Asian Journal of Agricultural Sciences 4(6): 403-410, 2012
ISSN: 2041-3890
© Maxwell Scientific Organization, 2012
Submitted: September 16, 2012 Accepted: October 25, 2012 Published: November 25, 2012

Evaluation of the Factors Associated with Shift from Pastoral to Agro-pastoral Farming Systems in Trans-Mara West District of Narok County-Kenya

[1]B.O. Bebe, [2]J.K. Lagat and [3]E.M. Magembe
[1]Department of Animal Production,
[2, 3]Department of Agricultural Economics and Business Management, Egerton University,
P.O. Box 536, Njoro, Kenya

Abstract: The Kenyan Government in partnership with the private sector has set up co-operative societies for marketing livestock and livestock products in Narok County. These co-operatives are supposed to trigger extensive expansion in livestock production. Despite perceived steady incomes, high turnover and ready market for livestock, the pastoral Maasai community is shifting from pastoralism to agro-pastoralism. This community is strongly traditional with much cultural and economic attachment to livestock. The shift brings to question the underlying drives which are not well understood. The drives are diverse, but little is known about their contribution to the engaged shift. The objective of this study was to determine the factors associated with the shift. Stratified proportionate random sampling procedure was used to get the appropriate sample. Data were collected from a sample of 130 households through interview schedule. Heckman two-step model was used to determine the factors associated with the shift. The findings indicated that household decision to shift was enhanced by more frequent group meetings and farmer trainings, declining land sizes, longer distance to watering points, shorter distance to market and more income from off-farm sources of incomes. The agro-pastorals choice to allocate higher proportion of land for crop production compared to livestock production was enhanced by more distance to watering points, low off-farm incomes, private land ownership, larger family, male dominance, more extension services, shorter distance to the market, less years of crop farming and little interaction with the neighbors. Whereas some households shifted out of necessity, others shifted by choice.

Keywords: Co-operatives, decision, determinants, household, maasai community

INTRODUCTION

There are over 200 million pastoralists in the world. In Kenya almost 8 million people who depend on livestock and dry land agriculture reside in Arid and Semi Arid areas (ASALS). The ASALS are characterised by high rainfall variability and recurring droughts which impact on rangeland productivity (Fratkin, 2001; Adeel and Uriel, 2005; Ellis, 1998).

In some ASALS, where rangelands receive reliable rainfall pattern which can support crop production, pastoral households have responded by introducing commercial crop production. Consequently, the response has been associated with gradual shift from pastoral livelihoods to agro-pastoral land use systems (Gumbo and Maitima, 2007; Mwang'ombe *et al*., 2009). In TransMara West of Narok County, the pastoral Maasai community is not exceptional. This community has a strong cultural attachment to livestock keeping, but currently a paradigm shift has been observed from pastoralism to agro-pastoralism, which pauses curiosity to the researcher (Mochabo *et al*., 2006).

In the county, integration of crops and livestock systems is on the increase, but the drives behind these land use system are not well understood. Increased conversion of fertile range lands to commercial cultivation in Trans-Mara West district has led to competition for land resource between livestock and crops. Remaining rangelands are themselves increasingly privatized through sub-division and allocation of rights for ranching and farming enterprises. Moreover, high rates of population growth and in-migration have added to both real and perceived pressures on pastoral lands (Coast *et al*., 2001, 2006; Tangus, 2004; Akinwumi *et al*., 1996). Land ownership remains communal in pastoral land use, unlike in agro-pastoral land use where, land ownership is private, which may be used for ranching and crop enterprises.

Access to extensive public land, offering potential for grazing and water resources is key in pastoral production system since it promotes pastoral mobility. Policies not in line with pastoral mobility increases pastoral vulnerability to drought and loss of livestock

Corresponding Author: E.M. Magembe, Department of Agricultural Economics and Business Management, Egerton University, P.O. Box 536, Njoro, Kenya, Tel.: +254725719013

assets, which pose threat to sustainability of pastoral-based livelihoods (Coast *et al*., 2006; Mwangi, 2005).

Faced with such threats, many pastoral communities have responded with diversification of livelihoods to agro-pastoralism (Binsbergen and Watson, 2008; Galvin, 2009; Freeman *et al*., 2008). To mitigate some sustainability threats to pastoral livelihoods, the Kenyan government in partnership with the private sector promoted integration of pastoral economy into market economy. This has been through setting up of co-operative societies in TransMara West district to open ready market for livestock and livestock products trading in order to accommodate financial and social capital. This development strategy has however not been able to support sustainable pastoralism, evidenced by ongoing gradual shift to agro-pastoral based livelihoods (Morton and Meadows, 2000; Mochabo *et al*., 2006). The drives behind the shift are many but the contribution of the key determinants to the shift has not been well understood. Therefore, the study sought to evaluate the factors associated with the shift from pastoral to agro-pastoral based livelihoods, so as to enhance better understanding of the household decision making process.

MATERIALS AND METHODS

Study area: The study was conducted in TransMara West District of Narok County, Kenya between June and August, 2011. The district lies on the south-western part of Rift Valley Province between Latitude 0° 50' and 1° 50' South and Longitude 34° 35' and 35° 14'. The topography of TransMara West district comprises three major categories:- the highlands which lie between 2,200 and 2,500 m above sea level, the plateau which rises from 1524 to 2200 m above sea level and the lowland which lie below 1524 m above sea level. The lowland receives 1000 mm of rainfall/year.

The district has seven divisions covering an area of about 2,846.40 km^2 with an estimated population of 170,591 (1999 census), growing at a rate of 2.23% and has a population density of 60 people/km^2 (MOFAP, 1999) with an estimated poverty index of about 40% (MOFAP, 1999). The study area is estimated to have 14517 households (in the eight locations of interest) with an average household size of 5 people (MOFAP, 1999). Settlement patterns in the district correspond to land use, land tenure and urbanization. Settlement is sparse where large stocks of livestock are reared, but comparatively denser in areas where crop farming is practiced and small stocks of livestock reared.

Sampling design: The study used stratified proportionate random sampling procedure. Within TransMara district, the divisions were stratified according to agro-ecological zones. Kirindoni and Lolgorian divisions were selected because of having prominent pastoral and agro-pastoral farming households within the same agro-ecological zone. Eight locations among the two divisions were randomly selected. The locations were further stratified into two namely: -pure pastoralism and a mixture of pure pastoralism and agro-pastoralism. Lastly, random selection of the respondents within the locations was made proportionate to the population of each location to obtain the required sample size. The needed proportionate sample in a location was computed from the households in a location divided by sum of all households in eight locations them multiplied by the needed sample estimate of 130 households.

Data collection: Data collection used interview schedule. Both large scale and small scale farmers were contacted. Secondary data such as the number of households in the area and the total population per location was collected from the Divisional and District Agricultural extension offices and the District development office in TransMara West district.

Data requirements for analysis of the factors included: -household characteristics (Age, family size, off-farm sources of incomes, gender and education level), institutional factors (land tenure system, access to credit, group meetings), physical factors (distance to market and watering points, asset owned) and farm factors (herd size, farm size).

Specification of the empirical model: Literature is rich on quantification of income diversification using econometric models such as censored Tobit model (Karugia *et al*., 2006), OLS (Babatunde and Qaim, 2007), Generalized linear regression analysis (BurnSilver *et al*., 2009) and Multinomial logit.

Heckman two stage and double hurdle models (Matishe and Young, 2004; Lansink *et al*., 2000) have been used to determine the factors influencing ones decision to participate in diversification and the extent of participation. However, in this study a Heckman two- step model was used. This is because the model works well when normality assumption is upheld; moreover, it provides guidance on which variables to be included in the first and second steps respectively (Obayelu *et al*., 2009). The two step procedure was chosen for estimation so as to correct the sample selectivity bias as per Heckman (1979). Both participation and extent equations were estimated simultaneously. The variables included in the model were age, farmer training, gender, off-farm income, education level, herd size, individual land tenure, frequency of group meetings, distance to market, extension services, household size, land size, distance to watering points, experience in crop farming, of

Table 1: Description of variables and expected signs

Variable	Full definition	Description of the variables	Expected sign
part	Participation decision	Dependent variable for selection equation (dummy)	None
lsize	Land size	Dependent variable for outcome equation (proportion of land allocated to crop and livestock enterprises)	None
dstmkt	Distance to the market	Time taken (hours) to the nearest market	+
agehh	Age in years	Household head age (years)	+/-
dstwater	Distance to watering point	Time taken (hours) to the nearest watering point	+
genderhh	Gender	Sex of the household head (dummy)	+/-
noconta	Extension services	Number of contacts with extension officers	+
owntd	Land title deed	Possession of land title deed by a household	+
freqmet	Frequency of meetings	Frequency of group meetings by a household (numbers)	+/-
cropfayr	Experience	Number of years in crop farming	+
ninfl	Neighborhood influence	Neighborhood influence to an household	+/-
off-farminc	Off-farm income	Income from off-farm income sources	+
crdtaces	Credit access	Households access to credit services	+/-
totherd	Total herd size	Households number of livestock	+/-
farmsize	Total farm size	Household farm size in acres	+/-
traintim	Farmer training	Number of times attended by a household	+
wealthpe	Wealth perception	Household perception towards livestock as a source of wealth (dummy)	+/-
educlevel	Education level	Farmer's level of education	+
hhsize	Household size	The size of households sampled	+

Survey data (2011)

neighbour influence and credit access. Marginal effects of variables were arrived at after post estimation of selection equation. The marginal effects were used for interpretation, since coefficients of both selection equation and outcome have no direct interpretation. The reason is that they are just values that maximize the likelihood function. Marginal effects have direct interpretation (Heckman, 1979). Therefore, this objective was modeled as two separate decisions:

- Whether or not to shift to agro-pastoralism
- The extent of the shift

The reason for separation was that these decisions are twofold. First, due to social or psychological drives, the individual may prefer not to engage in agro-pastoralism. Second, an individual may be a potential diversifier but for certain levels of relevant variables, decide not to diversify. The former represents abstention, the latter a corner solution. Heckman (1979) proposed a two-step procedure which only involves the estimation of a standard probit and a linear regression model. The two equations for the two steps were specified as follows:

Selection equation (probit):

$$\text{Participation decision} = \beta_0 + \beta_1 * (\text{agehh})_i + \beta_2 * (\text{off-farminc})_i + \beta_3 * (\text{educlevel})_i + \beta_4 * (\text{totherd})_i + \beta_5 * (\text{hhsize})_i + \beta_6 * (\text{owntd})_i + \beta_7 * (\text{freqmet})_i + \beta_8 * (\text{dstmkt})_i + \beta_9 * (\text{noconta})_i + \beta_{10} * (\text{dstwater})_i + \beta_{11} * (\text{crdtaces})_i + \beta_{12} * (\text{traintim})_i + \beta_{13} * (\text{genderhh})_i + \beta_{14} * (\text{farmsize}) \ldots + \varepsilon_1 \quad (1)$$

Outcome equation (simple OLS):

$$\text{Proportion of land allocated to crop production} = \beta_0 + \beta_1 * (\text{agehh})_i + \beta_2 * (\text{off-farminc})_i + \beta_3 * (\text{educlevel})_i + \beta_4 * (\text{totherd})_i + \beta_5 * (\text{hhsize})_i + \beta_6 * (\text{owntd})_i + \beta_7 * (\text{freqmet})_i + \beta_8 * (\text{dstmkt})_i + \beta_9 * (\text{noconta})_i + \beta_{10} * (\text{farmsize})_i + \beta_{11} * (\text{dstwater})_i + \beta_{12} * (\text{crdtaces})_i + \beta_{13} * (\text{traintim})_i + \beta_{14} * (\text{genderhh})_i + \beta_{15} * (\text{ninfl}) + \beta_{16} * (\text{cropfayr})_i \ldots + \varepsilon_2 \quad (2)$$

The variables which were fitted in the model are presented in Table 1.

RESULTS AND DISCUSSION

Heckman two-step procedure: Heckman two-step procedure was used to determine the factors influencing the shift from pastoral to agro-pastoral farming and the extent of the shift. The results of selection equation and outcome equation are presented in Table 2 and 3, respectively.

The Inverse Mills Ratio (IMR/Lambda) term was significant and positively signed (Table 2), which suggest that the error term in the selection equation is positively correlated. This implies that unobserved factors that make participation in the shift to agro-pastoral farming are more likely to be associated with higher score on the dependent variable. Six factors: off-farm income, farm size, frequency of group meetings, distance to the market, distance to the watering points and farmer training were significantly associated with household decision to participate in the shift to agro-pastoral farming.

Off-farm income sources significantly and negatively affected participation in the shift to agro-pastoral farming. Increasing incomes from off-farm sources would decrease shifting to agro-pastoral farming by 75%. This could be attributed to the possibility that as income increases, households pursue other opportunities (investing in fixed assets such as

Table 2: Heckman two-step selection equation results for dependent variable-participation in the shift from pastoral to agro-pastoral farming

Variables	Coefficient	S.E.	p>|z|	Marginal effects dy/dx
agehh	0.001	0.011	0.921	-0.000
crdtaces	0.439	0.278	0.115	0.159
off-farminc	-0.752	0.307	0.014**	-0.259
farmsize	-0.008	0.004	0.041**	0.003
educlevel	0.201	0.179	0.261	0.068
owntd	0.475	0.373	0.203	0.164
totherd	-0.000	0.002	0.916	0.000
freqmet	0.248	0.114	0.030**	0.087
dstmkt	-0.308	0.120	0.010**	-0.113
noconta	0.169	0.130	0.196	0.060
hhsize	0.085	0.062	0.171	0.030
dstwater	0.677	0.221	0.002*	0.243
traintim	0.289	0.154	0.061***	0.105
genderhh	-0.154	0.452	0.734	-0.054
mills lambda	0.160	0.777	0.039**	0.056

dy/dx: Marginal effects; *: Means significant at 10%; **: Significant at 5%; ***: Significant at 1%

Table 3: Heckman two-step outcome equation results (OLS results)

Extent of the shift-dependent variable

Variables	Coefficient	S.E.	p>|z|	Marginal effects dy/dx
agehh	-0.000	0.002	0.978	-0.000
cropfayr	-0.058	0.026	0.027**	-0.059
crdtaces	0.037	0.041	0.358	0.038
off farminc	-0.093	0.056	0.098***	-0.093
farmsize	-0.000	0.000	0.984	-0.000
educlevel	0.014	0.024	0.547	0.015
owntd	0.120	0.051	0.020**	0.121
totherd	-0.000	0.000	0.739	-0.000
freqmet	-0.018	0.016	0.255	-0.018
dstmkt	-0.071	0.024	0.004*	-0.071
noconta	0.077	0.019	0.000*	0.077
hhsize	0.016	0.009	0.064***	0.017
dstwater	0.082	0.035	0.020**	0.082
ninfl	-0.121	0.037	0.001*	-0.122
traintim	0.017	0.022	0.437	0.018
genderhh	0.225	0.084	0.007*	0.226

dy/dx: Marginal effects *: Means significant at 10%; **: Significance at 5%; ***: Significance at 1%

building, rental houses in town, buying motor vehicles and re-investing in business) but they would not completely exit from pastoralism because of strong cultural attachment to livestock in the area (Little, 2001; Bekure and Leeuw, 1991; Mochabo *et al*., 2006).

Declining land sizes increased the shift to agro-pastoral farming by 0.8%, implying that farmers with less land sizes could shift to agro-pastoral farming as compared to those with more land sizes. The reason could be that, farmers could not achieve self-sufficiency through livestock production alone so as a response they tended to diversify to crop production so as to provide a variety of food for their families (Liyama, 2006; Adewumi *et al*., 2009). An increase in time taken to reach the nearest market decreased the shift to agro-pastoral farming by 30.8%. The result was consistent with findings from previous agricultural market studies such as (Abele *et al*., 2009). The finding reinforces the argument that poor market access for households located in remote areas encourages pastoral livelihoods Studies from market chain analysis such as Gebregziabher (2010) indicate that households located far from the market, incurred high transportation and other related costs. Incurring high amount of transportation and other related costs due to long distance to market will discourage them from participation in the shift.

An increase in time taken to reach the nearest watering point increased agro-pastoral farming by 67.7%. This implied that households located further from the water points were more likely to shift to agro-pastoralism than those living closer to the water sources. The reason is that near water sources, natural salt licks are found (Ndumu *et al*., 2008; Galvin, 1992) which promotes the health of the animals, thus most pastoralists prefer grazing their livestock near water sources. Moreover, availability of salt licks saves farmers the cost of buying mineral licks for their livestock (Karbo, 2007).

Training of the household head was also significant with a positive sign. Almost 29% of the observed variation in the shift from pastoral to agro-pastoral farming could be explained by the number of trainings. An additional training session of the household head increased participation by 29%. Moreover, frequency of group meetings showed up as significant and positive in terms of explaining variation in the shift across farmers, increasing the explanatory power of the model to 25%.

Frequent meetings enhance access and exchange of new ideas and knowledge. Both household training and frequent group meetings increased participation in the shift since well educated farmers tend to be more receptive to new technologies (Kosgey *et al*., 2004; Kariuki *et al*., 2007).

Table 3 shows the results of Heckman two-step outcome equation. The extent of the shift was determined as the proportion of land allocated to crop production divided by total farm/land size. Variables determined to have significant association with the extent of the shift included: experience in crop production, other sources of income, land ownership with title deeds, household size, gender, neighbor influence, extension services, distance to the market, distance to the watering points and farmer training.

Years of crop farming experience had a significant negative effect on proportion of land allocated to crop cultivation. The intensity of crop production decreased by about 6% for every extra year of farming experience a household gained. The reason could be that, as one grows old the energy to work on the farm declines since crop farming is labor intensive (Adewumi *et al*., 2009). Also, it might happen that due to strong cultural attachment to livestock in the area, over time older farmers revert back to livestock production (Akinwumi *et al*., 1996). Research by Kristjanson *et al*. (2002) showed that diversification into cropping appeared to be a quite tenuous option, with many households not getting a harvest even in a year considered to be a 'good rainfall year'. Similarly, there is a possibility of farmers reverting back to pastoral production over time if returns from crop farming are low.

Income from off-farm sources significantly and negatively affected the proportion of land allocated to crop production. As incomes from off-farm sources increase, the proportion of land allocated to crop production decreases by about 9%. This result differs from what Lynne (2010) observed. The difference in observations could be attributed to the fact that as income increases, farmers can be able to use the money in buying a variety of foods rather than growing the crops. Pastoralists are known to sell livestock so as to buy food, clothing, pay medical bills and even school fees and in response they tend to adopt crop farming to supplement livestock incomes. Therefore, with increase in other sources of incomes, sell of livestock is limited and by so doing livestock units tend to increase. Over time, most farmers would have more livestock, implying more land will be allocated to livestock production compared to crop production (Boone *et al*., 2003; Markakis, 2004; Bebe *et al*., 2002; Deluca *et al*., 2010).

Land ownership with title deed showed up as positive and significant, along with household size. So, larger household sizes together with land title deeds appear to have an advantage when it comes to the proportion of land allocated to crop production. Private land ownership with title deeds gives farmers a right to use the land (security of tenure) thus creates an incentive for the farmers to make necessary investments in their land which are long term and even riskier (Rana *et al*., 2000).

A larger household size increased the probability of allocating more land share to crop production by 2%. Larger household sizes have been found to be associated with extra expenses (food, school fees and medical bills), thus households will allocate more land for crop production so as to cater for such expenses instead of selling livestock. Also due to change in dietary habits (from milk and blood) more land is allocated to crop production so as to get a variety of foods (Markakis, 2004; Deluca *et al*., 2010)

Extension service was measured by the number of household head contacts with extension officers and it proved significant with a positive sign. It was realized that 8% of the observed variation in the extent of the shift from pastoralism to agro-pastoralism could be explained by the number of contacts. An additional visit of the household head by the officers increased the extent by 8%. Extension agents supply farmers with important information and skills on production, management and even marketing. The availability of relevant and adequate information reduces the risk associated with crop production. The reduction in the risk therefore provides an incentive to the farmers to expand production of a particular crop. According to Alakpa and Onemolease (2009), farmers in contact with extension agents are two times more likely to increase adoption of crop-related innovations than those with no contact.

Distance to the market significantly and negatively affected the proportion of land allocated for crop production. An increase in time taken to reach the nearest market reduced the probability of allocating more land for crop production by 7%. This implies that increased distance to the market favors pastoralism in the area. This would be attributed to the fact that by moving further from town, a household is able to occupy less crowded pastures for livestock and there is much space for resting of livestock (during the day for lactating livestock and at night for non-lactating ones) (Doss and McPeak, 2005).

Distance to the nearest water source was significant and positively correlated with extent of the shift. Increase in time taken to reach the nearest watering point say by one hour increased the proportion of land allocated for crop production by 8%. Research by Herrero *et al*. (2006) has shown that households located closer to water points earn more returns from livestock as compared to households further from watering points. Thus, it might happen that households located further from water sources get demotivated by little returns (less milk, blood and little income from sales)

from livestock and in response they allocate more land for crop production. In addition, following the Kenyan government decision to privatize land in the area, it is difficult to access water given that already other farmers have fenced their land (Mwang'ombe *et al*., 2009; Griffiths, 2007; Semambo *et al*., 2009).

Gender of the head of the household had a significant impact on the proportion of land allocated to crops positively. There was a lower likelihood for female-headed households to allocate land for crop production compared to male-headed households (Deluca *et al*., 2010). The results indicated that if the household head is a male the probability of allocating more land for crop production increased by 22.58%. A plausible explanation for this could be that female headed households are resource constrained given that they do not own critical resources such as land and livestock. Moreover, they have no power to make decisions on resource use as noted by WIBD (2005).

Influence from the neighborhood significantly and negatively affected the extent of the shift. As farmers interacted more with their neighbors, the probability of allocating more land for crop production declined by 12.17%. In this context, the neighborhood comprised of other communities found in the area such as the Kisii, Luo and the Kipsigis. On the other hand, the Maasai themselves formed part of the neighborhood based on different Maasai clans. So, depending on who formed the neighborhood, farmers could decide to allocate more or less land towards crop production. A plausible explanation for this result is that the Maasai community has a long time history in livestock production. Besides, they have a strong cultural attachment to livestock (Mageka and Osero, 2007; WISP, 2008) hence they were likely to allocate much land to livestock production as compared to crop production. Langyintuo and Mulugetta (2005) argues that as farmers interact more with their neighbors and outside world, they become more able to assess the relevance of new technologies and ideas thus they exercise a choice.

CONCLUSION AND RECOMMENDATIONS

From the study, households would be better off with the shift from pastoral to agro-pastoral livelihoods, given that the shift was enhanced by more frequent group meetings and farmer trainings, shorter distance to market and more income from off-farm sources of incomes. Declining land sizes and longer distance to watering points forms the rationale of the observed behavior changes among households.

The agro-pastorals choice to allocate higher proportion of land for crop production compared to livestock production was enhanced by more distance to watering points, low off-farm incomes, private land ownership, larger family, male dominance, more extension services, shorter distance to the market, less years of crop farming and little interaction with the neighbors.

Distance to watering points was found to be key in influencing the shift, however, as much as most farmers have shifted, still culture inhibits complete exit from pastoralism, thus there's need for a policy to address water problems in the area (given that farmers took 1-2 h before they could reach the nearest water source), through targeted training programs that will enhance the knowledge of farmers on water harvesting technology. Moreover, the Government should drill more boreholes in strategic points to assist households during the dry season.

ACKNOWLEDGMENT

Collaborative Masters of Agricultural and Applied Economics (CMAAE) secretariat, headed by Prof. Willis Kosura, my university supervisors Dr. J.K. Lagat and Prof. B.O. Bebe, are gratefully acknowledged.

REFERENCES

Abele, S., J. Jangwe, G.A. Obare and E. Ouma, 2009. Determinants of smallholder farmers' participation in banana markets in Central Africa: The role of transaction costs. J. Agr. Econ., 41(2010): 111-122.

Adeel and Uriel 2005. Dry Lands Systems: In the Millennium Ecosystem Assessment, 2005. Retrieved from: http:// www. Millenni umassessment. org/ en/ index. aspx, (Accessed on: February 23, 2010).

Adewumi, M.O., A.F. Lawal and O.A. Omotesho, 2009. Land use pattern and sustainability of food crop production in the fadamana of southern guinea savanna of Nigeria. Afr. J. Agric. Res., 5(3): 178-187.

Akinwumi, J.A., M.A. Jabbar and V. Okoruwa, 1996. Crop-livestock competitions in the West African derived Savanna: Application of a multi-objective programming model. J. Agric. Syst., 52: 439-453.

Alakpa, S.O. and E.A. Onemolease, 2009. Determinants of adoption decisions of rural youths in the Niger Delta region of Nigeria. J. Soc. Sci., 20(1): 61-66.

Babatunde, R.O. and M. Qaim, 2007. The Role of off Farm Income Diversification in Rural Nigeria Driving Forces and Household Access. Draft of German Academic Exchange Service (DAAD), Sponsored Research Paper, pp: 1-26.

Bebe, B.O., W. Thorpe and H.M.J. Udo, 2002. Development of smallholder dairy systems in the Kenya highlands. Outlook Agr., 31(2): 113-120.

Bekure, S. and P.N. de Leeuw, 1991. The Potential for Improving the Livestock Production and Welfare of Pastoral Maasai. In: Bekure, S., P.N. De Leeuw, B.E. Grandin and P.J.H. Neate (Eds.), Maasai Herding: An Analysis of the Livestock Production System of Maasai Pastoralists in Eastern Kajiado District Kenya. Systems Study 4, ILCA (International Livestock Centre for Africa) Addis Ababa, Ethiopia, pp: 141-154.

Binsbergen, J.V. and D.J. Watson, 2008. Livelihood diversification opportunities for pastoralists in turkana. ILRI Research Report No. 5, Nairobi, Kenya.

Boone, R.B., K.A. Galvin and P.K. Thortorn, 2003. An agro-pastoral household model for the range lands of East Africa. J. Agric. Syst., 76: 601-622.

BurnSilver, S., P.C. Trench, K. Cochrane, M. Herrero, K. Homewood, F. Nelson, P. Kristjanson, M. Radeny, S. Serneels, D.M. Thompson and M.Y. Said, 2009. Methods in Analysis of Maasai Livelihoods. ILRI, Nairobi, Kenya.

Coast, E., K. Homewood, A. Kariuki, I. Kikula, J. Kivelia, E.F. Lambin, M. Said, S. Serneels and M. Thompson, 2001. Long Term Changes in Serengeti-Mara Wildebeest and Land Cover: Pastoralism, Polulation or Policies? ILRI Publications, ILRI, Nairobi, Kenya.

Coast, E., K. Homewood, S. Kiruswa, S. Serneels, P. Trench and M. Thompson, 2006. Maasai Pastoralists; Diversification and Poverty. LSE Research Online, London.

Deluca, L., J.T. McCabe and P.W. Leslie, 2010. Adopting cultivation to remain pastoralists: The diversification of maasai livelihoods in northern tanzania. J. Human Ecol., (38): 321-334.

Doss, C.R. and J.G. McPeak, 2005. Are Household Production Decisions Cooperative? Evidence on Pastoral Migration and Milk Sales from Northern Kenya, Center Discussion Paper No. 906, Yale University, P.O. Box 208629, New Haven, CT 06520-8269.

Ellis, F., 1998. Household strategies and rural livelihood diversification. J. Dev. Stud., 35(1): 1-38.

Fratkin, E., 2001. East African pastoralism in transition: Maasai, Boran and Rendille cases. Afr. Stud. Rev., 44(3): 1-25.

Freeman, H.A., S. Kaitibie, S. Moyo and B.D. Perry, 2008. Livestock, livelihoods and vulnerability in Lesotho, Malawi and Zambia: Designing livestock interventions for emergence situations. ILRI, Research Report 8, ILRI, Nairobi, Kenya.

Galvin, K.A., 1992. Nutritional ecology of pastoralists in dry tropical Africa. Am. J. Hum. Biol., 4: 209-221.

Galvin, K.A., 2009. Transitions: Pastoralists living with change. Annu. Rev. Anthropol., 38: 185-198.

Gebregziabher, D., 2010. Market chain analysis of poultry: The case of Alamata and Atsbi-Wonberta Woredas of Tigray region. M.Sc. Thesis, Department of Agricultural Economics, Haramaya University, Ethiopia.

Griffiths, S.M.N., 2007. How many wildebeest do you need? J. World Econ., 8(2): 41-64.

Gumbo, D. and J.M. Maitima, 2007. Land Use Changes in Sub-Saharan. In: Luanne, O. (Ed.), Global Climatic Changes and their Impacts on Africa. A Synthesis Perspective IGBP START Publication, East African Educational Publishers, ILRI, Nairobi, Kenya, pp: 116-140.

Heckman, J.J., 1979. Sample selection bias as a specification error. Econometrica, 47(1): 153-161.

Herrero, M., P. Kristjanson, D. Nkedianye and M. Radeny, 2006. Livelihood Choices and Returns Among Agro-pastoralists in Southern Kenya. ILRI, Nairobi, Kenya.

Karbo, N., 2007. Natural mineral licks to enhance livestock growth. Appropriate Tech., 34(1): 46-48.

Kariuki, P., M. Liyama and J. Maitima, 2007. Crop-livestock diversification patterns in relation to income and manure use: A case study from Rift-valley community Kenya. Afr. J. Agric. Res., 2(3): 058-066.

Karugia, J.T., W. Oluoch-Kosura, R. Nyikal, M. Odumbe and P.P. Marenya, 2006. Access to land, income diversification and poverty reduction in rural Kenya. Contributed Paper Prepared for Presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia.

Kosgey, I.S., G.J. Rowlands, R.L. Baker and J.A.M. Van Arendok, 2004. Small ruminant production in the tropics: A study of small holder pastoral/extensive farming systems in Kenya. In: Kosgey, Isaac, Sanga, Breeding objectives and breeding strategies for small ruminants in the tropics. Ph.D. Thesis, Animal Breeding and Genetics Group, Wageningen University, the Netherlands, pp: 272.

Kristjanson, P., M. Radeny, D. Nkedianye, R. Kruska, R. Reid, H. Gichohi, F. Atieno and R. Sanford, 2002. Valuing alternative land-use options in the Kitengela wildlife dispersal area of Kenya. A Joint International Livestock Research Institute (ILRI) and the African Conservation Centre (ACC) Report Undertaken for the Kitengela Community. International Livestock Research Institute, Nairobi, Kenya.

Langyintuo, A. and M. Mulugetta, 2005. Modeling Agricultural Technology Adoption Using the Software STATA. International Maize and Wheat Improvement Centre (CIMMYT) Training Manual No. 1/2005 (part two), P.O. Box MP 163, Mount Pleasant, Harare, Zimbabwe.

Lansink, A.Q., J. Peerlings and T. Woldehanna, 2000. Off-farm work decisions on Dutch cash crop farms and the 1992 and Agenda 2000 CAP reforms. J. Agric. Econ., 22: 163-171.

Little, P.D., 2001. Income Diversification among East African Pastoralists. Research Brief 01-08 PARIMA, Global Livestock CRSP, University of California, Davis, pp: 4.

Liyama, M., 2006. Livelihoods Diversification Patterns among Households and their Implications on Poverty and Resource Use: A Case Study from a Kerio River Basin Community. LUCID Project International Livestock Research Institute, Nairobi, Kenya.

Lynne, S., 2010. The Pastoral to Agro-pastoral Transition in Tanzania: Human Adaptation in an Ecosystem Context. Tanzania. Retrieved from: http:// economics-of-cc-in-Tanzania-org/ images/. Accessed on: January 23, 2011.

Mageka, G. and P. Osero, 2007. TransMara Integrated Development Project: Conservation and farming Initiatives (CAFI). Kisii, Kenya.

Markakis, J., 2004. Pastoralists on the Margin-Minority Rights Group Report. Marcel Reyes-Cortez/Andes Press Agency, U.K.

Matishe, I. and T. Young, 2004. Off-farm labour allocation decisions in small scale rural households in Zimbabwe. J. Agric. Econ., 30: 175-186.

Mochabo, M.O.K., G.A. Murilla, S.O. Nyamwaro and K.B. Wanjala, 2006. Conflict minimizing strategies on natural resource management and use: The case for managing and coping with conflict between wildlife and agro-pastoral production resources in TransMara district, Kenya. Policy Research Conference on Pastoralism and Poverty Reduction in East Africa, Nairobi, Kenya.

MOFAP, 1999. 1999 Population and Housing Census: Counting Our People for Development. CBS, Nairobi, Kenya, Vol. 1.

Morton, J. and N. Meadows, 2000. Pastoralism and Sustainable Livelihoods: An Emerging Agenda. University of Greenwich, Greenwich.

Mwangi, E., 2005. The Transformation of Property Rights in Kenya's Maasai Land: Triggers and Motivations. IFPRI, Washington D.C., USA.

Mwang'ombe, A.W., D.M. Nyariki and D.M. Thompson, 2009. Land use change and livestock production challenges in an integrated system: The Maasai mara ecosystem, Kenya. J. Hum. Ecol., 26(3): 163-173.

Ndumu, D., A.M. Okeyo, J. Solkner and M. Wurzinger, 2008. Lifestyle and herding practices of Bahima pastoralists in Uganda. Afr. J. Agr. Res., 3(8): 542-548.

Obayelu, A.E., V.O. Okoruwa and O.A. Onio, 2009. Analysis of rural and urban household food consumption differential in North-central Nigeria: A micro-econometric approach. J. Dev. Agric. Econ., 1(2): 18-26.

Rana, R.B., D. Gauchan, D.K. Rijal, S.P. Khatiwada, C.L. Paudel, P. Chaudhary and P.R. Tiwari, 2000. Socio-economic Data Collection and Analysis: Nepal. In: Jarvis, D., B. Sthapit and L. Sears (Eds.), Conserving Agricultural Biodiversity in Situ: A Scientific Basis for Sustainable Agriculture. International Plant Genetic Resources Institute, Rome, pp: 54-56.

Semambo, A.M., M. Wurzinger, D. Okeyo and J. Solkner, 2009. The sedentarization process of the Bahima in Uganda: An emic view. Afr. J. Agric. Res., 4(10): 1154-1158.

Tangus, J.K., 2004. Influence of enterprise diversification on risk management amongst Samburu pastoralists of Kenya. M.Sc. Thesis, Department of Natural Resource Management, Egerton University, Kenya.

WIBD, 2005. Participatory Research and Social Analysis with Special Emphasis to Gender in Pastoral Communities of Ethiopia. Addis Ababa, Ethiopia.

WISP, 2008. Forgotten Services, Diminished Goods: Understanding the Agro Ecosystem of Pastoralism. WISP Policy Note No. 8, IUCN. Nairobi, Kenya. Retrieved from: www .iucn. org/ wisp/ wisp-publications.html, (Accessed on: January 1, 2010).