Q01 Factors Building Pastoralists Resilience to Shocks: Evidence from West Pokot County, Kenya.

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Abstract:

Most pastoralists' households are adversely affected by shocks such as droughts, livestock diseases and declining pasture availability. These shocks lead to deterioration of livestock quality and even mass death of herds. This leaves pastoralists households vulnerable as they derive most of their food and income needs from livestock, necessitating the need to build resilience to these shocks. Against this back drop, this study analyzed factors that build household resilience among the pastoralists of West Pokot County. The household resilience index was constructed using Principal Component Analysis, PCA. An ordered probit regression was used to analyze the effect of socio-demographic and institutional factors on households' resilience. It was noted that years of schooling, household income, access to credit and extension and livestock management practices such as post harvest use of field crops for grazing, enclosures, stocking improved breeds, bee keeping, ethno-veterinary practices and afforestation have a positive and significant effect in building household resilience to shocks. There is therefore the need to direct investment to bolster pastoralists own efforts in this regard to realize the attainment of more resilient households. Key words: Shocks, Vulnerability, Resilience, Pastoralists

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JEL Codes: O13, R28

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Introduction

Resilience is defined as the capacity of a system to absorb disturbance and reorganize while undergoing change so as to retain essentially the same function, structure and feedbacks, and therefore identity, that is, the capacity to change while maintaining the same identity (Walker et al., 2004; Folke, 2006; Bene et al., 2012). Building resilience especially to climate related shocks is an important trajectory in achieving sustainable livelihoods as espoused in UNDP sustainable development goal 13.

Resilient households cope with and recover from shocks and stresses while maintaining and enhancing its capabilities and assets and provide opportunities for the next generation. This is achieved by a household having enough buffers against contingencies such as drought, crop failure, famine, sickness or social demands (Ellis, 2000). As a result, these households are less affected and are able to recover fast from the adverse effects of shocks such as drought or livestock diseases.

Pastoralism is the main livelihood activity in most arid and semi arid lands (ASAL's) of Sub Saharan Africa, SSA (WISP, 2010; IIR and CTA, 2013). Many ASAL's experience challenges that undermine pastoralists' resilience. One major change is the loss of grazing land as a result of urbanization and population growth. This has resulted in land degradation due to overgrazing and heightened conflicts with other communities over access rights to the little remaining grazing parcels (Verdoodt et al., 2010; Little and McPeak, 2014). The bleak situation is worsened by the negative effects of climate-change induced shocks such as droughts. With limited access to water and pasture, many pastoralists lose part of their herds during drought periods (WISP, 2010; IIR and CTA, 2013). Loss of livestock which is the main source of food and income plunges households down the vulnerability path and consequently, it may take a long time to recover and 'bounce back' to normal *ex ante* conditions.

Many studies have shown that compared to other livelihood groups, pastoralists are less resilient (Alinovi et al., 2010; Tesso et al., 2012; Opiyo et al., 2014; Ngigi et al., 2015). These studies document pastoralists' exposure to shocks and their vulnerability thereof. There is limited empirical evidence on what makes some households more resilient than others. This study therefore contributes to the body of knowledge by assessing factors that build resilience in West Pokot County, Kenya. Most of the area in the county falls within ASAL's and pastoralism is the main economic activity, supporting over 90% of the population. The county has low indices of income and food security which increases vulnerability in the event of shocks and thus concerted efforts from all stakeholders is required to build resilience (County Integrated Development Plan, CIDP, 2013).

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 about 600000 persons according to most recent national census of 2009. Rainfall varies from 400mm to 1,500mm per annum, while temperatures range from 10 °C 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.

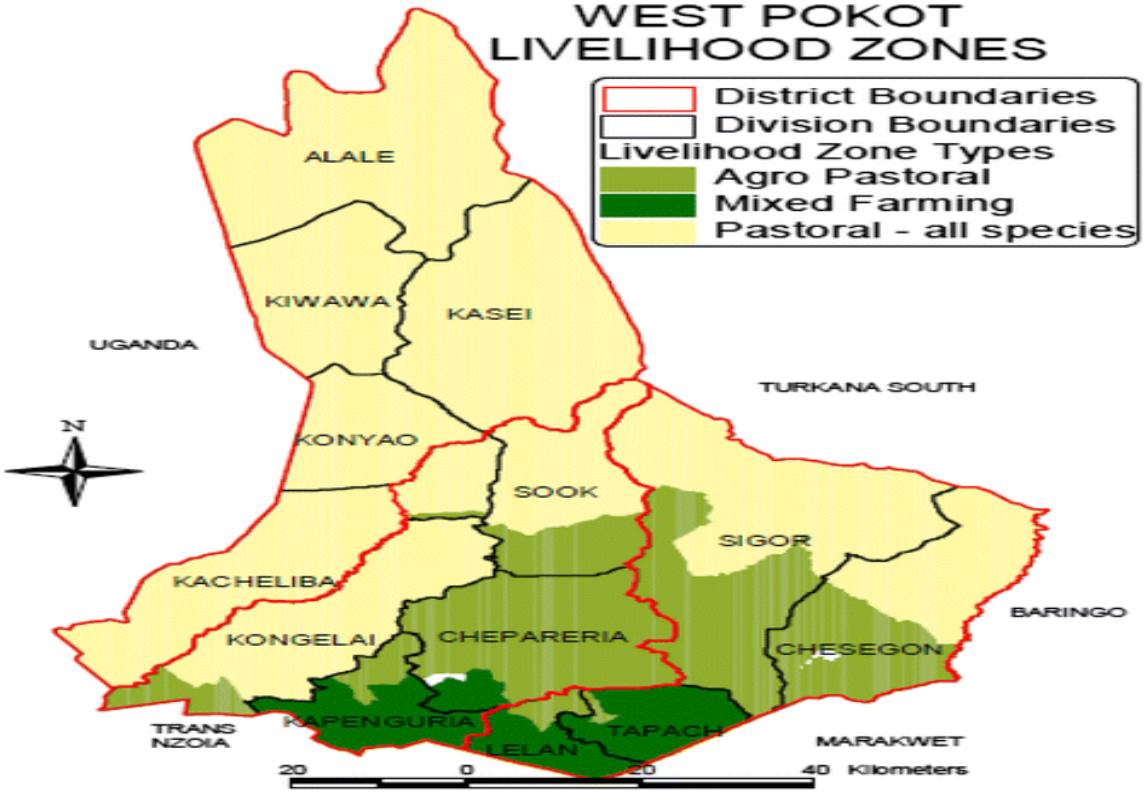

Figure 1: Map of West Pokot County showing different livelihood zones

Source: County Integrated Development Plan (2013).

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 that used in related previous studies

such as Tesso et al., 2012; Ghorbani et al., 2013 and; Ngigi et al., 2015.This method is applicable 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 were interviewed during the survey. Data was collected through face-to-face interviews using semi-structured questionnaires.

Data Analysis

Following Resilience Index Measurement and Analysis (RIMA) by the Food and Agriculture Organization FAO (Giuseppe et al.,2016), resilience was measured in terms of income and food access (IFA), assets- Agricultural and non Agricultural Assets (ANA), access to basic services (ABS), agricultural production technology (APT), social safety nets (SSN), economic activity (EC) and adaptive capacity (AC). This can be expressed as:

R= *f* (IFA, ABS, ANA, APT, SSN, EC, AC) ……..…....i

Principal Component Analysis (PCA) was used to generate indexes of each household. PCA is a common tool used by previous studies to generate the weights for the variables used in resilience index construction (Keil et al., 2008; Tesso et al., 2012; Opiyo et al., 2014; Browne et al., 2015). The chosen variables should be in keeping with the assumptions of PCA that variables should have at least an interval level of measurement and should be linearly related to one another. The Bartlett's test of sphericity and Kaiser-Meyer Olkin (KMO) measure of sampling adequacy were used to test variables' suitability for PCA. The scores generated using PCA were used to determine the indicator weights for the variables. Once the indicator weights have been estimated and the index of resilience constructed, the index is applied to the individual households and a score for each household is calculated using the formula below:

$$Aj = f1 \times (aj1 - a1) / (s1) + ... + fN \times (ajN - aN) / (sN) \quad \text{ii}$$

where Aj is the resilience score for household j, $f1$ is the component loading generated by PCA for the first variable, $aj1$ is the jth households value for the first variable, and $a1$ and $s1$ are the mean and standard deviation, respectively, of the first variable over all the households (Browne et al., 2014).

This can be summarized as; $R = \sum_j w_j F_j$ ……iii

where the resilience index is a weighted sum of the factors.

To assess the factors that affect household resilience, an ordered probit with three levels of resilience, 1 being least and 3 most resilience was employed after the indices were computed.
The ordered probit is derived from the latent variable model

$y^* = \beta_1 + \beta_2 x_2 + \cdots \beta_k x_k + \epsilon$ iv

Equation ii can be reduced to equation iii below:

$= x_i \beta + \epsilon$……..…v

Where ϵ is an error term, which follows standard normal distribution, with a normalized variance equal to one.

$\epsilon\ N\ (0,1)$

……..vi

The model does not contain a constant. The model defines *J* threshold parameters, α whereby α1< α2<….. α *j*

The latent variable $y^*$is not observable but we can observe the resilience categories according to the following:

$y = 1\ if\ \alpha_1 < y* \leq \alpha_2$

$y = 2\ if\ \alpha_2 < y* \leq \alpha_3$

$y = J\ if\ \alpha_j < y*$ ……..……vii

Results and Discussion

Table 1 below shows the Factor Loadings of the variables used in PCA to compute the household resilience index.

Table 1: Factor Loadings of Variables used in PCA

Variable	Factor score
Income	
Log of total income (Farm and off farm income)	0.3767
Food security	
Months that the household was unable to meet food requirements.	-0.3363
Assets	
Log of value of farm implements	0.3370
Log of value of tropical livestock units	0.2879
Log of value of land	0.3362
Access to basic services – Health	
Health expenditure	0.3084
Agricultural Practice and Technology	
Better farming practices- afforestation, terracing, enclosures	0.3213
Adaptive Capacity	
Dependency ratio	-0.2378
Proportion of losses incurred during shocks to total income	-0.3142
Increase savings to cushion against shocks	0.2863
Chi square = 1110.236, Degrees of Freedom= 45, *P- value* =0.000 H_0 – Variables are not intercorrelated Kaiser-Meyer Olkin, KMO measure of sampling adequacy = 0.908	

Source: Field Survey Data, (2017)

The Bartlett's score of Sphericity has a *p-value* of 0.000 which is highly significant at 5%. Thus the null hypothesis is rejected since the variables are inter correlated and this justifies the use of PCA. The KMO statistic is above the recommended minimum of 0.70 and thus unbiased inference can be drawn from the indices constructed using these variables.

In this analysis, income had the most impact in building resilience. It comprises of income derived from selling livestock, other farm products and income from formal and informal employment. A diverse income cushions household against drought related shocks. It is also a blueprint for other resilience indicators since cash income can be converted into assets. Income also enables households' access basic services such as healthcare and food, all which explain resilience (Ciani and Romano, 2013).

Food security in this study was explained by the number of months in a year that the household could not meet its' annual food requirement. Over 53% of the respondents could not meet their annual food

requirements. Over 50% cited that poor harvest and 45.7% attributed it to high food prices. The average number of meals per day was 1.5. Other studies (Alinovi et al., 2010, Ciani and Romano, 2013) used number of meals and expenditure on food to explain food security. However, these indicators vary across households, for example, a household having most of its food and livestock on the farm may have a lower expenditure for food items but may not necessarily mean that it is not food secure. To overcomes this obstacle, this study analyzed the number of months in a year a household is unable to meet its food requirement over the last 12 months. As expected, more months of food insecurity makes a household less resilient and this explains the negative factor coefficient.

Assets are a key element of a livelihood. They give a household the opportunity to have something to build an activity upon. By employing assets, households raise both their on and off farm incomes (FAO, 2016). This in turn, has a positive outcome on the households' resilience. As expected from other studies (Alinovi et al., 2010, Ciani and Romano, 2013) the assets used in this analysis, value of farm implements, value of land and value of the tropical livestock units have positive factor values on the resilience index (0.3370, 0.3362 and 0.2879 respectively). Unlike previous studies, this study incorporated tropical livestock units because of the importance livestock plays in pastoralists' households.

Access to basic services such as health, schools, and extension offices increases access to vital information and awareness creation in case of need. Isolated households are more vulnerable to shocks and are less likely to be accessed in times of need and because of this; these variables are treated as explanatory variables of resilience in this study. Health expenditure was used to compute factor variable for access to basic services. Health expenditure has a positive factor value implying that more resilient households spend more on health because they can travel to better equipped hospitals.

Agricultural adaptation and production technology is crucial as it enables farmers counter the effects of shocks in a system. In this analysis, a dummy variable of good farming practices was used to compute the factor score of 0.3231. The individual practices are treated as explanatory variables of resilience.

In this study, adaptive capacity was explained using dependency ratio, proportion of losses incurred during shocks and savings. Dependency ratio is the proportion of economically inactive to the total household population. A household with a high dependency ratio has few economically active members who have to meet the needs of all the other people in the household. This reduces savings and causes pressure on economic resources of a household. As expected, higher dependency ratios imply negatively on the household resilience index and that explains the negative factor score of -0.2378.

As in Carter et al. (2005), a household that looses most of its assets during a shock becomes more vulnerable to subsequent shocks. This may lead the household to be entangled in a poverty trap which requires lots of external interventions to get out. This explains the negative factor value of -0.3142 of value of income and assets lost during shocks in this analysis. Savings was a dummy variable captured as whether the household sets apart some income and assets to be used in the event of shocks. This has a positive effect on the household resilience index (factor value of 0.2863).

Income and monetary value of assets was taken in the logarithm form in order to reduce the range of variables and thus reduce outliers (Wooldridge, 2002). Following Giuseppe et al.,(2016), the resilience indices were re-scaled to lie between 0 and 1 for ease of analysis. The average household resilience index for the entire sample was found to be 0.4095. On a scale of 0 to 1, this is below average. Other studies also indicated pastoralists to have the lowest resilience scores compared to other livelihoods (Ciani and Romano, 2013; Alinovi et al, 2010). Figure 2 below shows the distribution of the household resilience index to shocks.

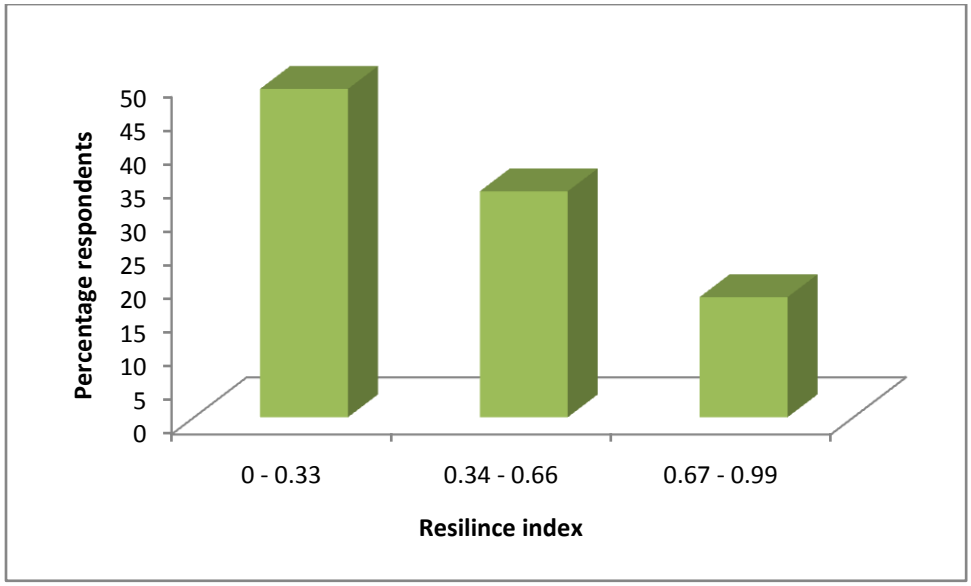

Figure 3: Resilience Index Distribution

Source: Field Survey Data, (2017)

Factors Influencing Household Resilience

Table 3 below show the results from the ordered probit regression

Variable	Coefficient	Marginal Effects		
		Prob (Y=1)	Prob (Y=2)	Prob (Y=3)
Age	0.027 (0.127)	-0.001	-0.001	0.003
Gender (1= Male headed household)	-1.467** (0.681)	0.079**	0.064	-0.144**
Years of schooling of the household head	0.154**(0.067)	-0.008**	-0.006**	0.015**
Title ownership of land owned	0.783 (0.630)	-0.043	-0.034	0.077
Proportion of off farm income of total income	3.585**(1.298)	-0.195**	-0.157*	0.352**
Distance to water source	-0.005 (0.213)	0.0002	0.0002	-0.0005
Distance to the market	0.076 (0.066)	-0.0041	-0.0033	0.0074
Distance to the health centre	0.033 (0.032)	-0.0018	-0.0014	0.0032
Access to extension advice	3.512** (0.873)	-0.191**	-0.154*	0.345**
Access to credit	0.365**(0.160)	-0.019**	-0.016**	0.036**
Access to social safety support	-1.049*(0.584)	0.057	0.046	-0.103*
Participation in governance institutions	0.680 (0.582)	-0.037	-0.029	0.067
Livestock vaccination	0.780 (0.772)	-0.042	-0.034	0.077
Pasture conservation	0.313 (0.468)	-0.017	-0.013	0.031
Planting drought tolerant crop varieties	1.262 (0.155)	-0.069	-0.055	0.124
Post-harvest use of crop fields	2.531**(0.858)	-0.138**	-0.111	0.249
Ethno-veterinary treatment of livestock	1.404**(0.535)	-0.076**	-0.062**	0.138**
Enclosing grazing land	3.162**(0.838)	-0.172**	-0.138**	0.311**
Growing fruits and afforestation	0.659*(0.385)	-0.036*	-0.029	0.065*
Stocking improved livestock breeds	1.754**(0.505)	-0.095**	-0.077**	0.172**
Incorporating camels in the herd	0.522 (0.587)	-0.028	-0.22	0.051
Bee Keeping	0.762*(0.438)	-0.415*	-0.033	0.075
α_1 = 14.298(2.398); α_2 = 20.498 (2.947); Wald Chi-Square (22) = 79.55 Log Pseudo likelihood = -30.538 Pseudo R^2= 0.7256 Notes: Robust standard errors are in brackets ** P value significant at 5%, * P value significant at 10% Marginal effects were calculated as a discrete change from 0 to 1 for dummy variables and at means for continuous variables				

Source: Field Survey Data, (2017)

The demographic characteristics included in this study are age, gender, years of schooling of the household head and proportion of off farm income to total income, a proxy variable to off farm diversification. It was noted that household headed by older members were more resilient than those headed by younger counterparts. This could be attributed to the vast production experience they have accumulated over the years.

In this study, male-headed households were found to be less resilient compared to female-headed households. The probability of female-headed households having a resilience index ranging between 0.67 - 0.99 is 14.4%. This is unlike previous studies (Opiyo et al., 2015; Tesso et al., 2012) that noted that

female-headed households are less resilient largely due to bias in resource allocation and decision making that leans towards males in most pastoral communities. IIR and CTA (2013) noted that there have been emerging trends in pastoralists' women such as increased demand in milk and poultry commodities which are largely managed by women, presenting an opportunity for women pastoralists to benefit.

Formal education augments local knowledge leading to better decisions and thus have a positive and significant effect on the household resilience recover fast. In this analysis, an increase in the number of years of schooling by 1 increases the probability of a household having an index ranging between 0.67 – 0.99 by 1.5%.

Livelihood diversification through of farm activities has a positive impact on household resilience. As noted by Ellis (2000), diversified livelihoods spread risks so that in the event of a shock from one activity, the others offset the effects of the shock making the household resilient. In this analysis, households augmenting farm income with off-farm income reduce the probability of having a resilience index ranging 0 – 0.33 by 19.5%, 0.34 to 0.66 by 15.7% but increases the probability of a household having an index ranging between 0.67 – 0.99 by 35.2%.

Distance moved to households' water source had an overall negative effect on resilience. Herders moved an average of 32 kilometers during the dry season in search of water and pasture. Animals trekking such a long distance become weak and are less likely to gain weight and thus fetch low revenues when marketed (IIR and CTA, 2013). This movement predisposes pastoralists to other shocks such as conflicts with other communities and attack by wild animals thus further undermining their resilience.

In this study, resilient households sold to more distant markets. Distant markets included slaughter houses and institutions. Households selling to these markets need to meet the high quality and quantity requirements but in turn earn more revenues that contribute positively to their resilience (IIR and CTA, 2013). The most marketing channel used by pastoralists is the open air markets which are nearby, an average return distance of 10 kilometres.

Unlike previous studies on resilience whereby the distance to health had a negative effect on household resilience (Ciani and Romano, 2013), the present study found that distance had a positive effect on household resilience. As noted earlier, the health expenditure had a positive factor loading implying more resilient households spend more on health. This complements the findings herein that these households are in a better position to travel to better equipped hospitals that could be far away.

Institutional factors included in this analysis were, land tenure security, access to extension and credit services. Land tenure security influences the application of practices that build resilience such as

enclosing grazing land, conserving pasture, planting trees and growing fodder. Access to extension advice raises pastoralists' awareness on issues that affect pastoralists such as climate related shocks and land constraints and ways through which the shocks can be mitigated and thus have a positive effect on household resilience. Extension advice increases the probability of a household having an index ranging between 0.67 – 0.99 by 34.5%. Credit access helps in making available the capital needed to undertake investments and thus facilitate the application of innovative practices. In this analysis, a household accessing credit increases the probability of a household having an index ranging between 0.67 – 0.99 by 3.6%.

Social safety nets help cushion households in the event of shocks. Such include support from family, friends and relatives, group members, county and national government and non government organizations. In this analysis, social safety nets had a negative overall effect on household resilience unlike in other studies (Alinovi et al., 2010; Ciani and Romano, 2013). Most households received support from family, friends and relatives in form of cash and the most cited use of this cash was to buy food. This explains that these households are non resilient and need to smoothen their consumption by the support received.

Pastoralists' participation in governance institutions contributes positively on their resilience. This gives pastoralists an avenue where they can air their concerns and collaborate with other partners in prioritizing development projects that aim at building their resilience. This is important because for a long time pastoralists across many countries have been ignored by practitioners and other policy makers (Markakis, 2004). The most common governance institutions were those at the community level. This is because of their proximity and thus members are at ease to meet and interact with others.

Pasture and forage conservation helps to smoothen livestock feed availability. Feed availability helps to maintain the livestock's body condition, which when sold earn higher revenues thus stabilizing household income. Fluctuations in milk production is reduced with the available feed, which enhances food security at the household level and thus build resilience.

Post harvest use of crop fields for grazing helps to augment locally available livestock pasture and feed which can be scarce in supply especially during the dry season. Where crops are harvested are harvested at the onset of a sry season, livestock are allowed to feed on the crop residues. This is a short term strategy in solving pasture scarcity. Households doing so are more likely to have a higher index ranging 0.67 to 0.99 by 24.9%.

Drought tolerant crops such as millet, sorghum and cassava thrive well despite the erratic rains that the county receives and thus households planting them improve their food sufficiency. Maguza-Tembo et al. (2016) similarly noted that among other strategies, planting drought tolerant crop varieties in Malawi enabled farmers to cope up with the vagaries of weather. Also, surplus produce is sold thus earning the household income and thus contribute positively to the ovreall resilience.

Ethno-veterinary knowledge and practice play an important role in livestock treatise thus averting effects related to shocks due to livestock diseases.This is important since most pastoralists live far of modern veterinary and pharmaceuticals and may not have access to modern treatment (IIR and CTA, 2013). From this study , households employing etho veterinary practices increase the probability of having a resilience index ranging from 0.67 – 0.99 by 13.8%.

Vaccination is a disease preventive measure and reduces the likelihood of livestock disease outbreaks that usually results in mass death of livestock. This cushions pastoralists of the losses that they would incur and instead, build their resilience.

Enclosures are fenced establishments on grazing land that restricts grazing of animals for sometime to allow grass to rejuvinate. The animals are allowed to graze on different enclosures on a rotational basis. Grass and other pasture species can be grown on these enclosures. The Enclosures ensure that there is enough livestock feed to last through all seasons. The marginal effects show that enclosing grazing land increases the probability of a household having a resilience index ranging between 0.67 – 0.99 by 31.1%.

Improved livestock breeds that are suitable in the areea are more marketable as they take a shorter time to mature and their meat is more tender (IIR and CTA, 2013). Nearly 10% of the respondents stocked improved Sahiwal cattle breeds, 8% cross cattle breed, 15% dopper goat breed, 3% cross goat breed, 16% dopper sheep breed,and 3% cross sheep breed. The main challenge noted with these breeds is that unlike their indigenous counterparts, these are more susceptible to diseases and cannot move long distances. For those with these stocks, the study showed that they were more likely to have a higher resilience index ranging between 0.67 – 0.99 by 17.2%.

Most pastoralist communities are incorporating camels in their herds. Camels are more advantageous to cattle as they have a low mortality rate in the event of drought or diseases, can survive for long periods without water and food and can move longer distance (Kagunyu and Wanjohi, 2015). This is a viable intervention in the lowland ASALs where land is still communally managed and transhumant livestock rearing is more common.

Bee keeping is another viable intervention in the arid areas. Over 90% of the respondents keeping bees were from the arid areas. Honey produced is used as food and surplus quantities sold thus earning the households income that help in building their resilience. Bee keeping households increased their probability of having a resilience index ranging between 0.67 – 0.99 by 7.5%.

Afforestation and fruit growing contributes positively to resilience. Fodder trees grown supplement livestock feed thus enhancing milk productivity and quality livestock which when sold earn higher revenues. Fruits such as mangoes, consumed at the household level complement other diets leading to better nutrition, an important component of food security which in turn builds household resilience. Households planting trees and growing fruits increase their probability of having a higher resilience index between 0.67 – 0.99 by 6.5%.

Conclusion and Implications to Policy

Building pastoralists resilience to shocks is an important aspect in achieving sustainable livelihoods. The recent developments across many ASALs of SSA predispose pastoralists to shocks. Declining open pasture and water resources together with climate related shocks entangle pastoralists in the vulnerability trap.

Pastoralists' own efforts coupled with external support can help put them back to a more resilient pathway. This analysis has shown that livestock husbandry practices such as enclosing grazing land, pasture conservation, bee keeping and improving livestock breed, afforestation, coupled with external support in form of credit and extension services have a significant effect in building resilience.

This implies that resilience building is multifaceted and calls for partnership from different stakeholders to invest in programmes that build pastoralists resilience. This includes infrastructure development that will help link pastoralists to markets such as road networks and livestock holding grounds at the markets. It will also help improve pastoralists' access basic services such as water and healthcare.

Institutional support in the forms of credit and extension need to be strengthened in the pastoralists' area. Providers of such services need to put into consideration the uniqueness of pastoralists' livelihoods such as dependence on livestock for income and seasonal mobility. Considering this will help them design credit products and extension services that best suit the pastoralists. Formal credit can be embedded with livestock insurance to cushion both the lender and the pastoralists in the event of catastrophic loss of livestock. Extension programmes and campaigns such as livestock vaccination can be implemented during seasons when pastoralists are more likely to be settled so that many households can benefit.

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