision making process in this case is unobserved and only the outcome, which is, migration, is observable. If we let X represent a vector of determinants of the decision to sell livestock, then the basic form of the binary probit function with Z as the predictor variable can be expressed as follows;

$$\check{Z} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_j X_j \qquad (2)$$

The probability that herder i would choose to sell livestock is predicted as;

$$LS = f(GHH^i, AG^i, ED^i, HHS^i, NLI^i, CARUINTY^i\ NCA^i, RSG^i, LO^i, AR^i, BC^i\ P_{lsd}{}^i) \qquad (3)$$

Where: LS represent probability of selling livestock; GHH^i represents gender of the household head; AG^i represents age of the household head; ED^i represents education level of the household head measured in terms of number of years in school; HHS^i represents the size of the household; $CARUINTY^i$ is a dummy variable representing cattle rustling intensity in the area; NLI^i is the non livestock income received by herder i; NCA^i is the number of cattle owned by herder i; RSGi is the ratio of sheep and goats to cattle owned by herder i; LO^i is a dummy variable representing type of land ownership by herder i; AR^i is a dummy variable representing whether a herder has lost livestock to cattle rustlers or not; $P_{lsd}{}^i$ is a dummy variable representing herder i's perception on sale of livestock; BC^i is a vector of biophysical characteristics

(disease/parasites and drought/famine).

To model the impacts of cattle rustling and livestock sale on herd size, the study estimated a herd size function using the production function approach. Kabubo-Mariara (2003) presented a simple model to compare the productivity of private and common property that could be modified to compare the effect of cattle rustling and herd management decisions on herd size as;

$$\Gamma = \nu_i CRV + \beta i P_i + \sum_{j=1}^{n} \alpha_{ij} X_j + \mu_i \qquad (4)$$

Where: Γ is average herd size; CRV is representing cattle rustling variables influencing livestock sale decision; P_i is the predicted probability of selling livestock from equation (3); X_j is the vector for exogenous variables other than rustling that affect herd size; ν_i α_{ij} and β_i are unknown coefficients and μ_i is the stochastic disturbance term. Following this approach, the herd size model could be specified as;

$HS^i = f$ (GHH^i AG^i, ED^i, HHS^i, NLI^i, $CARUINTY^i$, LO^i, AR^i, BC^i, $INHERIT^i$, $DOWRY^i$, $BOUGHT^i$, $PRLS^i$) (5)

Where: HS^i is the herd size of herder 'i'; $INHERIT^i$ is a dummy variable representing whether or not herder 'i' inherited livestock; $DOWRY^i$ is a dummy variable representing whether or not herder 'i' received dowry; $BOUGHT^i$ is a dummy variable representing whether or not the herder 'i' bought livestock; $PRLS^i$ is the predicted probability of selling livestock estimated in equation (3); All other variables are as defined above. The number of cattle, perceived impact of migrating on herd size and the ratio of sheep and goat to cattle were used as the identifying factors for the decision to sell livestock equation.

RESULTS AND DISCUSSIONS

The results of this study are discussed in two sections. The first discusses the results of the descriptive analysis, which include an overview of the socio-economic characteristics of the household among the pastoral Baringo communities. The second section discusses results from estimation of Probit and multiple regression models on factors influencing livestock sale and herd size respectively.

Descriptive statistics

The descriptive statistics give description of the household attributes. Results of the household attributes are presented in Table 1.

According to the results in Table 1, the average age of the household head in the study area is 44 years with some household heads as old as 72 years and others as young as 18 years. This suggests that household heads are relatively young and energetic and therefore are likely to make radical decision in terms of herd management decisions. The results further show that majority (89%) of the households among the pastoral Baringo community are headed by males while the remaining 11 % are headed by females. In cases where a woman is the head of the household, culture demands it that she must consult the oldest son during decision making.

The level of education of the household head influences household decision making. In Baringo, the level of education is greatly influenced by cattle rustling and the insecurity generated by it. Indeed, the study showed that more than 80 % of the herders are illiterate. Parents however teach their children differently according to their sex to prepare them for their future roles in the society. Some of the household heads enrolled in primary schools but later dropped out. Many others have not gone to school at all. A few have however gone up to secondary school with some training as career professionals.

The average household size in this study was

14 persons with some households having as many members as 36 and others as few as 3 members. Large households make it easy for pastoralist to use self/family labour as opposed to hired labour in livestock grazing and especially during times of livestock migration. Self labour is readily available without having to incur any monetary expenses. Approximately 96 % of the pastoralists use family (self) labour as opposed to 4 % who use hired labour. This is probably because there is plenty of cheap and unused labour from the household.

Results in Table 1 indicate that approximately 70% of the residents of the study area believe that cattle rustling is a severe activity in the area. The remaining 30 % are of the view that cattle rustling is conducted in a moderate form. The truth of the matter is that irrespective of the intensity, cattle rustling interrupts the economic activities of the pastoral community. Majority (94 %) of the herders own land communally. Only 6% claimed that they own land privately. The implication is that communal land ownership combined with the harsh climatic conditions may make it difficult for non livestock activities.

Inferential Statistics

Probit and Ordinary Least Squares models were used in this section. STATA statistical software was used to analyse the data. The potential problems experienced included; specification error, omitted variables, simultaneity, and heteroscedasticity, which were taken care of using appropriate econometric procedures. In the OLS model, heteroscedasticity was tested using hettest which is available in STATA as a default. When the p-value is very small we reject the hypothesis and accept the alternative hypothesis that the variance is not homogenous. Multicollinearity was tested using vif (variance inflation factor for the independent variables) command downloaded within STATA.

Determinants of Livestock Sale Decision

Markets determine the capability and proficiency for livelihood growth. Livestock markets put forth considerable influence over the source of revenue for the pastoralists. When livestock are sold during times of crises they are usually accompanied by very low prices. The probability that a herder will sell his stock at the market price can be predicted by estimation of Probit or Logit model. Indeed, the Logit and Probit models tend to produce extremely similar results and you usually need a lot of data in the tails to notice a difference in fit. Probit model was used to model the binary outcome variables whose dependent variable was a dummy variable of

Table 1: Household Attributes

Description		Unit
Age of household head (Mean 44)	Minimum	18 Years
Gender of household head	Male	89.1 %
	Female	10.9 %
Education level of the household	Educated	20 %
	Not educated	80 %
Household size (Mean 13 persons)	Minimum	3 Persons
	Maximum	36 Persons
Type of labour used by household	Self	95.5 %
	Hired	4.5 %
Cattle rustling intensity	Severe	69.6 %
	Moderate	30.4 %
Type of land ownership by household	Communal	93.6 %
	Private	6.4 %

Source: Survey results, 2010

binary nature. The study estimated a discrete choice model whose probability to sell is a function of a number of attributes or factors including cattle rustling. Probit models also assume the standard normal distribution. Marginal effects were computed because the estimated coefficients do not have a direct economic interpretation. Since the dependent variable in this study was a 0-1 dummy variable, the marginal effects at mean (denoted the change in the probability of selling livestock (Y=1) that results from changing Xi) represent discrete change of dummy variable from 0 to 1. Moreover, STATA will also automatically drop variables that are highly correlated and/or collinear within the regression model. Some variables were also transformed into logs. The results of the probit estimates on determinant of livestock sale decision are presented in Table 2. The Chow test for the goodness of fit {LR Chi2 (12) =71.03} indicate that the model fits the data significantly at 1 % level (P<0.01).

Results indicate that gender of the household head has a positive significant (P<0.1) influence on the decision to sell livestock. Households that are headed by males are 28% more likely to sell their livestock due to cattle rustling than those headed by their female counterparts. This is probably because all vital decisions concerning management of the herd are made by the male counterpart among the Pokot. Women are not allowed to sell any stock unless during times of emergencies, such as sickness. Even then, the pressure to sell comes from relatives outside the family and preferably from brothers of the husband. If the husband is dead the wife must consult the eldest son.

Age decreases the likelihood of selling livestock. The age coefficient in Table 1 is negative and significant (P<0.05). The results imply that an extra year in age decreases the chance of selling livestock by 0.6%. This may be attributed to the cultural background since elder people are less risk averse. They will be inclined to keep cattle for other socio-cultural reasons other than source of income and believe that livestock are not meant for sale. In the past pastoralists who sold their livestock were ridiculed by the community. Elder people tend to possess "cattle complex". That is, they value livestock for religious, institutional and social status other than for generation of income. This is shown by the extent of livestock mortality during times of crises such as Drought, diseases and raiding. Many livestock that could otherwise have been sold perish.

The observation that cattle are held as a store

Table 2: Determinants of the decision to sell

Variable	Coefficient	Std. Err.	P>z	Marginal Effects
Gender of household head	1.295*	0.670	0.053	0.281
Age of household head	-0.059**	0 .023	0.009	-0.006
Education level of household head	0.009	0.055	0.865	0.001
Size of the Household	0.065*	0.037	0.077	0.007
Number of cattle owned	0.007	0.006	0.289	0.001
Ratio of sheep and goats to cattle	0.312***	0.109	0.004	0.033
Log non livestock income	0.272 *	0.144	0.060	0.029
Intensity of Cattle rustling	-0.775*	0.477	0.094	-0.068
Type of land ownership	0.409	0.841	0.627	0.033
Drought and/or diseases	1.360*	0.857	0.098	0.316
Livestock lost to rustlers	2.050***	0.555	0.001	0.386
Herder's perception on livestock selling	2.038***	0.588	0.001	0.318
Constant term	-1.415	1.254	0.259	
Number of observations	110			
LR chi2(12)	71.03			
Prob > chi2	0.000			
Log likelihood	-25.787			
Pseudo R2	0.579			

Note: ***, **, * Significance at 1%, 5%, and 10% respectively

of wealth and are only sold to meet specific cash needs has been made elsewhere in southern Africa (Doran *et al.,* 1979). Younger generation of household heads might also have more uses for money than older people. This may fuel their decision to sell livestock.

The coefficient of the education level of the household head is positive but not significant. This implies that educated pastoralists are more likely to sell their livestock than the uneducated ones. Education influences the reasoning capacity positively. However, results in Table 1 showed that the level of education in these areas is very low. In order to provide alternative livelihood to pastoralists, the government needs to stand firm on its policy in education in these area. Children must be forced to attend school and prosecution of parents who do not take their children to school must take place. Education is a step towards improving livestock management and reducing and/or stopping cattle rustling conflicts.

Results also indicate that the coefficient for the size of the household is both positive and significant ($P<0.1$). Increasing the size of the household by one person is likely to increase the probability of selling livestock by a meagre 0.7%. This is probably because the larger the household the more food and other necessities are needed and thus the demand for income rises.

Non livestock income is a significant ($P<0.1$) determinant of livestock selling decisions. The positive coefficient implies that herders that engage in other non livestock income generating activities are 2.9% more likely to sell their livestock to create time and space for other activities. The government should develop policies that give pastoralists alternative sources of livelihood besides pastoralism such as initiation of irrigation schemes and other investments. This would help supplement livestock production and improve the nutrition values of these communities.

The ratio of sheep and goats to cattle influences the probability to sell livestock positively and significantly at 1% level of significance. Increasing the ratio of sheep and goats to cattle by one unit will increase the probability of selling livestock by 3.3 %. This is probably because goats and sheep have ready market than cattle and thus are the major source of income for the household. Cattle are mainly sold when there are ceremonies of rites of passage from childhood to adulthood.

The intensity of cattle rustling has a significant ($P<0.1$) influence on livestock sale. The negative coefficient implies that when the intensity of cattle rustling is severe, herders are 6.8% less likely to sell their livestock compared to an otherwise moderate intensity. This is probably because high frequencies of attack greatly reduces (through death and loss) the numbers of livestock available for sale and increases the risks undertaken by the traders and thus making markets inaccessible. Inaccessible markets are generally associated with lower sales rates. Convenient livestock markets require proper security and overall good infrastructure. Furthermore livestock buyers are less willing to undertake the risk of buying and transporting livestock in these cattle rustling prone areas. Herders are also not comfortable with the low prices that accompany sale of livestock in the rangelands during times of frequent attacks. The fear of attack discourages traders' entry and forces them to extract significant risk premium from pastoral suppliers (Barret, 2001). The government should therefore engage in policies that ensure livestock and livestock product markets are integrated by investing in roads and transportation and removing institutions and policies impeding domestic trade

Whether a herder has previously lost livestock to rustlers has a positive and significant ($P<0.01$) influence on the decision to sell. This implies that herders who have previously lost livestock

to cattle rustlers are 38.6% more likely to sell part of their livestock as insurance against loss than those who have not. This is probably because pastoralists experience big livestock losses during crisis periods such as cattle rustling, drought and diseases when animals are not removed from areas with such crisis through sales or migration (McPeak, 2001). Herders may also sell their livestock to reduce the herd because principally cattle rustling affects those with large stock and those unable to split herds (Hendrickson *et al.,* 1996).

Livestock mortality through drought and diseases positively and significantly ($P<0.1$) influence the herders' decision to sell. Those that have lost livestock earlier to drought and diseases are 31.6% more likely to sell their livestock than those who have not. The immediate effect of drought on pastoral production is a decline in the fodder availability. Where herd numbers are already close to the maximum carrying capacity, this fodder shortfall will affect levels of animal nutrition, causing a fall in milk supplies, calving rates and animal live weight. Death among stock will start to rise as the period of drought lengthens and fodder scarcity intensifies. As milk supplies fall, pastoral households will need to buy more grains leading to increased sales of livestock. Stock sales will increase further as herders seek to recoup some value from animals before they die. Unlike cases of insecurity brought about by cattle rustling, buyers are more willing to buy cheap livestock from rangelands where prices are low due to excess supply as a result of drought. However disease problems may lead to closure of certain markets with stringent health requirements.

Market perception is a big determinant of probability to sell. Herders perceive markets in different ways. Those that perceive livestock market positively are 31.8% more likely to sell their livestock than those that perceive it negatively. Results indicate that herder's perception on livestock sale positively and significantly ($P<0.01$) influences the sale decision. In the traditional context cattle confer among other things security, prestige and status. In as far as security, prestige and status are concerned, numbers of animals are often more important than the value they command. The government should therefore encourage pastoralists to sell their livestock by setting up formal market outlets within short distances over space to provide quick markets to farmers. The government can also set up (or invite the private sector to set up) slaughter houses and processing factories in conjunction with Kenya Meat Commission. With good roads and invention of large cooling facilities to provide meat storage, combined with the development of bulk trucks installed with cooling systems, a possible assembly method can be provided. This would not only provide efficient livestock and livestock product marketing system but would also help reduce cattle rustling since rustlers target live animals.

Determinants of Herd Size

Multiple regression estimates were used to show the impacts of cattle rustling and the decision to sell livestock among other factors on the herd size. The problem of simultaneity due to feed back effects between the dependent and independent variables was tested by use of Three-Stage Least Squares (3SLS) method. Both results (single equation estimation and 3SLS) compare very closely. The goodness of fit of the model and the stability of the coefficients to changes in specification are confirmed by the Chow tests (F statistics). The results of the estimation of 3SLS are presented in the Appendix Table A5. The hottest test for heteroscedasticity and the VIF (Variance Inflation Factor) for the independent variables tests for multicollinearity are presented in Appendix Table A3 and Table

A4 respectively. The tests reveal that there is no multicollinearity among the independent variables. Anytime a tolerance level gets somewhere below 0.40 (a rule of thumb), multicollinearity may be a problem. Similarly, VIFs over 2.50 start to indicate relatively high levels of multicollinearity. The mean VIF in this case is 1.44 and none of the independent variable has a tolerance value greater than 0.9 implying that they cannot be considered as a linear combination of another independent variable. The chi-square value from the hettest test for heteroscedasticity also was small {Chi2 (1) = 0.84]} and the p-value (Prob > Chi2 = 0.3596) was not significant indicating heteroskedasticity was probably not a problem (or at least that if it was a problem, it wasn't a multiplicative function of the predicted values).

Results indicate that gender of the household head has a positive and non significant influence on herd size. On the other hand, the age of the household head positively and significantly Influences the herd size at 10% significance level. The indication is that elderly people are more likely to keep bigger herd of livestock than their younger counterparts. Indeed, the elderly people are more deep rooted in their culture and will essentially keep large stocks of livestock without regard to the economic value in what has come to be known as "cattle complex". For as long as cattle are regarded as an end in themselves, they cannot be disposed off like any other good in the market.

Herders with higher level of education are more likely to reduce their herds of livestock by approximately 2% compared to the uneducated ones. This is exemplified by the negative and significant (P<0.1) influence the variable has on herd size. This could be attributed to the fact that education gives people the opportunity to understand better the environmental degradation caused by overgrazing and other benefits of keeping smaller stock such as the management aspect. Educated herders are also more likely to engage in other income generating activities, and they could also sell their livestock for a variety of other reasons including school fees and trade.

The results also indicate that larger households own larger herd size than small households (P<0.01). In majority of the households, large households were representative of the wealth accumulation. These views have also been shared by Ahuja, (1998) and Kabubo-Mariara, (2002).

Attacks on herders by cattle rustlers have led to many losses of livestock and human lives. The results indicate that the intensity of cattle rustling influences the herd size negatively and significantly (P<0.1). It means that severe intensity of cattle rustling is likely to reduce the herd by almost 12%. Hendrickson *et al.,* (1996) and Mkutu, (2003) also attest that increase in the intensity of cattle rustling leads to increased death and loss of livestock. Indeed, herders that have lost their livestock and relatives in earlier cattle rustling attacks are most likely to keep smaller herds to avoid greater losses. Moreover, the impacts of cattle rustling on the livelihoods of the pastoralists are very diverse. In the most direct way, cattle rustling lead to death injury and loss of livestock and human beings. Indirectly, cattle rustling affect pastoralists in terms of the unfavourable and pro-poverty decisions that they make in order to avoid or reduce the risks that accompany cattle rustling. As such, herders resort to selling their livestock or migrate without regard to prices in the market and availability of pasture and water respectively.

Results in Table 3 further indicate that there is a significant (P<0.001) negative correlation between non livestock income and herd size. An increase of household's non livestock income by 1%, is likely to lead to approximately 6 % decrease in herd size. This could probably mean that herders do not invest their non livestock in-

Table 3: Single Equation Regression for Determinants of Herd Size

Variable	Coefficient	Std. Err	z	P>|z|
Gender of household head	0.184	0.144	1.28	0.205
Age of household head	0.004*	0.004	1.09	0.076
Education level of household head	-0.015*	0.009	-1.67	0.098
Size of the Household	0.026***	0.006	4.47	0.000
Log non livestock income	-0.059***	0.020	-2.96	0.004
Intensity of Cattle rustling	-0.116*	0.086	-1.34	0.082
Type of land ownership	0.027	0.168	0.16	0.872
Drought and/or diseases	-0.372**	0.160	-2.32	0.023
Livestock lost to rustlers	-0.051	0.107	-0.48	0.634
Livestock inherited	0.439**	0.181	2.43	0.017
Dowry received	0.119	0.097	1.22	0.226
Livestock bought	0.128	0.085	1.50	0.138
Predicted probability of selling	-0.011**	0.175	-0.06	0.049
Constant term	0.368	0.273	1.35	0.180
Number of observations	110			
F(13, 96)	6.15			
Prob > F	0.000			
R-squared	0.454			
Adj R-squared	0.381			
Root MSE	0.397			

Note: ***, **, * Significance at 1%,5%, and 10% respectively
Source: Survey results, 2010

come into increasing their herd size. It may also mean that such herders may sell their livestock to invest in non livestock income earning activities, which may prove venturous because of the insecurity generated by cattle rustling and its threat.

Like expected, the variable representing drought and diseases has a negative and significant (P<0.05) influence on herd size. Pastoralists that have lost their livestock to drought and disease are more likely to reduce their herd by 37% than those that have not. Unlike cattle rustling insurgence in which some herders may be lucky to escape the attack, droughts and diseases deplete livestock universally and the impacts are catastrophic. The government should provide pastoralists with drought monitoring early warning mechanisms to cushion the pastoralists from the devastating effects of droughts and diseases that reduce their herd.

The type of land ownership even though not significant influences both the decision to sell and herd size positively meaning that communal land ownership encourages the pastoral community to hold more livestock. It is therefore of critical importance for the government to formulate and implement a national policy and legislation on land tenure systems.

Livestock inheritance is a widely practised culture among the Pokot pastoralists. Without a doubt, the variable shows a very significant (P<0.01) positive influence on the herd size. It is therefore correct to argue that other factors remaining constant, herders who have inherited livestock are more likely to have larger herds by approximately 44% than their counterparts who have not inherited. Livestock inheritance brings into the household large numbers of livestock thus explaining the increase in herd size. The variables representing whether or not herders have bought livestock or received dowry though not significant, have a positive authority on herd size.

The predicted probability of selling livestock has a significant (P<0.05) inverse relationship with herd size. The indication here is that herders who sell their livestock are 1% more likely to keep smaller herd than those who do not. The smaller herd may directly be a reduction of stock due to sale, or it may come from realization

that smaller herd are better managed and thus fetch more money in the market. However, in the traditional context, cattle confer among other things security, prestige and status. In as far as security, prestige and status are concerned, numbers of animals are often more important than the value they command. For as long as cattle are regarded as an end in themselves, they cannot be disposed off like any other good in the market.

CONCLUSIONS

The study explored the determinants of livestock sale under the uncertainties of cattle rustling among other factors. The analysis of the determinants of the decision to sell indicate that gender of the household head, size of the household, drought and /or diseases, ratio of sheep and goats to cattle, non livestock income, livestock lost to rustlers and the herder's perception on livestock selling are the significant variables that explain sale of livestock positively. On the other hand, cattle rustling intensity and age of the household head, influence livestock sale both negatively and significantly.

The analysis of the determinants of herd size indicate that the age of the household head, size of the household, livestock inherited and predicted probability of migrating significantly influence herd size positively. Education level of the household head, cattle rustling intensity non livestock income, drought and/or diseases and the predicted probability of paying dowry significantly influence herd size negatively.

It is worth noting that the tendency to retain or increase cattle numbers even under crisis is a widespread and a characteristic feature of many pastoralist communities that may stop them from selling. This view is supported by Doran *et al.,* (1979) who argues that pastoralists will sell the minimum number of livestock whenever cash needs arise and will seek the highest priced markets precisely because this means that one can sell fewer cattle and thereby maximize their livestock wealth. However during cattle rustling insurgence and especially where human lives and property are lost, pastoralists are more willing to sell their livestock to avoid further losses and attacks. Even then, the poor marketing infrastructure and the insecurity generated by cattle rustling make market inaccessible by both buyers and sellers. McPeak, (2001) adds that market access is a critical factor influencing market participation and risk management by pastoralists. Nevertheless, livestock owners are often forced to trek with animals for long distances to trading centres where they are at the mercy of the trader's low prices that are offered. If the livestock are not sold, pastoralists are faced with the long trek back home. The long treks also expose them to more attacks from the raiders. Whichever way you look at it, with the current state of insecurity, markets seem to aggravate rather than upgrade the risks livestock producers face. Similar inconsistencies are revealed in debates about the role of markets in pastoral diversification, with some condemning and others applauding it (Hogg, 1987; Fratkin, 1991; Holtzman, 1996; Bailey *et al.,* 1999; Little, 1992, Little *et al.,* 2001). It is however good to note that people in the pastoral communities are aware of the importance of marketing but because of the low prices, selling livestock feels just like being raided. They sell animals as last resort. Policies targeted at conflict prone areas must therefore aim at improving existing livelihood sources, mainly based on livestock, and also provide alternative livelihood strategies so as to achieve food security.

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Appendix I

Table A1: Single Equation Regression Summary

Source	SS	df	MS
Model	12.604	13	0.970
Residual	15.134	96	0.158
Total	27.739	109	0.254

Source: Survey results, 2010

Table A2: Three-Stage Least Squares Regression Summary

Equation	Obs	Parms	RMSE	"R-sq"	Chi2	P
probsell	110	12	0.309	0.484	103.24	0.000
loghrdsz	110	13	0.371	0.454	91.48	0.000

Source: Survey results, 2010

Table A3: Hettest Test for Heteroscedasticity in the determinant of herd size

Breusch-Pagan / Cook-Weisberg Test	
Ho:	Constant variance
Variables:	Fitted values of herd size (log)
chi2(1)	0.84
Prob > chi2	0.3596

Source: Survey results, 2010

Table A4: VIF Test for Multicollinearity in the Determinants of Herd Size

Variable	VIF	1/VIF
pred	2.43	0.411938
ar	1.77	0.563532
hhsize	1.59	0.629945
ag	1.54	0.650256
dowry	1.49	0.669725
ghh	1.41	0.710698
inherit	1.36	0.736655
lognli	1.26	0.793333
bought	1.24	0.803217
lvlobpfs	1.21	0.825139
educlvl	1.19	0.838205
landown	1.17	0.855106
caruinty	1.11	0.903588
Mean VIF	1.44	

Source: Survey results, 2010

Table A5: Three-Stage Regression for Determinants of Herd Size

Variable	Coefficient.	Std. Err.	z	P>|z|
Gender of household head	0-.191	0.135	-1.42	0.157
Age of household head	0.004	0.003	1.20	0.229
Education level of household head	-0.015*	0.008	-1.77	0.077
Size of the Household	0.026***	0.006	4.78	0.000
Log non livestock income	0-.059***	0.019	-3.18	0.001
Intensity of Cattle rustling	-0.117**	0.081	-1.45	0.047
Type of land ownership	0.027	0.157	0.17	0.863
Drought and/or diseases	-0.368**	0.150	-2.46	0.014
Livestock lost to rustlers	-0.045	0.100	-0.46	0.649
Livestock inherited	0.443***	0.169	2.63	0.009
Dowry received	0.115	0.091	1.26	0.207
Livestock bought	0.128	0.080	1.60	0.109
Predicted probability of selling	-0.028*	0.163	-0.17	0.066
Constant term	0.363	0.255	1.43	0.154
Observations	110			
RMSE	0.371			
“R-sq”	0.454			
P	0.000			
Chi2	Chi2			

Note: ***, **, * Significance at 1%, 5%, and 10% respectively
Source: Survey results, 2010