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The Role of Pastoralists' Indigenous Knowledge and Practices in Reducing Household Food Insecurity in West Pokot, Kenya: A Binary Probit Analysis

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In recent decades, researchers and development practitioners have explored strategies to manage shocks and reduce food insecurity in the arid and semi-arid lands (ASALs) especially through introduction of modern scientific approaches and interventions; for instance promotion of exotic livestock breeds, but these interventions have not yielded desired results. This has been attributed to the fact that most of these interventions ignore pastoralists' own indigenous knowledge and practices and thus tend to have low acceptability. Recognizing the need for context-specific locally-acceptable and adaptable solutions to pastoralists' challenges, the present study assessed the role of indigenous knowledge and practices in reducing food insecurity in pastoralists' households in West Pokot County, Kenya. Data was collected from arid and semi arid locations. A focus group discussion, key informant interviews and individual surveys on 191 households were conducted. Results demonstrate the value attached to traditional customs, guided migratory patterns and sustainable human-environment interactions in adapting to the harsh environment and mitigating food insecurity. Results from a binary probit regression analysis showed that seasonal transhumant migration, traditional pasture conservation and planting indigenous drought tolerant crops have a significant effect in reducing household food insecurity. The findings point to the need for documentation of indigenous knowledge and practices and their integration in long-term programs and plans aimed at building resilience in pastoralist systems.

Key words: Pastoralists, indigenous knowledge, local practices, food security.

INTRODUCTION

Indigenous knowledge (IK) is the insight possesed by local people that enables them to make a living in a given environment (Dinucci and Fre, 2003; Ghorbani et al., 2013; Abate, 2016a). This knowledge is well adapted to the requirements of local people and conditions. Moreover, IK is typically owned by indigineous peolple who are defined as people whose social, cultural and economic conditions makes them stand out from other

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sections of the national community (Emery, 2000). The IK is unique to a partcular culture and society. It regulates customs, traditions, and local decision making in agriculture and resource management. The IK is different from formal knowledge generated by research institutions or private firms. Formal knowledge is written and easily shared across people, cultures and generations, while IK is tacit and engrafted in practices and experiences (Emery, 2000; Oba, 2009). It is worthwhile to note that IK is more experiental than theoretical and is learnt through repetition. Moreover, IK is exchanged orally by demonstration through apprentices, parents to children or neighbor to neighbor. This is only possible where both the provider of IK and the recipient speak similar language and share cultural practices than across cultures.

Over the last few decades, there has been a noted erosion of IK and practices among many indigenous communities (Oba, 2009). It has been perceived that IK is old fashioned and archaic and for many years, it has been disregarded by many practitioners. However, recent studies have shown that IK in most communities is innovative and actually help in reducing and mitigating risks. The practices are creative and incorporate external influence with inside innovations and thus are always dynamic. There is therefore a need to preserve IK, its valuable skills and problem-solving strategies along modern technologies. This requires a clear understanding of the critical role that IK plays in the overall process of sustainable development (Gorjestani, 2004). Sharing IK within and across communities enables development planners to learn the local conditions of the people they work with and this enables design of context-relevant, locally acceptable and adaptable solutions to existing challenges (Emery, 2000; Oba 2009).

Pastoralists are stewards of and users of IK and practices, through which they are able to make a living in the harsh arid and semi-arid lands (ASALs) that characterize many parts of the developing countries. IK enables pastoralists to cope with shocks such as droughts and livestock diseases and thus manage transitory and chronic food insecurity. Understanding IK is therefore a pedestal for researchers and extension workers to find best solutions that are readily acceptable to bolster pastoralists own efforts to make a living.

However, recent occurences of droughts and other related shocks such as livestock diseases and inter-community conflicts undermine pastoralists' resilience to food security. Previous studies highlight the need of integrating IK with scientific knowledge in development of a common understanding of pastoralists' livelihoods (Angassa and Oba, 2007; Abate, 2016b). Mutual understanding between local communities and external practitioners will go along way in identifying best development solutions and innovations to adress challenges such as food insecurity.

The Food and Agriculture Organization of the United Nations (FAO) defines a status of food security to be existing when all people at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs. There are four important components of food securty: availability, access, stability and utilization. Food availabilty is determined by food production and stock level. Access to food is determined by disposable income and food prices. Stability is determined by weather, political and economic conditions. Utilization is determined by dietary diversity, energy and nuitrent intake. Failure to meet food and dietray requirements leads to a situation of food insecurity.

Because of heavy reliance on livestock to meet food and income needs, shocks such as drought and livestock diseases increase pastoralists vulnerability to food insecurity (Opiyo et al., 2014; Ngigi et al., 2015). Many pastoralist communities are characterized by chronic food insecurity (Alinovi et al., 2010). Many studies have focussed on the role of IK in pastoralists' rangeland management (Mapinduzi et al., 2003; Oba, 2009, 2012; Selemani et al., 2012; Abate, 2016a). Dinnucci and Fre (2003) focussed on the role of IK in livestock management among pastoralists in Eritrea. There is a striking knowledge gap regarding the role of IK on reducing household food insecurity among the pastoralists communities. The present study bridges this gap by documenting the IK and quantifying the effects of these practices on households' food insecurity among pastoralists in the marginal ASALs of West Pokot County in Kenya.

MATERIALS AND METHODS

Study area

The study was carried out in West Pokot County, Kenya (Figure 1). It covers an area of 9,169.4 km^2 with an estimated population of 512,690 persons according to most recent national census of 2009. Rainfall varies from 400 to 1,500 mm per annum, while temperatures range from 10 to 30°C. Communities in West Pokot County practice agro-pastoralism, combining mixed farming with nomadic pastoralism with over 90% of the population in the county depend on pastoralism for their livelihoods; mainly agro-pastoralism and nomadic pastoralism. The county indices on poverty, literacy, illiteracy and gender inequality are above the national's average and way beyond the recommended. For example, the food poverty index is nearly 70%, illiteracy is 60% and infant mortality is almost 13% (County Integrated Development Plan, CIDP, 2013).

Focus group discussion

A focus group discussion (FGD) comprising of 20 participants, 15 key informant interviews and individual surveys on 191 households were conducted to collect data. Most of the participants in the FGD were pastoralists with over 20 years of experience. They shared their perspectives on IK for the last 3 to 4 decades. Few youth pastoralists and an officer from the county extension department also attended the FGD to share insights on various aspects. From

Figure 1. Map of West Pokot County showing different livelihood zones.
Source: County Integrated Development Plan (2013).

the focus group discussion and key informant interviews, 15 indigenous practices were identified as having great potential in reducing household food insecurity. These are planned transhumance migration, enclosing grazing land, rotational grazing, post harvest use of crop fields for grazing, night grazing during dry seasons, traditional pasture conservation, use of browse trees as human and livestock food, use of herbs for ethno veterinary treatise, use of naturally occurring salt, traditional bee keeping, planting drought tolerant indigenous crops, herd management practices such as herd splitting, increasing herd size in rainy seasons, altering herd composition of grazers and browsers depending on pasture availability and stocking female dominated herds.

Sampling and household survey

Household survey data was collected from 191 respondents. Sampling was purposively done to capture the arid and semi arid locations to enable a livelihood comparison between the two areas within West Pokot, Kenya. The villages and households within the locations were randomly selected for study. A total of 19 sublocations were studied across the locations. These were Asilong, Chepareria, Chepkopegh, Kacheliba, Kipkomo, Kitelakapel, Kolopot, Kongelai, Korrelach, Lateg, Nakuyen, Orolwo, Pertum, Riwo, SLA, Suam and Ywalateke. The sample size of 191 follows the used in related previous studies such as Selemani et al. (2012); Ghorbani et al. (2013) and Ngigi et al. (2015). This is a better sampling method in situations where it is impossible to carry out a population census or use a formula to get a sample from the entire population because the population size is unclear, for instance due to persistent migration of pastoralists (Israel, 1992). Only household heads or their spouses or household members over 18 years old who had lived in the household for at least 1 year and were familiar with the daily household activities interviewed during the survey. Data was collected through face-to-face interviews using semi-structured questionnaires.

Data analysis

The induced innovation theoretical framework

This study is anchored on the theory of induced innovation (Hayami

and Ruttan, 1971; Rodima-Taylor et al., 2012), which hypothesizes that changes in agricultural conditions necessitate innovations meant to cushion individuals from the effects of these changes. In the pastoralists context, different forms of IK and practices are the key innovations that are borne out of the necessity to manage the recurrent and/or unpredictable climatic factors such as prolonged periods of drought, erratic rainfall patterns and non-climatic factors such as livestock diseases, human settlement on transhumant paths and even institutional factors such as policies advocating for sedentarization. Recent studies (Carter, 2009; Chhetri, 2011) have explored the role of public action through research funding on innovation systems. In the present study, emphasis is laid on the role of IK as an innovation in reducing household food insecurity.

Binary probit model estimation

In order to understand the association between indigenous practices and household's food security, a binary probit was estimated. Aspects of food security such as expenditure on food, average meals per day, number of months in a year that the household was unable to meet its food requirements and the duration of the period of lacking food were used to ascertain if the household is food secure or not. This dummy variable is treated as the dependent variable in the Probit model, where $y = 1$ measures the household's inability to meet food requirements, 0 otherwise. *Y* is a continuous latent variable that is rationally bounded between 0 and 1. In practice, the probability that a household is food insecure cannot be observed; rather, the actual outcome of households being food insecure or not can only be observed. Using the observed variables of indigenous practices, the probability of a household being food insecure was estimated by solving the model:

$$y^* = \beta_1 + \beta_2 x_2 + \cdots \beta_k x_k + \epsilon \quad (1)$$

In Equation 1, x_i is a vector of the observed variables explaining the latent variable and ϵ is the unobserved component of the latent variable. The Probit model assumes that ϵ follows a standard normal distribution (Train, 2009).

The probability of a household being food insecure, $y = 1$ is derived as follows:

$$\Pr(y = 1 \text{ given } x) = \Pr(y^* > 0 \text{ given } x)$$
$$= \Pr(x\beta + \epsilon > 0 \text{ given } x$$
$$= \Pr(\epsilon > -x\beta$$
$$= 1 - N\left(-\frac{x\beta}{\sigma}\right) \text{ (Integrate) } \sigma = 1 \text{ following standard normal distribution.}$$
$$= \Phi(x\beta) \quad (2)$$

The Probit model allows for correlated observations that explain the latent variable (Train, 2009). This provision relaxes the condition of independence from irrelevant alternatives of the logit model and thus, provides a better approach for this analysis since many indigenous practices are correlated with one another. The observed components x_i in this paper are the indigenous practices of a household. The variables are hypothesized to have negative coefficients, implying that practicing these activities is expected to reduce household's probability of being food insecure.

RESULTS AND DISCUSSION

Demographic characteristics of the respondents

As shown in Table 1, in this study, most (82%) of the respondents were male. The average experience in pastoralism livestock production is 13 years. The mean tropical livestock unit (TLU) in this study is 12.48 indicating the importance of a high livestock number to pastoralists as they serve as a measure of wealth and offset losses in the event of droughts and diseases (WISP, 2010; Dinucci and Fre, 2003).

The mean number of years of schooling is 5 years implying most of the household heads did not complete primary school education. The household mean annual per capita income is slightly over Kshs 19,000. This implies that most pastoralist households live below the minimum threshold of two and a half dollars per day. The mean dependency ratio is slightly above 0.5. This means the few household members working have to cater for the needs of the rest of the household members. As in the county development plan (CIDP, 2013) over 70% of the population are poor and cannot meet their basic food and income needs. This implies negatively on other development indicators too for instance infant mortality is about 13% and literacy level slightly above 50% against the nation's average 5 and 60%, respectively (CIDP, 2013). This necessitates the urgency for beneficial complementary and sustainable interventions to reverse this trend.

Land in the arid areas is mostly communally owned with only about 10% of the respondents having private ownership as compared to over 60% of respondents in the semi-arid area who even have proof of land ownership. Over 80% of the respondents from arid areas had access to communally shared pasture grounds compared to less than 10% from the semi-arid lands. This shows that pastoralism in the semi arid area is more sedentary than in the arid areas. These findings concur with Geutjes and Knutsson (2014) who attribute this sedentarization to private land ownership in the semi arid region. The average return transhumant distance moved is 36.82 km. Respondents from the arid region moved the most with an average of about 60 km compared to about 10 km by those in the semi arid areas. Turner et al. (2014) noted that pastoralists can move up to an average of 50 km in transhumance. This enables them explore new water and pasture grounds.

Exposure to shocks

Pastoralists across the world face many shocks in their domain, especially recurrent droughts and livestock diseases, which result to quality deteroriation and even death of livestock leading to loss of pastoralists income (Little and Macpeak, 2014; Ngigi et al., 2015). Figure 2

Table 1. Household characteristics.

Household characteristics	Frequency/Mean (n= 191)	Standard deviation
Respondents from arid locations (%)	54.5	-
Gender (% male)	81.7	-
Age (mean)	46.3	10.89
Years of schooling of household head (mean)	5.1	4.30
Number of household members (mean)	7.4	2.36
Household total annual income (mean Kshs)	139143.9	136205.00
Per capita annual income (mean Kshs)	19290.4	17033.23
Dependency ratio	0.5779	0.1240
Years in livestock production (mean)	13.9	9.48
Land size (mean acres)	3.8	3.70
Land allocated to livestock (mean acres)	1.3	0.96
Tropical Livestock Unit* owned by the household (mean)	12.5	10.44
Households accessing communally owned pasture grounds	52.4	-
Transhumance distance moved (mean return kilometers)	36.8	15.43

*Tropical Livestock Units computed as: cattle=1, camels=1, donkeys=0.8, goats and sheep=0.2 and poultry= 0.04 (World Initiative for Sustainable Pastoralism, WISP, 2010). Kshs 100 were equivalent to USD$1 at the time of the survey.
Source: Survey Data (2017).

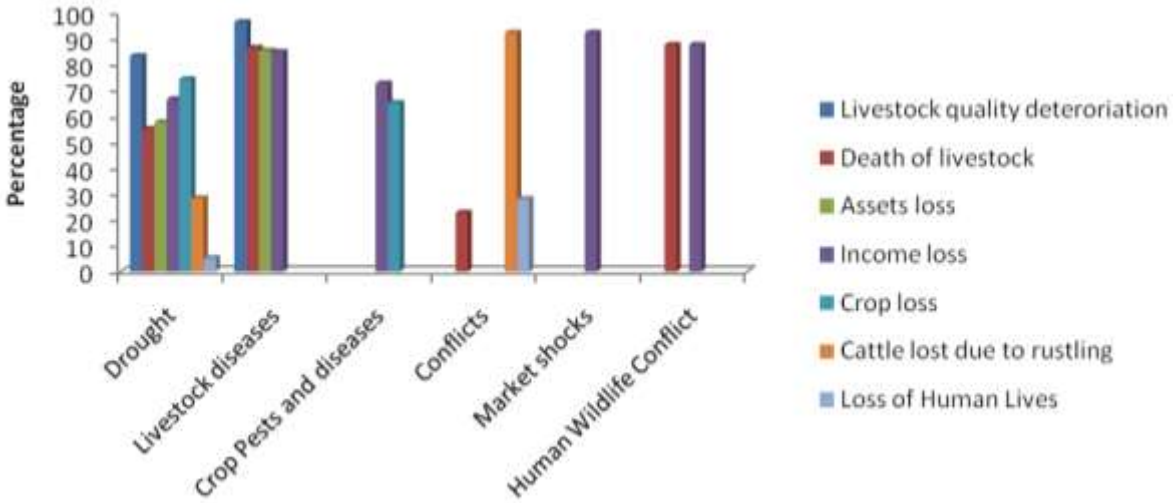

Figure 2. Households' exposure to shocks and their Effects.
Source: Survey Data (2017).

shows the different shocks that the respondents were exposed to and their effects on livelihoods in West Pokot.

Some shocks occur concurrently. It was noted during the FGD and key informant interviews that during drought occurences, many livestock caretakers migrate across the defined transhumant paths. This migration sometimes results to increased incidences of conflicts with other pastoral communities, cattle rustling and even loss of human lives. Livestock pick up diseases in the shared pasture grounds and the most common disease cited was foot and mouth disease (locally known as *ngorion*). The shocks also have multiple effects on the households for example besides livestock loss during drought, households reported crops loss due to lack of rainfall.

Households cope with these immediate shocks differently. Relatively well-endowed households utilize their savings and sell part of their assets (80 and 60%, respectively) to smoothen their consumption patterns. On the contrary, the less endowed households often have to borrow from relatives and friends, send part of their family members to stay with other relatives or depend on aid from government and other humanitarian organizations (58, 36 and 35%, respectively). How households cope with shocks is critical in the attainment of food security.

Table 2. Indigenous knowledge and practices among the pastoralists' community in West Pokot, Kenya.

Indigenous knowledge and practices	Proportion of respondents adopting the practice (%)		
	Arid area (n=104)	Semi arid area (n=87)	Pooled sample (n=191)
Planned transhumance migration	82.0	10.0	49.2
Herd splitting	75.0	22.0	50.8
Increasing herd size during rainy seasons	68.0	51.0	60.2
Altering grazers and browsers composition	100.0	82.0	91.6
Stocking female dominated herds	99.0	93.0	96.3
Night grazing	90.0	20.0	58.1
Traditional pasture conservation	23.0	66.0	42.4
Use of browse trees	100.0	83.0	92.1
Use of wild herbs to treat livestock diseases	94.0	83.0	89.5
Post harvest use of fields	86.0	96.0	90.6
Planting drought tolerant varieties	49.0	50.0	49.7
Use of natural occuring salt	93.0	68.0	81.7
Traditional bee keeping	34.0	10.0	22.5
Rotational grazing	84.0	71.0	78.0
Partitioning grazing land into enclosures	58.0	29.9	92.0

Source: Survey Data (2017).

Carter et al. (2005) noted that if a household's assets and income level fall below a minimum threshold after a shock, then they become entangled in a deprivation trap characterized by food insecurity.

Use of indigenous knowledge and practices to manage shocks

Table 2 shows the different indigenous practices used by pastoralist households to cope with the shocks in West Pokot. Differences in practice across arid and semi arid areas were tested and the results are also shown through the t-statistic measure.

Participants in the FGD, KII and household survey acknowledged that transhumant migration enables them to adapt to changing vegetation patterns in their environment. Herders take the livestock to the shared grazing area (*ka' tich)* before the onset of droughts and they return at the start of rains. Other studies such as Turner et al. (2014) and Abate (2016a,b) have shown that planned transhumant migration enables pastoralists escape shocks such as drought.

Splitting part of the herd into smaller groups and moving some of them to new areas prevent overgrazing calves and lactating cows are left as the other part of the herd is moved. This reduces competition for limited pasture resources and thus ensuring the in-calf, calves and lactating cows which can not walk long distances thrive. A similar observation was noted in a study of pastoralists' indigineous knowledge in Eritrea by Dinucci and Fre (2003).

Regarding the herd composition, increasing herd size in wet seasons helps to cushion against losses during dry periods. Altering herd composition between grazers and browsers also allows pastoralists to make use of varying quality and amount of of vegetation available at different times (WISP, 2010; Abate, 2016a). During wet seasons, grass is plenty and thus they usually stock more of grazers (cows and sheep). In the dry seasons however, grass is scarce and thus browsers like goats and camels thrive well on available trees and shrubs than the grazers.

Female-dominated herds offset the long calving periods, a characteristic of the indigineous cattle and thus ensure stable milk production. This is because milk is an important part of the pastoralists' dietary requirement (Little et al., 2010; Farmer and Mwika, 2012). During drought seasons, herders graze their cattle at night to escape the intense heat at day time. The herders graze their livestock in groups so as to provide security to each other in the event of attacks by cattle raiders or even wild animals. During the day, both the livestock and herders rest under sheds close to water points. This limited movement during the day enables livestock to optimally utilize the little food available and thus survive in the wake of intense drought. Similarly, Butt (2010) noted that reduced livestock movement generally increases livestock productivity.

In seasons of surplus forage, pasture and crop residues, stover are conserved for use during the lean period. Harvested maize, millet and sorgum residues and grass is cut, dried and stored on top of trees and will be released in small amounts for livestock use until the wet season. As shown in Table 2, pastoralists from semi arid areas are more likely to conserve pastures since they

have incorporated crop production and thus have more crop residues to store. Also they are more sedentary and their transhumance movement; with an a average return distance of 10 kilometres compared to 50 km for their counterparts in the arid areas.

Agro-pastoralists make good use of their farms after harvesting crops. Livestock are allowed to graze and feed on the crop residues. At the sime time, livestock drop dung as they graze, which is useful in enhancing soil fertility. Pastoralists who do not grow any crops make arrangements with those who do, sometimes as far as in the neighbouring Trans Nzoia county. The farmers allow the pastoralists to graze catle on their farm in exchange of milk or a goat as a gift. This was similarly noted by Dinucci and Fre (2003).

Older key informants and participants in the FGD recalled that in the previous years, drought tolerant crops such as traditional sorghum, millet and cassava varieties were mostly grown. But, with increased demand for maize and its products, many farmers have abandoned the traditional drought tolerant crops for maize. The yileds are low; the respondents recorded an average of 4 bags per acre in the arid areas and 8 bags in the semi arid areas. Such low harvest cannot sustain an average household untill the next harvest season and thus many households who plant maize still cannot meet their annual food requirements. On the other hand, millet, sorghum and cassava thrive well despite the erratic rains and thus households planting them enhance their food security as well as cope with the vagaries of weather (Mulwa et al., 2015).

Natural salt sources *(ngeny')* are important especially to pastoralists in the arid areas. Livestock are taken at least once a week to *ngeny'* sources whose rocks are rich in minerals. Some respondents mentioned that this salt reduces livestock diarrhoea which is a symptom of many livestock diseases. However, most of them also reported that livestock pick up foot and mouth disease (*ngorion),* from this source and many have lost part of their herds in this process. Household who could not afford to buy livestock salt and relied on '*ngeny'* sources excusively were the most affected.

The practice of rotational grazing allows grass and forage to rejuvinate and prevent overgrazing and land degradation (Mureithi et al., 2010). Transhumance movement is key to rotational grazing (Turner et al., 2014). More sedentary households divide their grazing land into enclosures that animals are allowed to graze rotationally. Grass and other pasture species can be grown on these enclosures. This ensures there is enough livestock feed to last through subsequent seasons.

Traditional institutions govern the access and use of communal grazing lands *(ka'tich).* Grazers and browsers are separated at the shared grounds due to different feed requirements. Theft is not allowed. Herders violating any of these rules are penalised. A recent peace agreement between the Pokot and Karamoja of Uganda sharing a common grazing ground saw to it that for any livestock stolen, the herder responsible will have to return it back together with four others as a fine. This has greatly reduced conflict incidences among those two pastoral communities.

Pastoralists posses and use a wide array of ethno veterinary practices (Dinucci and Fre, 2003). They know herbs and trees that can be used to treat different livestock diseases. For example, the roots and leaves of some wild trees possesing ethno veterinary properties are given to cows that have still-births, premature births or abort their calves. This also reduces milk quality deteriaration and possible transmission of foodborne diseases such as Brucellosis to humans.

Honey is produced in traditional log hives that are hung under shady trees especilly along river banks and other quiet places. Bees have a preference for the traditional log hives made from indigineous trees (locally known as *mokong'wo* and *koral*). The logs from the trees are made hollow and the inside of the hollow log burnt. These indigenous trees produce an appealing smell when burnt that attracts bees to the hive. The hive is partioned into two compartments to separate the queen from worker bees thus keeping the honey clean. Honey is important in food preservation and treating wounds.

These practices have enabled pastoralists in West Pokot to continue thriving amidst shocks previously discussed. A binary probit model was fitted to estimate the effect of these practices on the probability of a household being food insecure. Individual household characteristics, dependency ratio, extension advice received from formal sources such as government and informal such as from farmer to farmer and access to credit was included in the analysis. This is because augmenting IK practices and formal knowledge can produce much more desirable results. The results in Table 3 show that indigenous practices have the potential of reducing food insecurity. Marginal effects are computed at means for continuous variables and a discrete change from 0 to 1 for dummy variables. Pseudo R^2 =0.7036 (p= 0.000). Wald Chi^2 (14) =79.96.

The null hypothesis of the Wald Test states that the indigenous practices are independent. The *p*- value (0.000) is highly significant and thus the null hypothesis is rejected since the practices are interdependent. This justifies the use of a probit regression which allows for interdependence amongst variables. The Heteroscedastic consistent estimation (HCE) was used to minimize standard errors in the estimation of the model.

Role of indigenous knowledge and practices in reducing household food insecurity

Pasture conservation, planting drought tolerant varieties, bee keeping all supported with extension advice have a significant effect in reducing household food insecurity.

Table 3. Effects of indigineous practices on household food insecurity.

Variable (Indigenous Knowledge and Practice)	Coefficient	Marginal Effects (dy/dx)
Constant	2.3988**(1.4517)	-
Age	-0.0117 (0.0147)	-0.0012
Gender (1- male, 0 Female)	-0.3114 (0.5422)	-0.3334
Years of schooling	-0.0513(0.0465)	-0.0055
Dependency Ratio	2.4230*(1.2523)	0.2602*
Credit access (1- Yes)	-0.8979*(0.4684)	-0.0964*
Access to extension services (1 - Yes)	-0.8709*(0.5151)	-0.0935*
Herd diversification (1- Yes)	0.9023 (0.8635)	0.9669
Pasture conservation (1- Yes)	-1.0907**(0.3889)	-0.1399**
Enclosing part of grazing land (1- Yes)	-0.5679 (0.4962)	-0.0609
Drought tolerant varieties (1 - Yes)	-1.3028**(0.4229)	-0.1399**
Natural salt (1 - Yes)	1.8230**(0.4435)	0.1957**
Use of wild herbs and browse trees	-1.8323**(0.5121)	-0.1968**
Planned transhumance migration	-0.2666(0.5589)	-0.0286
Bee keeping	-1.1466**(0.4962)	-0.1231**

Statistical significance levels:**5%, *10%; Robust Standard errors are shown in parentheses.
Source: Survey Data (2017).

Uses of wild herbs and browse trees for both food and ethno veterinary have the biggest effect on reducing household food insecurity in this study. The wild herbs and trees thrive well even during dry seasons and a famous tree locally known as *sokoria* provide leaves which are eaten by both humans and livestock. As a last resort, the wild herbs and trees provide food during drought season, enabling households grapple food insecurity.

Pasture conservation smoothens livestock feed availability during dry seasons. This enables livestock produce milk which is an important constitute of pastoral households' diet. Households planting drought tolerant crop varieties are assured of a harvest despite the erratic rains and thus enable them to reduce food insecurity. Honey produced through traditional bee keeping is used as food and medicine. With value addition and marketing support from various NGO's in the area, surplus honey is sold, raising households' income which is used to buy food, enabling households reduce the probability of being food insecure.

The most striking finding of this study was that many respondents who took their livestock to natural salt licks were affected by foot and mouth disease in the previous year. Losing their livestock to the contagious disease imply that their main food and livelihood source were lost and for some time, they were unable to meet their food and income needs. This explains the positive and significant effect on household food insecurity. Households having high dependency ratios rely on the few members who work to meet their food and income needs and in the event of any shock, they will not be able to meet their food needs and thus the positive and significant effect on food insecurity.

Institutional support in form of credit and extension services has a significant effect in reducing household food insecurity. Credit enables households undertake on and off farm investments that in turn raise incomes and increase food security. Extension advice augments local knowledge in good crop and livestock husbandry and thus leads to increased food productivity.

CONCLUSION AND POLICY IMPLICATIONS

This study concurs with previous studies which noted that pastoralists are indeed custodians of indigenous knowledge. Understanding IK enables the development of extension services aimed at pastoralists to their specific needs. Understanding and applying pastoralists' IK by practitioners is effective in reaching out to them because it is an important asset that they posses and use to make a living. Pastoralists value their own IK and this forms a blue print for interventionists to learn and appreciate pastoralists own coping mechanisms and thus contribute to the body of knowledge.

There is an increasing shift in attention in analyzing food security at the household level. This is because managing food access, availability, stability and utilization at a global, regional or national level may not necessarily translate into good nutritional status at the household level. This study has shown that these practices, *inter alia* have the potential of reducing food insecurity at the household level. Traditional pasture conservation, planting drought tolerant crop varieties, traditional bee keeping and use of wild herbs and browse trees

significantly reduce household food insecurity. This forms a basis for further research on how best these practices can be incorporated in development programmes. These findings call for the need to document IK and practices, lessons learnt and how it can be applied in other areas. This will ensure that these valuable practices are handed over to coming generations and thus reduce the threat of their extinction.

Planned transhumant migration enables pastoralists escape shocks and thus reduces the effect of these shocks on food security. There is need for more inclusive rather than exclusive rights on land to allow for this movement especially in the arid areas. Traditional institutions regarding access to and use of communally-owned land need to be strengthened by formal institutions. This includes recognition of communal land rights bestowed on communities. This can provide an incentive for pastoralists to manage communal land better. There is also need to address the issue of intellectual property rights to communities who are stewards of IK.

Provision of formal institutional support through provision of formal credit and extension advice is critical to enable pastoralists undertake viable on and off farm investments that can improve their livelihoods and reduce food insecurity. Formal education complements local skills and leads to better decision making. Formally trained members of the household can use their skills both on and off farm and this can help to reduce the dependency ratio and thus reduce food insecurity at the household level. All these combined with traditional knowledge can go a long way in addressing the issue of household food insecurity.

CONFLICT OF INTERESTS

The authors have not declared any conflict interests.

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REFERENCES

Abate T (2016a). Contribution of Indigenous Knowledge to Climate Change and Adaptation Response in Southern Ethiopia. J. Earth Sci. Clim. Change 7(377):2.

Abate T (2016b). Indigenous Ecological Knowledge and Pastoralist Perception on Rangeland Management and Degradation in Guji Zone of South Ethiopia. Consilience: J. Sustain. Dev. 15(1):192-218.

Angassa A, Oba G (2007). Relating long-term rainfall variability to cattle population dynamics in communal rangelands and a government ranch in southern Ethiopia. J. Agric. Syst. 94(3):715-725.

Butt B (2010). Seasonal space-time dynamics of cattle behavior and mobility among Maasai pastoralists in semi-arid Kenya. J. Arid Environ. 74(3):403-413.

Carter MR, Little PD, Mogues T, Negatu W, Ababa A (2005). The long-term impacts of short-term shocks: Poverty traps and environmental disasters in Ethiopia and Honduras. Basis Brief P. 28.

Carter MR (2009). Inducing innovation: risk instruments for solving the conundrum of rural finance. Population and natural resources. https://arefiles.ucdavis.edu/uploads/filer_public/2014/06/19/carter_afd_eudn_paper_rev.pdf

Chhetri N, Pashupati C, Puspa RT, Ram BY (2011). Institutional and technological innovation: Understanding agricultural adaptation to climate change in Nepal. Appl. Geogr. 33: 1-9

County Integrated Development Plan (CIDP) (2013). County Government of West Pokot. First county integrated development plan 2013 –2017. http://www.westpokot.go.ke/images/downloads/ CIDP final draft.pdf. Accessed 2nd May 2016

Dinucci A, Fre Z (2003). Understanding the indigenous knowledge and information systems of pastoralists in Eritrea. Communication for Development Case Study (FAO). 46pp.

Emery AR (2000). Integrating Indigenous Knowledge in Project Planning and Implementation. A partnership publication of the International Labor Organization, the World Bank, the Canadian Onternational Development Agency, and kivu nature.

Farmer E, Mbwika J (2012). End market analysis of Kenyan livestock and meat: a desk study. Project under USAID Rep. no. Micro REPORT 184.

Geutjes L, Knutsson P (2014). Coping with climate change variability in West Pokot, Kenya: The influences of land use on responses to climate variability by pastoralists and agro pastoralist communities in arid and semi arid areas of West Pokot Kenya. Master thesis in global studies, University of Gothenburg.

Ghorbani M, Azarnivand H, Mehrabi AA, Jafari M, Nayebi H, Seeland K (2013). The role of indigenous ecological knowledge in managing rangelands sustainably in northern Iran. J. Ecol. Soc. 18(2):15

Gorjestani N (2004). Indigenous knowledge for development. Protecting and promoting traditional knowledge: Systems, National Experiences AND International Dimensions P. 265.

Hayami Y, Ruttan VW (1971). Induced innovation and agricultural development. Staff Papers Series 71(1):3

Israel GD (1992). Sampling the Evidence of Extension Program Impact. Program Evaluation and Organizational Development, IFAS, University of Florida. PEOD-5. October.

Little PD, McPeak JG (2014). Resilience and pastoralism in Africa South of the Sahara. Resil. Food Nutr. Secur. P. 75.

Mapinduzi AL, Oba G, Weladji RB, Colman JE (2003). Use of indigenous ecological knowledge of the Maasai pastoralists for assessing rangeland biodiversity in Tanzania. Afr. J. Ecol. 41(4):329-336.

Mulwa C, Marenya P, Rahut D, Kassie M (2015). Response to Climate Risks among Smallholder Farmers in Malawi: A Multivariate Probit Assessment of the Role of Information, Household Demographics and Farm Characteristics. Adoption Pathways project discussion paper 3 February 2015.

Ngigi M, Mueller U, Birner R (2015). The role of livestock portfolios and group-based approaches for building resilience in the face of accelerating climate change: An asset-based panel data analysis from rural Kenya. Available at SSRN 2676574. ZEF- Discussion Papers on Development Policy No. 205, Center for Development Research, Bonn, October 2015.

Oba G (2009). Harnessing pastoralists' indigenous range management knowledge for droughtresilient livelihood systems in the Horn of Africa. Nairobi: International Union for Conservation of Nature and Natural Resources. http://www.fao.org/fileadmin/user_upload/drought/docs/Harnessing_Pastoralists_indigenous_Knowledge_Review%202009.pdf

Oba G (2012). Harnessing pastoralists' indigenous knowledge for rangeland management: three African case studies. Pastoralism:

Res. Policy Pract. 2(1):1.
Opiyo F, Wasonga OV, Nyangito MM (2014). Measuring household vulnerability to climate induced stresses in pastoral rangelands of Kenya: Implications for resilience programming. Pastoralism: Res. Policy Pract. 4:10.
Rodima-Taylor D, Olwig MF, Chhetri N (2012). Adaptation as innovation, innovation as adaptation: An institutional approach to climate change. Appl. Geogr. 33:107-111.
Selemani IS, Eik LO, Aring T, Mtengeti E, Mushi D (2012). The role of indigenous knowledge and perceptions of pastoral communities on traditional grazing management in north-western Tanzania. Afr. J. Agric. Res. 7(40):5537-5547.
Train KE (2009). Discrete choice methods with simulation. Cambridge university press pp. 100-130.
Turner MD, McPeak JG, Ayantunde A (2014). The role of livestock mobility in the livelihood strategies of rural peoples in semi-arid West Africa. Hum. Ecol. 42(2):231-247.
World Initiative for Sustainable Pastoralism (WISP) (2010). Building climate change resilience for African livestock in sub-Saharan Africa - World Initiative for Sustainable Pastoralism (WISP): a program of IUCN - The International Union for Conservation of Nature, Eastern and Southern Africa Regional Office, Nairobi, March 2010.