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RESEARCH PAPER

Factors determining intensity of camel adoption in Karamoja, Uganda

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Abstract

Camels are increasingly being integrated in mainstream livestock production systems as an adaptation strategy to droughts. In this study we determine the level and intensity of adoption of camels and the socio-economic factors influencing the two processes among pastoral households in the sub-region. Econometric results show that increasing age of the household head and the households living in Moroto were significantly associated with increasing intensity of adoption whereas household size, credit access, household's experience of food insecurity and crop area cultivated significantly affects the intensity of camel adoption. The study recommends improvement of on-farm productivity in crop areas cultivated to leverage higher benefits from smaller areas cultivated. It is also important that livestock markets are improved to leverage full benefits from camel products and camel related businesses.

Key words: Camels, Livestock, Pastoral, Intensity, Adoption, Semi-arid

Introduction

Climate variation–induced shocks have led to serious ecological and economic consequences to rangelands and rangeland inhabitants especially in Africa (Vetter, 2009). For instance, shocks such as recurrent and prolonged droughts negatively affect the livelihoods of pastoral and other dry lands households (United Nations Development Program (UNDP), 2009) through increased land desertification and worsening of animal health (Nardone, Ronchi, Lacetera, Ranieri, and Bernabucci, 2010). It is expected that increasing variability in climate will continue to negatively affect livestock production systems in all parts of the world, including the rural poor in Arid and Semi-Arid lands (ASALs) whose main source of livelihood is livestock (Kima *et al.*, 2015). Climate change projections indicate that global climate change will increase ASALs in Africa by five to eight percent, leaving 75 to 250 million people exposed to droughts by the year 2080 (Intercontinental Panel on Climate Change (IPCC), 2014). This increase in arid and semi-arid land will in part drive the change in ecological systems and survival tactics of the affected communities, majorly pastoralist communities (IPCC, 2014).

Pastoral communities in ASALs engage in livestock production as the most important source of livelihood (Oxfam, 2008). Livestock species commonly kept include cattle, sheep, goats, chicken, donkeys and camels. Besides providing income, food and nutrition security (Descheermaerker et al., 2010), livestock are an important form of productive and buffer assets to pastoral communities. Livestock serve as a form of savings but most importantly ensuring food security, hence, reducing vulnerability during times of stress such as drought periods (Heffernan, 2012). However, livestock productivity and its significance to household livelihood stability is hampered by the increased frequency and severity of droughts. Frequent and prolonged droughts threaten the survival of conventional livestock in these areas. For example, a study by Kagunyu and Wanjohi (2014) reported that the drought that hit Kenya between 2005 to 2006 reduced cattle, goats and sheep herds by up to 70% in the most affected areas, leaving the affected communities poorer and dependent on aid to live through the drought. This calls for strategies to enhance the resilience of pastoral communities to negative shocks such as drought.

Pastoral communities traditionally survive the effects of drought through breeding locally adapted livestock species, stock diversification and resource management practices such as calf grazing paddocks (The International Union for Conservation of Nature (IUCN), 2010). Zwaagstra *et al.* (2010) reports that people in northern Kenya opted for strategies including migrating to neighbouring and less affected districts, storing food produce, selling livestock and household assets and some rely on social safety nets and food aid. Some of these strategies such as sale of household assets and productive livestock are unsustainable. Poorer households sell their productive assets to levels below the minimum threshold thus, find it difficult to recover from such recurrent shocks (Carter, Little, Mogues, and Negatu, 2006). This is because the time interval from one drought to the next may not be enough for the household to recover the lost assets hence, curtailing long term asset accumulation. Furthermore, rising populations coupled with reduced land per household in neighbouring districts precludes migration as a sustainable adaptation route due to conflicts between pastoral and agricultural communities. The limited applicability and long-term sustainability of the practiced adaptation mechanisms underscores the need to build on time tested methods of stock diversification, breeding locally adapted species and efficient resource management albeit with a modern approach in order to build community resilience to droughts.

Earlier studies have reported integration of camels into mainstream herds and preference of camel to cattle in dry lands by some communities which did not previously keep camels (Farm-Africa, 2002) as a response to the devastating effects of droughts on cattle and other livestock species. In their assessment of the impacts of the 2008-2009 droughts in northern Kenya, Kagunyu and Wanjohi, (2014) found that communities that had traditionally not reared camels were increasingly integrating camels into their herds as a coping strategy to drought occurrence. Further, Kagunyu and Wanjohi (2015) reported that pastoralists in drought prone areas of northern Kenya had been observed to prefer rearing camels to other livestock species. This was due to high death rates of cattle and other livestock during the drought periods and their inability to go without water for many days during drought. Pastoral tribes (Samburu and Turkana) in northern Kenya have begun to increase the number of camels that they manage, substituting them for cows in order to have more drought-resilient herd (Kagunyu and Wanjohi, 2014, 2015; IUCN, 2010). Kenya camel population increased from 0.8 million in 1999 to three million in 2009 (Kagunyu and Wanjohi, 2014).

The total population of camels world-wide was estimated at about 37.5 million in 2019, 85% of which were found in Africa and the rest in the Indian subcontinent and the countries of the Middle East (FAOSTAT, 2019). In the East African region, camels are reported to be found only in Uganda and Kenya (Keya and Rubaihayo, 2013). There was an estimated 32,870 camels in Uganda (Uganda Bureau of Statistics (UBoS), 2010). Of these, an estimated 32,030 (97%) were reported in Karamoja sub-region. Wilson (2017) estimates this number to have increased to about 41,000 camels in 2017. Camels are mainly owned by the Pokot (also known as Suk) tribe in Amudat district and Matheniko tribe in Moroto district in Uganda (Wilson, 2017). The mean national camel herd size was 10 camels per household. Households in Karamoja reported about 11 camels per household while three camels per household were reported for other regions.

Camels are important livestock species in the subsistence economy of rural pastoral communities especially in arid and semi-arid lands (Aujla, Rafiq, and Hussain, 2013). They contribute to household food security through meat and milk (Ahmad *et al.*, 2010), are used as pack animals for transport, and provide household income through sale of live animals, meat, milk and other by-products such as hair and hides (Aujla *et al.*, 2013; Faye, Abdelhadi, Ahmed, and Bakheit, 2010; Mochabo *et al.*, 2005). Field (2005), estimated that the volume of milk produced by camels is six times that produced by indigenous cattle found in the dry lands especially during the dry periods. Mochabo *et al.* (2005) further identified that camels are given as bride price in Kenya and are kept as security against calamities and natural disasters such as drought and disease that may be devastating to other livestock species kept.

Extensive keeping of livestock is the major economic activity in Karamoja sub-region due to its semi-arid nature (UNFPA, 2018). While pastoralism is observed as an adaptation strategy to effects of droughts (Oxfam, 2008), recurrent and prolonged droughts greatly erode the resilience capacity of the pastoralists Kagunyu and Wanjohi,

(2014) Camels' unique adaptability to drought conditions presents a unique pathway for building resilience among pastoral communities in Karamoja sub-region. Camels are able to survive well in ASALs due to their biological and physiological characteristics which help them cope with harsh environmental conditions (Kagunyu and Wanjohi, 2014; Yosef *et al.*, 2014). They drink less water and are able to stay for many days without water due to their tolerance to dehydration compared to other livestock species. They are able to convert the scanty plant resources of the ASALs into milk, meat and fiber (Ahmad *et al.*, 2010). They have got almost no competition for feed with other animals since they are hardy animals and eat less (Khan, Iqbal, and Riaz, 2003). This makes it easier to integrate them into other production systems.

Integration of camel production in the traditional livestock system is increasingly gaining importance as a strategy for household adaptation to prolonged and recurrent droughts in African ASAL, including Uganda. In the East African pastoral and agro-pastoral region, researchers and development partners are increasingly getting interested in promoting camels as a strategy to mitigate the effects of prolonged droughts (Kagunyu and Wanjohi, 2014, 2015; Nalule, 2010). Salamula, Egeru, Asiimwe, Aleper, and Namaalwa (2017) studied the factors that determine adoption of camels. However, rigorous empirical evidence on intensity of camel adoption in Uganda remains scarce. This study sought to address the information gap by determining the intensity and factors influencing intensity of camel adoption in Uganda. Understanding household camel integration behaviours can guide promotion of integration of camels into mainstream herds in drought prone areas in Uganda.

Study Area

Karamoja experiences a semi-desert type of climate with sporadic uni-modal rainfall patterns experienced between May and August; and an intensely hot dry season occurring from November to March (Mubiru, 2010; Nalule, 2010). The rainfall ranges between 350-1000mm per annum, variable in space and time (Mubiru, 2010; Nalule, 2010). However, Egeru *et al.* (2014) reported a general increase in the rainfall of this sub-region despite the existence of below normal rainfall amounts. The temperatures range between a maximum of 28ºC-32.5ºC to and a minimum of between 15ºC to 18ºC. This area has suffered climate variations manifested in extended dry spells, cyclic droughts and erratic rainfall patterns which have affected crop production and livestock production (Wilson, 2017).

The topography of Karamoja consists of a low-lying plateau, rolling plains rising to an altitude of 1,000 to 1,440m in most locations (Egeru, 2015). The dominant soils are black clays and dark grey clay with low organic matter and medium moisture storage capacity (Mubiru, 2010). Karamoja is mostly semi-arid savannah covered with seasonal grasses, thorny plants, and occasional small trees (Mubiru, 2010). The area is dominated by indigenous tropical grasses and the over story is mostly composed of Acacia species (Egeru *et al.*, 2014; Nalule, 2010).

Karamoja sub-region, is the poorest region in Uganda with a population of about 1.2 million, 61% of which was reported to be living below the poverty line in 2017 (UNFPA, 2018). The sub-region has in the past suffered cross boarder conflicts and is also prone to increasingly frequent and severe natural disasters, especially droughts, in part as a result of climate change (Caffrey *et al.*, 2013; UNDP, 2009; WFP, 2009). Three types of livelihood options dictated by the amount of rainfall received are practiced in this part of the country. These include; crop production which runs along the western flank of Kaabong, Kotido, Abim, Moroto and Nakapiripiriti districts. These areas receive the highest rainfall in the sub-region of 800-1200 mm per annum (Livelihood Profiles, 2010) and have the most fertile soils that can support a wide variety of crops. However, the majority of the people in these areas still exhibit sedentary livelihood. The second livelihood option is the agro-pastoral where crop agriculture performs fairly but less in comparison to the western green belt. This is practiced in areas that receive on average 500 to 800 mm of rainfall annually (poorly distributed) with relatively high surface temperatures including central Kaabong, most of Kotido, central Moroto and central Nakapiripiriti. The third livelihood option-pastoralism is practiced in areas that receive poorly distributed rainfall that amounts to less than 700mm per annum. This is mainly practiced in the eastern parts of Kaabong, Moroto, Nakapiripiriti and most of Kotido. These regions experience high surface temperatures and erratic rainfall resulting in extended dry conditions, high pest and disease incidence, poor infrastructure, cattle thefts, bush fires, periodic low water and pasture availability (UNFPA, 2018).

Methods

Data Collection

The study used a comparative approach, comparing camel and non-camel rearing households. Two districts (Moroto and Amudat) were purposively selected for the study due to the presence of high camel numbers. Basing on a reconnaissance field visit, the areas known for camel rearing were selected for the study. These were sub counties of Rupa in Moroto district, Amudat, Looro and Amudat TC in Amudat district.

A list of camel rearing parishes was obtained with the guide of a sub-county local leader and livestock production officers. The study population was stratified into camel and non-camel households. The parishes included in the study were randomly selected from the obtained list. Villages and then participating households were the randomly selected from the respective sampling frames. Replacements were made in case of absence of target responds or unwilling households. The sample size for the study was determined using the following formula adopted from Banda (2015):

$$n = \frac{Z^2}{e^2}\left(\frac{p.q.N}{(N-1)+Z^2.p.q}\right)$$

where; n was the sample size determined, p was the proportion of pastoral households in the region, a proportion of 0.8 was used as reported from the reconnaissance study, q represented the proportion of non-pastoral households; Z was the number of standard deviations at a given confidence level (i.e. 95 per cent in this study) equal to 1.96, *e* was the acceptance error (0.05) and N (25,000) the estimated number of households in the selected sub counties, giving an estimated sample size of 245 households. However due to respondent unavailability, time and resource constraints 122 households were interviewed. With further cleaning, the sample size reduced to 116 households that were used in the analysis due to missing information for some respondents.

The study collected data by conducting key informant interviews and household level interviews between January-February 2016. Key Informants Interviews (KII) were conducted to provide information on the institutional arrangements and efforts towards camel production in the area. District production departments, political leaders at the sub-counties, veterinary and extension personnel were interviewed. KII also guided the characterization of the study population and preparation of the sampling frame for the parishes and households in the elected villages. In the later stages, KII were used to qualify and validate information obtained from the household interviews. A key informant question guide (Appendix 1) was used to guide the discussions. Information of interest included the institutional efforts towards livestock value chain development and resilience building in households and communities and community level adoption of camels. Information on livestock extension and input delivery systems at community level, condition of infrastructure such as roads, schools, water sources and health units, marketing infrastructure for livestock and livestock products in general and any efforts to promote camel production in the area was also obtained.

Household level data were collected using a semi-structured questionnaire (Appendix 2). The questionnaire was administered with the help of local language interpreters. Household head, spouse or older children familiar with household routine activities and camel related activities were the main respondents. The questionnaire captured information on personal identification, basic household information, household direct productive assets such as land, livestock, crops and indirect productive assets such as transport and communication equipment, on farm and off-farm, migration and remittances. Information on social and economic connectivity of a household was also collected. Questions on household food security status in the last one year were included to establish a household's drought resilience and coping abilities. Further, information on numbers of camel kept, camel products obtained, proportions of products consumed and sold and sale prices. This allowed both qualitative and quantitative description of the camel adoption behaviors in the study area.

Data Analysis

Economic theory

The study examined the determinants of the level and intensity of camel adoption by smallholder pastoralists in Karamoja using the conventional random utility model. In this framework, individuals were assumed to make rational decisions by choosing to increase the number of camels kept if doing so maximized their expected utilities. Following Hanemann (1984), Baltas and Doyle (2001) a random utility function for a smallholder farmer in Karamoja facing a decision to increase number of camels kept was specified as in equation (1) below;

$$V_{ij} = \bar{V}_{ij} + \varepsilon_{ij} = X_{ij}\theta + \varepsilon_{ij}, i = 1,...,n \qquad (1)$$

where V_{ij} -utility of alternative *j* for consumer *i,* is a function of the deterministic component $\bar{V}_{ij}$ and the random component ε_{ij} ; X is a vector of observed socio-economic and demographic characteristics of the individual, and ε is the stochastic component of the utility function representing the unobserved attributes affecting individual *i*'s choice of the practice, heterogeneity in tastes and measurement errors.

A rational pastoral household would choose increase camels kept if the expected utility derived from an additional camel (V_{i1}) was higher than that generated from the status quo (V_{i0}), given the constraints, such as access to resources, information and knowledge about camels. This study used descriptive method to compute intensity of adoption of camels in the study area. The intensity of adoption was captured as the proportion of Camel Tropical Livestock units (TLUs[1]) in the herd to the total herd TLUs as specified in equation (3) below;

$$Intensity of adoption (Ic) = \frac{Camel\ TLUs\ owned\ by\ the\ household}{Total\ TLUs\ owned\ by\ the\ household} \qquad (2)$$

[1] Tropical Livestock units(TLU) a standardized animal unit obtained by multiplying total number of animals with a conversion factors that takes into account "feed requirements" for the animals; cattle and donkeys =0.5, goats and sheep=0.1 and Chicken=0.01

Econometric Methods; Determinants of the Intensity of Camel Adoption

The major focus of this study was to determine the factors influencing intensity of camel adoption. fractional response model was used to estimate the determinants of adoption intensity since the dependent variable is bounded between zero and one (Papke and Wooldridge (1996). Intensity of adoption estimation could be done using ordinary least squares estimation methods, but this has two major draw backs. First, there is a possibility of obtaining estimated intensity outside the zero-one range yet the dependent variable (intensity of adoption) is a proportion bound between zero and one. Secondly, the assumption that there exists a linear effect of explanatory variables on the response variable may not be exactly realistic in the current scenario. To this, a fractional logit model which assumes a logistic distribution of the random disturbances and binds the estimated intensity of adoption between zero and one (Papke and Wooldridge (1996)) was adopted for the study. The general model for intensity of adoption is specified in equation 3 below.

$$E(\log[y_i/(1-y_i)] \mid x) = x\beta \qquad (3)$$

where Y_i was defined as proportion of camel TLUs in the herd, β is a K x 1 vector of parameters, x is an N x K matrix of explanatory variables. The variables included in the empirical models were drawn from empirical studies on household technology adoption behaviour (Akinbode and Bamire, 2015; Alexander and Mellor, 2005; Bandiera and Rasul, 2002; Diiro and Sam, 2015; Lavinson, 2013; Mwangi and Kariuki, 2015; Namara, Weligamage, and Barker, 2003; Reardon, Stamoulis, and Pingali, 2007). These included age of the household head, main occupation of the household head (dummy 1=pastoralist 0 otherwise), marital status (dummy 1=married 0 otherwise, a household members' completion of primary education, household size, dependence ratio, household experienced feeling of food scarcity, asset ownership, tropical livestock units of large ruminants excluding camels, tropical livestock units of small ruminants, membership to social groups, distance to input stockist, access to livestock extension services, access to credit, household received remittances, number of alternative sources of income and proportion of off-farm income to total household income, crop area cultivated and the location dummy (1=Moroto and 0=Amudat).

Results

Socio-Economic and Demographic Characteristics of the Sampled Households

Table 1 presents a summary of socio-economic, demographic and community level variables some of which were included in the econometric model, characterizing households in terms of adopters and non-adopters of camels. The summary statistics in Table 1 show that the two farmer categories are generally comparable with respect to most of the attributes except per capita income, and income from the farm and non-farm sectors, and age of the farmer. Camel adopters were older and reported higher per capita income and income from the farm sector than farmers without camels. Higher per capita income is an indicator of household accumulation of capital assets and income generating potential. Furthermore, a head of a camel rearing household was about eight years older (54) than their non-camel counter parts (46). Age of the household head is likely to be associated with wealth accumulation in households but has been associated with decreased ability to make capital intensive investment decisions due to increased risk aversiveness among older people. The descriptive statistics show that 45% of the surveyed households owned at least one camel and camel Tropical Livestock Units (TLUs) constituted 25% of the total TLUs of the herd among adopting households.

Table 1: Other socio-economic and demographic characteristics of the surveyed households

Variable	All Households (n=116) Mean	Std. Dev.	Camel Households (n=52) Mean	Std. Dev.	Non-Camel Households (n=64) Mean	Std. Dev.	t-statistic
Per Capita income (Ushs '000)	163.06	303.767	231.67	419.315	107.32	138.063	-2.230**
Occupation of household head (1=pastoralist; 0 otherwise)	0.74	0.440	0.75	0.437	0.73	0.445	-0.190
Age of household head (years)	49.62	14.975	54.19	13.776	45.91	14.982	-3.070*
Years of experience in rearing camels			26.05	20.281			
Marital Status (1=married polygamous; 0 otherwise)	0.74	0.439	0.81	0.398	0.69	0.467	-1.446
Household size (continuous)	11.05	5.138	11.27	5.010	10.88	5.272	-0.410
Household member completed primary	0.17	0.379	0.19	0.398	0.16	0.366	-0.507
Dependence ratio	0.67	0.818	0.71	0.823	0.64	0.819	-0.423
On-farm Income (Ushs '000)	1085.00	1471.227	1628.80	1728.317	643.16	1044.305	-3.791*
Off-farm Income (Ushs '000)	411.35	1172.925	318.04	526.811	487.17	1507.846	0.771
Proportion of off-farm income to total income	0.36	0.379	0.26	0.353	0.44	0.381	2.667*
Access to credit (1=yes; 0 otherwise)	0.29	0.457	0.25	0.440	0.32	0.471	0.783
Number of alternative sources of income (continuous)	1.00	0.780	0.92	0.788	1.06	0.774	0.9567
Assets owned (0=only Agric. 1=agric & non-agric)	0.66	0.510	0.73	0.490	0.61	0.523	-1.279
Crop area cultivated	4.40	3.691	4.86	4.037	4.02	3.371	-1.220
Feeling of food scarcity (1=yes, 0=no)	0.93	0.254	0.88	0.323	0.97	0.175	1.788***
Months of scarcity	5.49	4.622	5.00	4.847	5.89	4.622	1.010
Meals consumed per day in times of scarcity	1.45	0.450	1.47	0.504	1.43	0.450	-0.336
Proportion of food consumed in scarcity	0.59	0.595	0.66	0.726	0.54	0.471	-1.063
Received extension	0.41	0.495	0.48	0.505	0.36	0.484	-1.319
Member of social group	0.41	0.494	0.31	0.466	0.49	0.504	0.291
Received remittances	0.21	0.407	0.15	0.364	0.25	0.436	1.269
Distance to nearest input stockist	8.31	6.756	9.19	6.473	7.63	6.942	-1.204
Distance to nearest extension office	6.69	5.817	6.41	5.648	6.91	5.980	0.446
Distance to nearest health center	4.08	3.520	4.17	3.555	4.01	3.520	-0.242
Distance to nearest primary school	2.67	3.110	3.04	4.258	2.36	1.604	-1.154
Distance to nearest secondary schools	11.09	6.663	11.44	7.124	10.83	6.355	-0.469

Note: ***significant at 10% **significant at 5% *significant at 1%

Intensity of Camel Adoption in Karamoja Sub-Region

An average household had about 18 camels, with about eight female camels, five male camels and five calves. The mean camel holding per household reported in this study is higher than the 10 camels per household reported in the 2008 livestock census (UBoS, 2010). With regard to districts, an average adopting farmer reported more camel heads in Amudat (22 camels) than their counterparts in Moroto with about 14 heads of camels (Table 2).

Table 2: Number of Camels Owned by a Household in Amudat and Moroto Districts, 2015

Type of camel	All Camel households (n=52)			Amudat District (n=27)			Moroto District (n=25)		
	Mean	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
Male	4(7.15)	0	50	4(3.26)	0	15	4(9.68)	0	50
Female	10(12.37)	1	70	12(15.29)	2	70	7(7.99)	1	30
Calves	5(5.76)	0	31	6(6.93)	0	31	3(3.75)	0	13
All camels	18(22.12)	1	116	14(18.97)	1	90	22.7(24.75)	5	116

Note: Figures in brackets are standard deviations

Livestock diversification is one of the ways households adapt to the effects of recurrent and prolonged droughts in ASALs. Tropical livestock units (TLU)-a standardized unit of animals basing on their feed requirements was used to compare livestock across households (Food and Agriculture Organisation of the United Nations (FAO), 2003). The TLUs for camels was about 9.2 (Table 3), representing about 25% of the TLUs for all livestock tended in a household. Other large ruminants such as cattle and donkeys formed the largest share of the TLUs in camel rearing households (about 42%). These results suggest that households appear to be integrating camels in the livestock systems to complement other livestock rather than substituting them.

The results in Table 3 also show that camel adopters had significantly more TLUs (about 35.7 %) relative to only 13.2% reported by their non-adopting counterparts. Since livestock serves as an asset base and a form of savings in pastoral communities, lower TLUs among non-adopters may imply an increase in vulnerability to stress from both external and internal shocks.

Table 3: Livestock Ownership among Camel and Non-Camel Adopting Households (TLU[2])

Type of livestock	Camel households (n=52)	Non-camel households (n=64)	t-statistic
Camels	9.2 (15.46)		
Other large ruminants	15.0 (21.34)	7.2 (9.72)	-2.616**
Small ruminants	4.8 (9.18)	2.9 (2.78)	-1.770*
Total TLU	35.7(42.07)	13.2(15.73)	-3.954***

Note: ***significant at 1%, **significant at 5%, *significant at 10%; Standard deviation in parentheses.

Figure 1 presents the farmers' main source of the first stoke of camel. As indicated in, about 60% of the households were obtaining camels through gifts, inheritance or bride price as compared to buying or exchanging with other livestock (40%). This highlights the social cultural importance of camels in the adopting communities in general. However, marked differences are observed between the two districts. About 80% of farmers surveyed in Moroto district acquired their first stock of camels through inheritance, gifts or bride price whereas most camel farmers (about 60%) in Amudat purchased their first stock. This finding suggests that camels could be more of an economic asset than a social cultural asset in Amudat as compared to Moroto district. Proximity of Amudat district to the Kenyan boarder could also explain the higher camel purchases. This is because there is a more developed camel market in the neighboring Kenyan districts of the Turkana region.

[2] Tropical Livestock units(TLU) a standardized animal unit obtained by multiplying total number of animals with a conversion factors that takes into account "feed requirements" for the animals; cattle and donkeys =0.5, goats and sheep=0.1 and Chicken=0.01

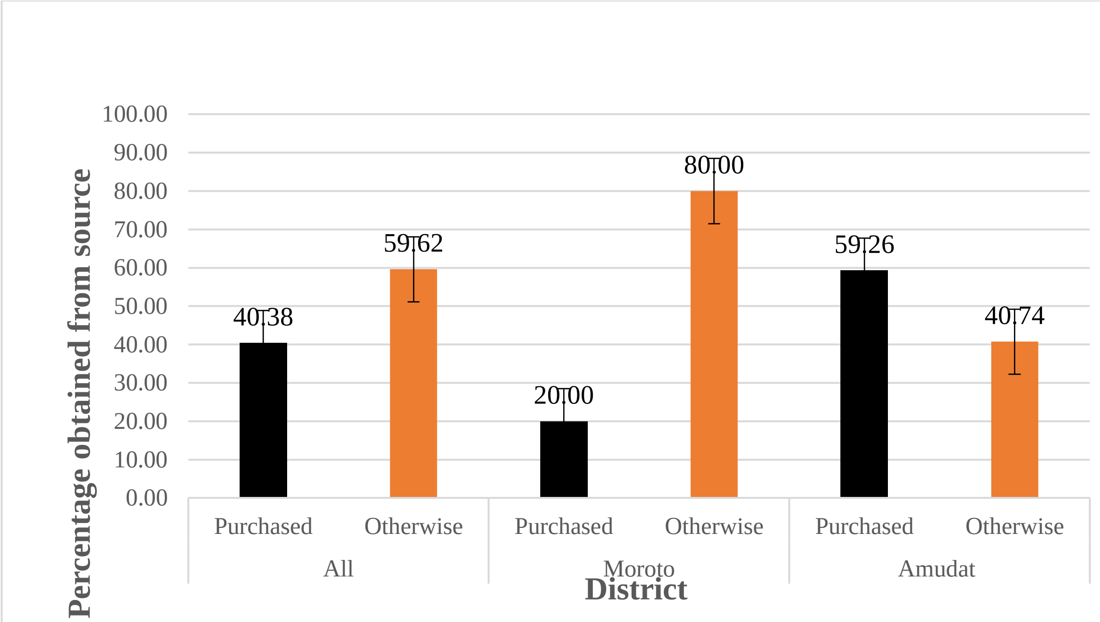

Figure 1: Source of Initial Camel Stock for Adopting Households

Econometric Results

Factors influencing intensity of camel adoption in Karamoja sub-region

As earlier stated, camels were being integrated into mainstream herds other than replacing other livestock species. The study therefore, estimated the factors driving intensity of camel adoption in the sub-region. A fractional logit model was adopted based on the fact that the dependent variable is not entirely continuous but fixed within the range of zero and one. A Wald chi value of 43.34 with a p-value less than 0.000 shows that the model fits the data well. The results presented in Table 4 show that intensity of adoption is positively and significantly associated with age of the household head and the location of the household. On the contrary, intensity of adoption is negatively and significantly related to household size, credit access, household experience of food insecurity and crop area cultivated.

The age of a household head exhibits a positive and significant effect on intensity of camel adoption at 1% level of significance similar to the effect of age on the decision to adopt. Implying that older household heads were more likely to have higher adoption intensities than their younger counter parts. A small increase in age of the household head from the mean increased the marginal change in intensity of camel adoption by 0.007 percentage points holding other factors constant. Increased desire for social prestige and accumulated wealth to buy camels could well explain this trend of effect. It was also observed that contrary to cattle that migrate in search of pasture and water, camels tend to remain in the homesteads. This encourages settlement of the household that is more likely to be a characteristic of older household heads than the younger household heads.

Similarly, location of the household has a positive and significant effect on intensity of adoption at 10% level of significance. Household in Moroto had 0.96 adoption intensities higher than those in Amudat. In addition, households in Moroto were 0.092 percentage points more likely to increase their intensities compared to their Amudat counterparts holding all other factors constant. As observed earlier in the study, camel adoption in Amudat district is a relatively new practice compared to Moroto district. Livestock accumulation through birth takes a long time. Adopters reported that a camel gestation period is about 12 months. This means that accumulation of camels could take some considerable amount of time depending on the initial animals one starts with, the managerial skills and the environment factors. These factors could explain the adoption intensity differences in the two districts.

Table 4: Fractional Logit Estimates of the Factors Influencing Intensity of Camel Adoption in Karamoja Sub-Region

Proportion of camel TLUs to total TLUs	Coefficient	Standard errors	Marginal effects
Constant	-3.243*	1.154	
Age of the household head (years)	0.070*	0.016	0.007
Occupation of the household head (dummy 1=pastoralist)	0.090	0.479	0.009
Marital status (dummy)	0.413	0.528	0.040
A household member completed primary (dummy)	0.049	0.553	0.005
Household size	-0.108**	0.047	-0.011
Dependence ratio	0.008	0.251	0.001
Number of alternative sources of income	0.492	0.308	0.048
Proportion of off-farm income to total income	-1.061	0.671	-0.103
Asset ownership (1= agricultural and non-agricultural assets, 0=only agricultural assets)	0.302	0.479	0.029
Experienced feeling of food scarcity (dummy)	-2.246*	0.554	-0.218
Access to credit (Dummy)	-1.254**	0.510	-0.122
Household received remittances (dummy)	-0.671	0.475	-0.065
Membership to social groups (dummy)	0.465	0.516	0.045
Household received animal related extension (dummy)	-0.182	0.412	-0.018
Crop area cultivated (acres)	-0.100***	0.056	-0.009
District (dummy 1=Moroto; 0=Amudat)	0.951***	0.493	0.092
Number of observations	114		
Wald chi2(16)	44.340		
Prob> chi2	<0.000		
Pseudo R2	0.185		

Note: *** 10%, ** 5% and * 1% level of significance.

Contrary to conventional literature of adoption that suggests a positive relationship between technology adoption and credit access (Mohamed and Temu, 2008; Mwangi and Kariuki, 2015), the results from this study showed a negative and significant relationship (at 5% level of significance) between intensity of adoption and household access to credit. Households that had accessed credit in the past 12 months were less likely to increase the proportion of camels in their herds compared to their counterparts who had not received credit. Precisely, access to credit led to a 0.122 percentage point decrease in change in adoption intensity for households that accessed credit compared to those that did not. It should also be noted that households that had experienced a feeling of food insecurity were significantly (at 1% level of significance) less likely to increase camel intensity in their herds. Feeling of food insecurity was associated with a 0.218 percentage point decrease in change in intensity of adoption for households that experienced it as compared to those that did not experience it. This suggests that households' acquisition of credit was not for investment but rather smoothing of consumption or short-term response to shocks. In this case, households solve their pressing needs (food shortage for example) using the credit obtained rather than using it for increasing camels in the herd even if they wanted until their immediate needs are satisfied.

Similarly, household size presents a negative and significant effect on intensity of adoption (at 5% significance level) indicating that increasing household size reduced the intensity of adoption among adopting households. Following a small increase in household size, change in adoption intensity reduced by 0.01 percentage points holding other factors constant. Increase in household size implies increased expenditures on household needs such as food, healthcare and education, this may reduce the saving propensity of the household. This reduces the ability of acquiring relatively expensive assets such as camels, even though the labor to attend to them may be available.

The coefficient on crop area cultivated is negative and significant at 10% level of significance. A small increase in acreage cultivated decreased the change in adoption intensity by 0.009 percentage points holding other factors constant. Crop cultivation is likely to discourage sedentary lifestyles and encourage settlement. So does the rearing of camels. Increasing intensity of camel adoption and crop area cultivated should have complementary effect on each other in encouraging settlement of pastoral households. However, these two could potentially compete for the same resource-mainly labour. As the household indulges more in crop cultivation, the intensity of camel adoption goes down. This implies that there is a competitive relationship between the two enterprises. In addition to labour competition, the two enterprises demand completely different managerial experience that may not be equally available from a single manager. Therefore, pastoralists find themselves with some sort of tradeoff decision to make, that is to master livestock at the expense of crop production or otherwise.

Conclusion

This study used cross sectional data from 116 households residing in Karamoja sub-region in Uganda to examine the factors influencing household intensity of camel adoption in Karamoja sub-region in Uganda. The study captured the intensity of camel adoption as the proportion of TLUs of camels in a household to the total livestock TLUs. Descriptive statistics show that adopting and non-adopting households were generally comparable with respect to most of the attributes except per capita income, income from the farm sector, tropical livestock units (TLUs), and age of the household head. Econometric results show that increase in age of the household head and the households living in Moroto increased intensity of adoption whereas household size, credit access, household's experience of food insecurity and crop area cultivated decreased intensity of adoption.

Recommendations

The study recommends introduction of on-farm productivity enhancing technologies for cultivated crops ox drawn ploughs, planters and weeders for commonly grown crops like beans to reduce time spent in crop cultivation and release time for other activities. This would allow balancing time for both crop cultivation and tending to livestock without increasing the negative impact of crop area expansion on intensity of camel adoption. The improvement of the productivity is through designing and introducing technologies that increase complementarity relationships between livestock and crop production while also enhancing household resilience to droughts. The study further recommends improvement of livestock markets to leverage full benefits from camels. With increasing intensity, it is important that surplus farm production finds its way into the markets so as to make significant contribution to household income

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