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ANALYSIS OF ADAPTATION DIVERSITY TO CLIMATE VARIABILITY AND CHANGE AMONG PASTORAL COMMUNITIES IN NORTH-EASTERN UGANDA

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ABSTRACT

Adaptation framing remains one of the major challenges to achieving greater implementation of adaptation initiatives in Sub-Saharan Africa (SSA). Using an integrated analytical framework that frames adaptation indicators into three dimensions; adaptive, absorptive and transformative capacities, we analysed the adaptation diversity in Karamoja sub-region, Uganda. We found a strong perception of the existence of climate variability and change manifested through the occurrence of droughts, floods, hailstorms, late onset and early rainfall onset. Absorptive capacity revealed varied status of asset ownership, custodianships, and access to these assets, presence of informal social safety nets, and social cohesion. Adaptive capacity revealed the presence of a diversity of livelihood sources, livelihood assets and associated income, but its human capital indicator revealed considerably high illiteracy levels among respondents. Meanwhile, transformative capacity revealed existence of network structures, governance and institutions, facilitated access to early warning information on pests, diseases and rainfall onset. Traditional institutions and the justice system played a key role in conflict resolution, mediation and negotiation for kraals establishment, grazing, and watering rights. We conclude that pastoral communities in Karamoja have a high inclination to maintenance of stability while their flexibility and ability to change decreases with the intensity of change pro-rata.

Key Words: Absorptive, adaptive, conflict resolution, transformative

RÉSUMÉ

Le cadrage de l'adaptation reste l'un des défis majeurs pour parvenir à une plus grande mise en œuvre des initiatives d'adaptation en Afrique subsaharienne (ASS). En utilisant un cadre analytique intégré qui encadre les indicateurs d'adaptation en trois dimensions; capacités d'adaptation, d'absorption et

de transformation, nous avons analysé la diversité de l'adaptation dans la sous-région de Karamoja, en Ouganda. Nous avons trouvé une forte perception de l'existence de la variabilité et des changements climatiques qui se manifestent par la survenue de sécheresses, d'inondations, de tempêtes de grêle, d'apparition tardive et précoce des précipitations. La capacité d'absorption a révélé des statuts variés d' actifs de propriété, de la *protection* de ses *actifs* et d'accès à ces actifs, la présence des *réseaux* de la sécurité sociale informels et la cohésion sociale. La capacité d'adaptation a révélé la présence d'une diversité de sources de subsistance, d'actifs de subsistance et de revenus associés, mais son indicateur de capital humain a révélé des niveaux d'analphabétisme considérablement élevés parmi les répondants. Pendant ce temps, la capacité de la transformation a révélé l'existence de structures de réseau, de gouvernance et d'institutions, a facilité l'accès aux informations d'alerte précoce sur les ravageurs, les maladies et l'apparition des pluies. Les institutions traditionnelles et le système judiciaire ont joué un rôle clé dans la résolution des conflits, la médiation et la négociation pour l'établissement des étables et les droits de pâturage et d'abreuvement. Nous concluons que les communautés pastorales du Karamoja ont une forte tendance au maintien de la stabilité tandis que leur flexibilité et leur capacité à changer diminuent avec l'intensité du changement au prorata.

Mots Clés : Absorbation, adaptation, résolution de conflits, transformation

INTRODUCTION

Climate variability and change are major concerns in sub-Saharan Africa, where the rural agrarian communities almost entirely depend on rain-fed agriculture and livestock production systems for their livelihoods (Orindi and Eriksen, 2005; Ayanlade *et al.*, 2018; Partey *et al.*, 2018). Pastoral and agro-pastoral holders depend on the length of the growing period that is fundamentally controlled by the onset and cessation of rainfall, as well as rainfall seasonality (Thornton *et al.*, 2014; Herrero *et al.*, 2016). Traditionally, pastoralists had mastered the rainfall seasonal calendar, distribution, regime and predictability (Hurst *et al*., 2012). This formed the basis for their activity planning, including seasonal livestock movement between wet and dry season grazing areas, negotiation of grazing and water rights, formation of alliances, and agistments among other actions (Chang'a *et al*., 2010). However, the once predictable seasons have changed; variability in the amount, onset and cessation of rainfall is increasingly apparent. As such, seasonal patterns are no longer a reliable planning tool for these communities (Selemani *et al*., 2012; Worku *et al.*, 2019). This makes the current rain-fed agricultural and livestock production systems vulnerable to climate variability and change with major impacts on peoples' livelihoods (Cooper *et al.*, 2008; Twomlow *et al.*, 2008). Further, the occurrence of extreme weather events particularly drought and floods is unprecedented over the last two decades (Nicholson, 2001; Mishra and Singh, 2010). This has weakened the adaptive capacity of small-holder farmers and livestock keepers (Reid and Vogel, 2006; Simotwo *et al*., 2018) yet, this situation is predicted to continue. For example, climate projections over Uganda show that there will be an increase in average temperatures by up to 1.5°C in the next 20 years and by up to 4.3°C by 2080s with observed extreme events in rainfall most pronounced in semi-arid areas (Niyibizi *et al*., 2013; *Nyasimi et al*., 2016).

Uganda's semi-arid belt also known as the cattle corridor with diverse pastoral and agro-pastoral communities routinely experiences extreme climate events. These extreme events have led to one or a combination of effects associated with reduction in productivity livestock and food crops, increased pest and disease prevalence, water scarcity, changes in diet patterns and proliferation of 'new crops' (Okonya *et al*., 2013; Call *et al*., 2019), livestock losses (Catley and Ayele, 2021), and shifts in social networks and risk management

behaviour necessary for recovery from short-term risks (Iyer, 2021) among others. However, these communities have over the years utilised diverse adaptation mechanisms within their reach. This coping and adaptation range has involved; the coping range in itself changing either moving up or down, expanding or contracting thus reflecting new adaptations in the system (Smit and Wandel, 2006). The coping range reflects the adaptive capacity which is the potential of a system to adapt and alter to better suit a climatic stimulus.

Adaptation and adaptation action is constructed within a specific context that relates to who and what adapts. It is this that is referred to as the system of interest and/or the sensitive system (Carter *et al.*, 1994). In this study, this is represented by the pastoral and agro-pastoral communities in the semi-arid Karamoja sub-region. These communities, like in most parts of rural Uganda, have resource limitations (Olapade-Olaopa *et al.*, 2014), yet the failure to adapt and/or maladaptation can lead to significant deprivation, displacement, morbidity, and mortality (Smit and Pilifosova, 2003); as well as shifts in vulnerabilities and inequality (Galvin, 2021).

Pastoral and agro-pastoral communities have unique adaptation options not a keen to those of commercial producers such as ranchers and trackers (Smit and Pilifosova, 2003; Ayal *et al.*, 2018; Amare *et al.*, 2019). However, there are growing calls in the adaptation science and practice cycles to reconceptualise adaptation as an element of pathways of interacting global changes and societal changes. This is particularly because of two critical concerns. Firstly, there is need to take a look at the predominantly incremental actions that address proximate causes of vulnerability or development needs; while modifying these to ensure that they inform systemic change. Secondly, there is need to take note of the intentions and outcomes of societal change. This is vital in understanding the influence of existing rules and values on framing and decision making in society. It also influences how to change the rules and values to enable society anticipate and proactively guide systems to desirable pathways in the context of global change (Wise *et al.*, 2014).

Taking this direction brings to the fore from the appreciation that the framing of adaptation is contextual and in conceptualising adaptation as an element of pathways of interacting global changes and society responses, intensity of change and different dimensions of adaptation become apparent. Adaptation researchers have consequently identified five dimensions of adaptation challenge that are poorly integrated in research and practice (Leach *et al.*, 2010; Pelling, 2010; Maru *et al.*, 2014; Wise *et al.*, 2014). These include (i) climate adaptation is contextual to the cultural, political, economic, environmental and developmental circumstances and is one of the many societal responses; (ii) there are several transboundary changes and responses that can lead to threshold effects; and (iii) several inter-temporal characteristics tend to exist owing to positive feedback loops and system inertia that often tend to be expressive through historical determinism and path-dependency. Others include (iv) the several emergent properties of socio-ecological systems as they respond to change are often difficult to measure and monitor; and, (v) societal processes are enabled or constrained by the prevailing rules, values and knowledge cultures, and their interdependencies. This makes it important to recognise and understand the influences of these interdependencies and how to change them to better enable adaptation transform the wellbeing of disadvantaged and politically marginalised populations whose current state of vulnerability could be a result of existing power relations, norms and institutions. Conceptually, several athours (Cutter *et al.*, 2010; Béné *et al.*, 2012 and Opiyo *et al.*, 2018) summarised these five dimensions into three dimensions; namely absorptive, adaptive and transformative capacities with indicators to better facilitate identification and monitoring of adaptation.

This study builds on these conceptual dimensions to analyse the adaptation diversity

to climate variability and change among pastoral and agro-pastoral communities in north-eastern Uganda with a view of providing information to better organise adaptation responses in the sub-region.

MATERIALS AND METHODS

Description of study area. The study was conducted in Karamoja sub-region of Uganda that is located in the north-eastern Uganda, between 1°.42 - 4.24°N and 33°502 - 35°E (Fig. 1). The sub-region is home to a number of inhabitants including pastoral Karamojong, who form part of the larger Karamoja cluster, (Nyangatom of Ethiopia, Toposa of South Sudan, Turkana in Kenya and the Karamojong of Uganda) spread in East Africa (Gradé *et al*., 2009). The climate in this area is of semi-desert type with persistence of high rainfall variability, changes in rainfall onset and cessation and increase in temperatures (Egeru *et al.*, 2014). Rainfall is poorly distributed, thus increasing the cases of crop failure in the sub-region. For that reason, livestock herding remains the mainstay of most people in Karamoja (Levine, 2010), with a number of livestock specific strategies such as seasonal mobility, herd splitting, and keeping diverse livestock species (Akabwai, 2021).

The area is dominated by C4 grasses including among others *Themeda triandra, Heteropogon, Andropogon, Aristida adscensionis, Eragrostis superb, Panicum maximum, Chloris gayana, Setaria sphacelata, Brachiaria platynota, Hyparrhenia rufa, Cenchrus ciliaris, Cynadon dactylon, Bothriochloa, Loudetia simplex, Hyparrhenia diplandr, and Hyparrhenia filipendula* (Nalule, 2010; Egeru *et al.*, 2015). The sub-region has extensive grasslands, thickets and shrublands which are, however, being threatened by rapid increase in bushland and subsistence cultivation in the last decade (Egeru *et al.*, 2014).

The rangelands serve as an important grazing ground for livestock for the Karamojong pastoralists, as well as that from the neighboring Kenya and Sudan. However, because of tribal conflicts, some of these are presently under-utilised (Levine, 2010). Nonetheless, certain areas are heavily grazed leading to degradation an aspect that is linked to disruption of conventional herd management practices especially by the 'protected kraal' system rather than the stocking capacity (Levine, 2010; Mugerwa *et al*., 2014).

Conceptual framing. The focus of this study was to identify the various adaptation options to perceived climate variability and change in the semi-arid pastoral production system of Karamoja sub-region. We took the holistic perspective of adaptation which is able to lead to resilience to guide the identification of diversity of adaptation options in Karamoja sub-region (Fig. 2). In this framework, three components; absorptive, adaptive and transformative capacities are utilised to ease the identification and measurement of adaptation indicators in its broadest sense. This is also essential in better characterising the adaptation indicators into a logical sequence. Absorptive, adaptive and transformative capacities as three components of focus are the central subject of analysis in this study. Accordingly, absorptive capacity was analysed in this paper following the understanding that it is the various coping strategies by which individuals and/or households moderate or buffer the impacts of shocks and stresses on their livelihoods and basic needs without suffering permanent, negative impacts on longer-term well-being (Cutter *et al*., 2010; Béné *et al.*, 2012; Opiyo *et al.*, 2018). In this case, absorptive capacity is identified from the range of household capitals; and their dynamics reflect absorptive capacity of the individual and/or household (Opiyo *et al.*, 2018). Adaptive capacity describes the ability of a household or community to adjust to changing social, economic and environmental conditions including climate variability and extremes to moderate potential damages, and take advantage of opportunities, or to cope with

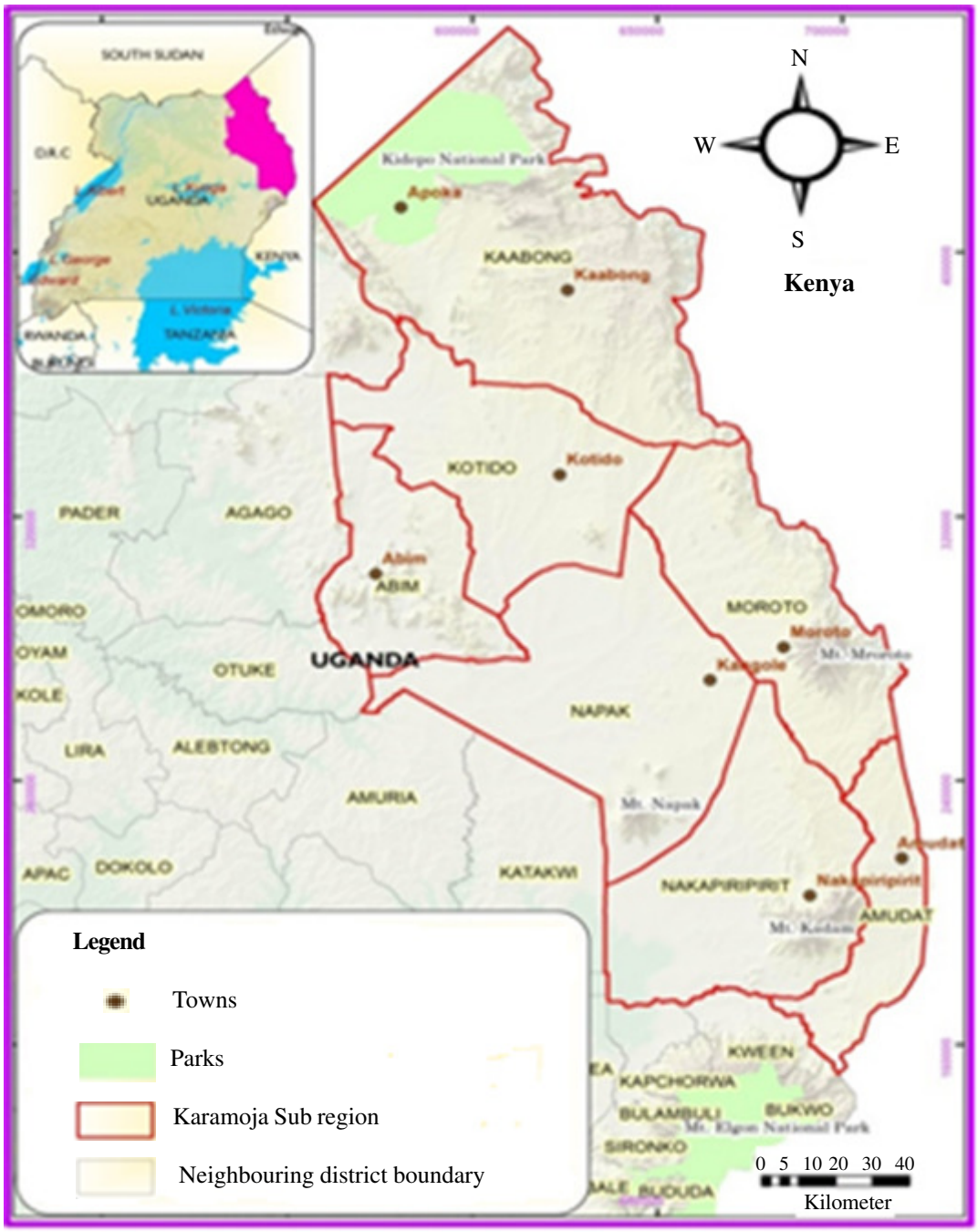

Figure 1. Location of Karamoja sub-region in Uganda.

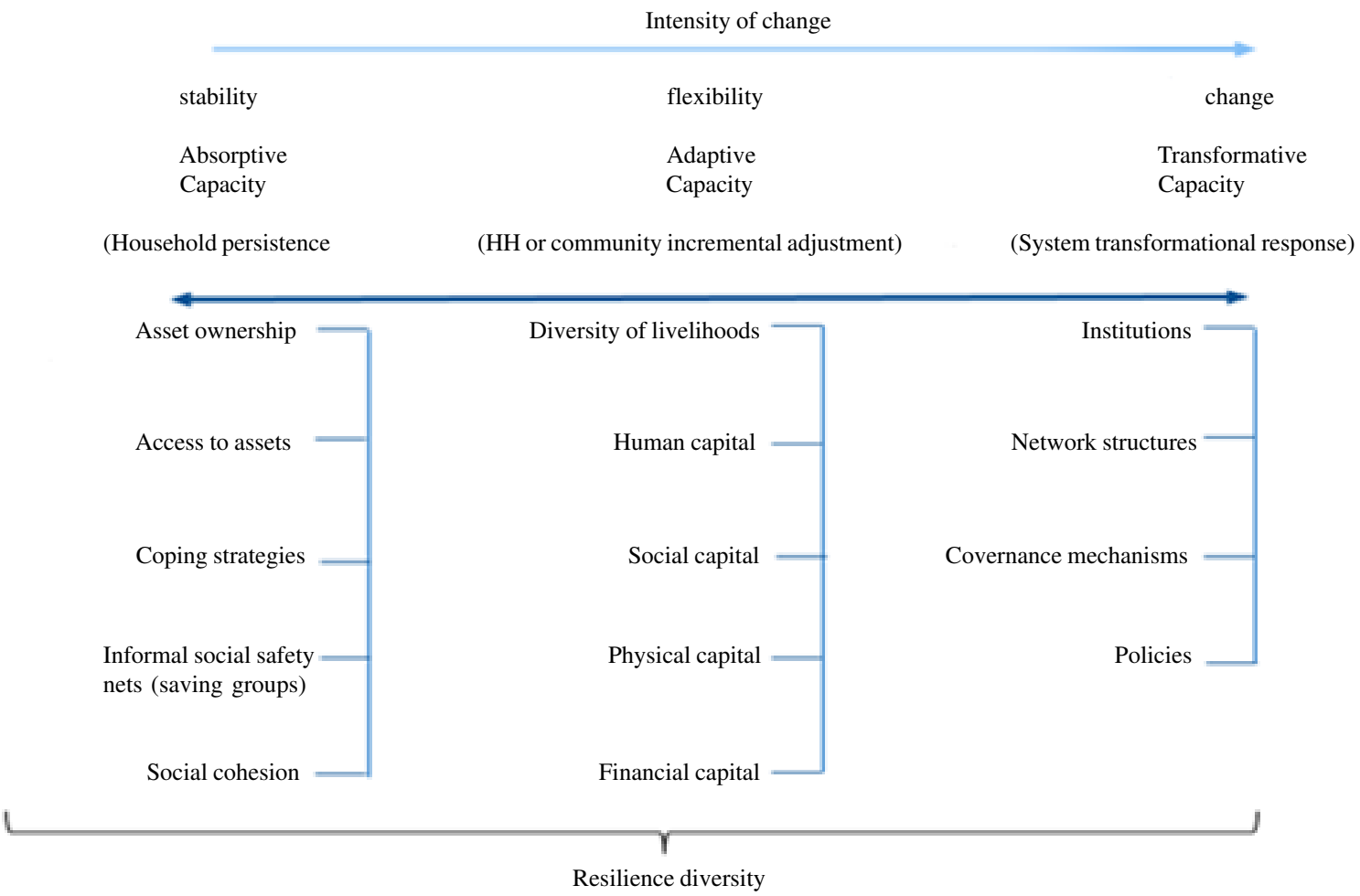

Figure 2. An integrated analytical framework for resilience indicators (Ifejika *et al.*, 2014; Opiyo *et al.*, 2018).

the consequences (Adger, 2006). It is represented by proactive responses taken by individuals, households and communities in response to extreme events and in this case to perceived climate variability and change. Meanwhile, transformative capacity reflective of transformational adaptation is viewed from the perspective of challenging the status quo by moving a system into a fundamentally different state when the when ecological, economic or social structures make the existing system untenable (Walker *et al.*, 2004; Galvin, 2021). In this case, we identified actions that were either intentionally driven deliberate actions of people, autonomous as a result of spontaneity to extreme climate events and/or unintentional actions responding to thus forced transitions imposed from outside the system.

Data collection. A multi-stage sampling approach was adopted in the three districts of Karamoja sub-region that were purposively selected to represent the three livelihood zones (pastoral, agro-pastoral and agricultural). Besides representing the three livelihood zones in the region, the districts also represented three important tribal groupings of the Karamoja cluster, namely; Bokora (Napak district), Matheniko (Moroto district) and Jie (Kotido district). The target respondents were then identified through simple random sampling technique. A total of 207 respondents was interviewed in a one-month long survey. Sample size was proportionately allocated based on the 2002 Population and Housing Census (Uganda Bureau of Statistics (UBOS), 2005) such that; 75, 53, and 79 heads of household were to be interviewed in Napak, Moroto and Kotido districts respectively. Out of the 207 households, 198 heads of household were interviewed in fifty-three villages in the three districts. This represented 94.3% overall success rate. Face to face interviews were preferred because they allow for longer and more detailed survey time once the interviewer has gained entry and initial cooperation and acceptance from the respondent (Neuman, 2012). A pre-tested semi-structured questionnaire whose Conrach's reliability static had been confirmed at 88.5%, was used to guide the interviews with the pastoralists. The questionnaire was administered in the local language of Ngakaramojong by locally recruited and trained enumerators.

Data analysis. We make use of descriptive statistics to summarise the quantitatively verifiable data. This was supplemented with thematic analysis to summarise and articulate the qualitatively obtained data from key informant interviews and focus group discussions that had been undertaken. Respondents had been asked to state what they perceived to be the main cause of climate variability and change. Using these responses, we categorised the respondents into those that had environmental change (scientific) causes *versus* those that had non-environmental (non-scientific) reasons or superstitious reasons as the main cause of climate variability and change. Respondents were also asked to state actions taken against negative changes of climate variability and change with "No action taken" as one of the possible responses. Accordingly, we use two sample t-tests to investigate whether there were any differences in actions based on perceived cause of climate variability and change. We also pairwise correlation to determine if there was relationship between taking action against any of the changes and the perceived cause of climate variability and change. Statistical analysis were undertaken in STATA and figures plotted in excel.

RESULTS

Perceptions about climate variability and change. Respondents (98.0%) strongly believed that there was climate variability and change taking place in the sub-region. Through multiple responses, they identified early rainfall onset (99.1%), late rainfall onset (97.5%), late rainfall cessation (96.7%), torrential rainfall

(94.9%), floods (97.2%), hailstorms (96.9%), 'new diseases for both humans and livestock' (96.2%), and new pests (93.8%) as some of the indicators of climate variability and change. The perceptions of the respondents towards what could be the cause of the climate variability and change in the sub-region can be grouped into two; perceived environmental change (38.4%) and superstitions (61.6%). Perceived environmental change consisted of reasons such as destruction of vegetation cover, bush burning, strong winds and construction of large dams. Meanwhile, reasons associated with superstitious beliefs included: witchcraft, God's blessings, an eagle with misfortune flying when it is about to rain, shedding of innocent blood, slaughtering donkeys, elders getting angry at the shrine, killing of dogs, existence of peace, destroying the elder's shrine, initiation of Ngilobae (Antelope) age group among others (Fig. 3). Correlation analysis results revealed that respondents with superstitious perceptions were significantly more likely to take action against changes in rainfall timing and changes in duration of the rains but less likely to take action against changing livestock breeds and poor access to markets than their counterparts with environmental change perceptions (Table 1). There was a weakly positive but significant correlation between perceived cause of climate variability and change and not acting against changing duration of the rains. This implies that a respondent perceiving environmental change related causes was weakly positively correlated with them not taking action against change in rainfall duration (Table 1).

Absorptive capacity

Asset ownership. Asset ownership, access to assets, coping strategies to drought and other extreme events; floods and livestock disease outbreaks, informal social safety nets and social cohesion indicators were identified. In terms of the productive assets, land was reported to be customarily owned by 97% of respondents and was accessible to about 99%

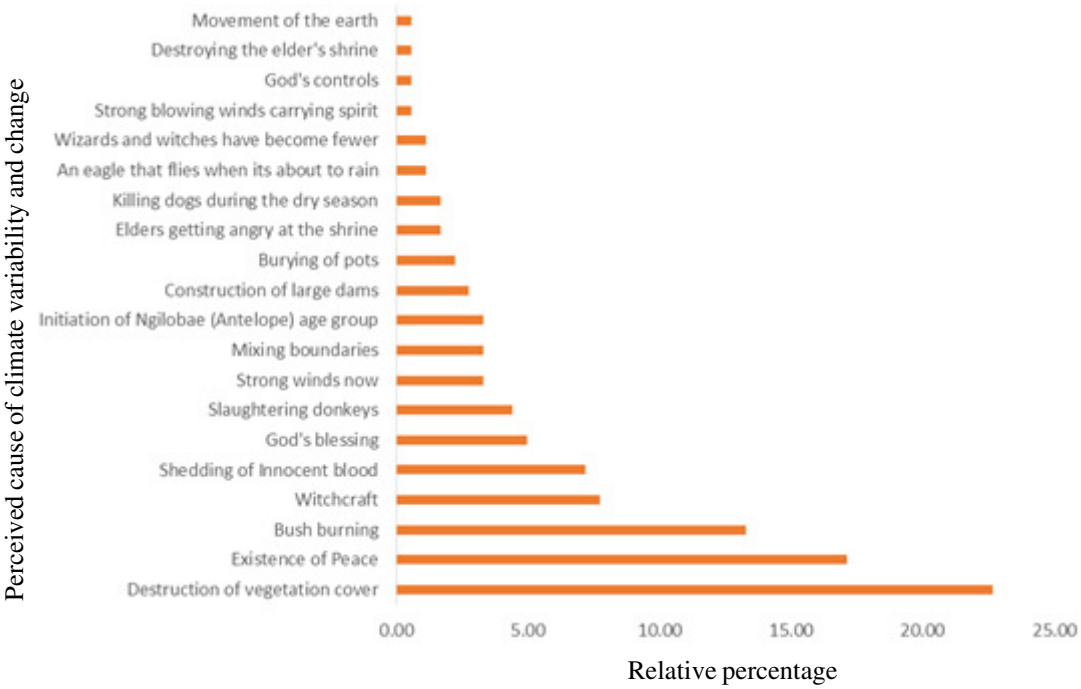

Figure 3. Perceived causes of climate variability and change in Karamoja sub-region, Uganda.

TABLE 1. Percentage of respondents not taking action against perceived climate variability and change effects in Karamoja, Uganda

Variable	Pooled sample		Superstitious		Environmental		t-statistic	Pairwise correlation coefficient
	Percent	Std. Dev.	Percent	Std. Dev.	Percent	Std. Dev.		
No action rainfall amounts changed	31%	0.46	28%	0.45	36%	0.48	-1.015	0.082
No action to rainfall timing changed	46%	0.50	41%	0.50	53%	0.50	-1.329*	0.115
No action to rainfall duration changed	42%	0.50	34%	0.48	56%	0.50	-2.348***	0.210**
No action to changed yields	54%	0.50	51%	0.50	58%	0.50	-0.682	0.062
No action to changing varieties	69%	0.47	71%	0.46	66%	0.48	0.502	-0.059
No action to crop failure	60%	0.49	58%	0.50	63%	0.49	-0.592	0.055
No action to crops destroyed	53%	0.50	54%	0.50	51%	0.51	0.353	-0.032
No action to new disease	38%	0.49	37%	0.49	41%	0.50	-0.367	0.036
No action to disease incidence	34%	0.48	35%	0.48	31%	0.47	0.369	-0.039
No action to reduced milk yield	51%	0.50	55%	0.50	42%	0.51	0.917	-0.121
No action to animal health	34%	0.48	36%	0.48	29%	0.46	0.562	-0.064
No action to breeds changed	80%	0.41	93%	0.26	50%	0.52	3.474***	-0.491***
No action to water inadequacy	24%	0.43	27%	0.45	14%	0.36	1.179	-0.129
No action to poor market accessibility	72%	0.45	83%	0.39	33%	0.52	2.594***	-0.447**

of the respondents. Majority (59%) of the respondents noted that this land was inherited from parents and would be transferred to the next kin. Part of this land was used for farming as indicated by 98% of the respondents. There was a significant relationship between the farming calendar food availability patterns at household level. Accordingly, results showed a linkage between periods of food shortages and farming activities in the sub-region (Figs. 3.1-3.4). Besides own farm and off-farm sources of food, respondents also indicated that they obtained food from food relief. Reliance on food reliance commenced gradually from the months of December (29.7%) and most pronounced in the months of April (60.0%), May (74.4%) and June (65.1%) respondents reporting to receive food aid.

In the last half of the year (July to December), food was generally available across most households. During these months, households secured food from own farm (44-70%), off-farm (0.5-4%) and some received food relief (20-29%). In terms of on-farm activities, 99% of households planted crops; including grains like sorghum, maize and millet; and legumes like beans, cow peas and ground nuts (Fig. 4). Respondents owned a range of non-productive assets; namely housing units and 'security equipment-including bows and arrows; and undeclared fire arms' (Fig. 5). Households barely had access to sanitation facilities and those that did have hardly used them consistently.

Livestock assets. Majority (78%) of the respondents had mixed herds, with goats being the most owned livestock; followed by sheep and cattle (Tables 1 and 2). On the other hand, camels were the least owned livestock type, limited to Moroto district among the sampled districts (Tables 2 and 3). For all the livestock types, females dominated the herds. The livestock herd also had more adult animals than sub-adults (Tables 2 and 3). Cattle herd was larger in Moroto district (35.56±55.89) compared to Kotido (15.30±15.94) and Napak districts (7.41±16.44); and of these districts' cattle herd displayed a strong variability (Table 3). In terms of ownership, cattle and shoats (goats and sheep) were mostly owned by fathers who were the household heads in most households; whereas women were the predominant owners of the camel and donkeys in households that had these livestock species (Table 4). The sons were hardly entitled to any livestock in the household, except for camels in Moroto district and Kotido district where there was a slight meaningful comparative percentage in ownership of 11% and 38%, respectively.

Access to assets. We identified access to assets in terms of access to grazing lands, access to water sources and access to other public assets such as schools, health facilities, all weather road infrastructure and the nearest town/trading centre. Results of this analysis revealed that in the wet season, the nearest grazing sites were about 6 kilometers; while in the dry season it was 23 kilometers to access the nearest grazing sites. Majority of the respondents revealed that the grazing sites were very accessible and very frequently used by the herders with ease regardless of the tribal grouping. Majority of the respondents indicated having access to water for their livestock that is cattle (97%), goats (98%), sheep (97%) and donkeys (97%) respectively. All respondents indicated to have access to the markets (3.8±4.7 Km), 99.4% had access to a primary school (0.9±1.0 Km), 96% (8.8±7.6 Km), 97.9% access to medical facility (2.3±2.2 Km), 91.9% access to all weather road (3.1±3.1 Km) and 92.4% access to the nearest town (10.0±4.6% Km).

Social safety nets and social cohesion. Informal and social safety nets and social cohesion are part of absorptive capacity indicators. We relied on information dissemination and actions in response to information received to identify both social

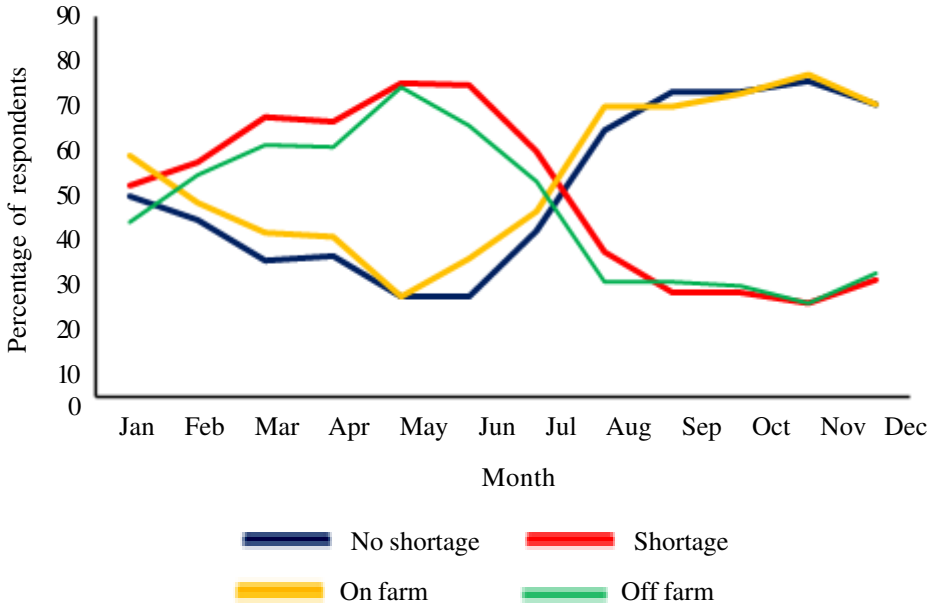

Figure 3.1. Overall food availability and source of food across the year in Karamoja sub-region, Uganda.

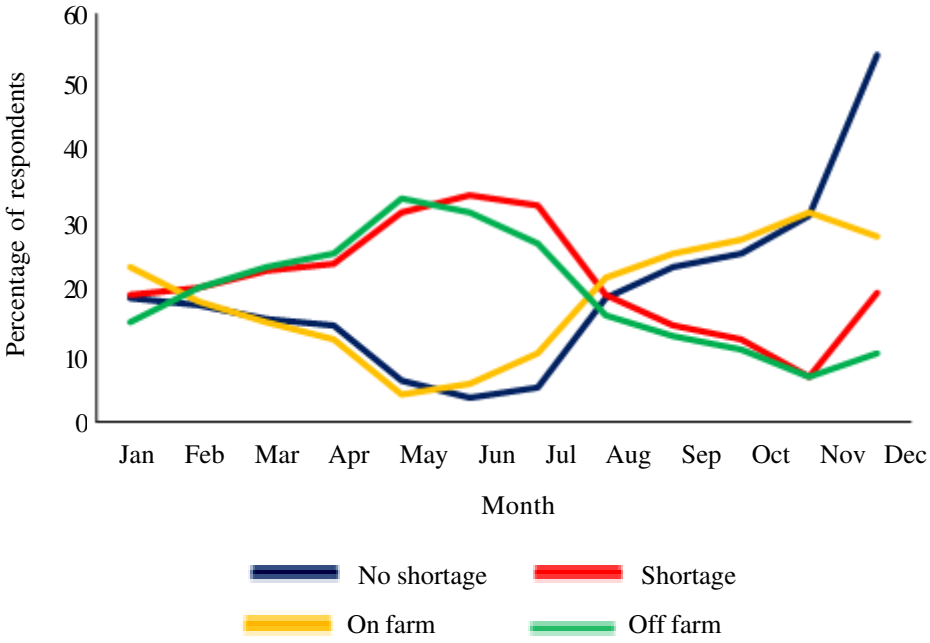

Figure 3.2. Food availability and source of food in Napak district across the year.

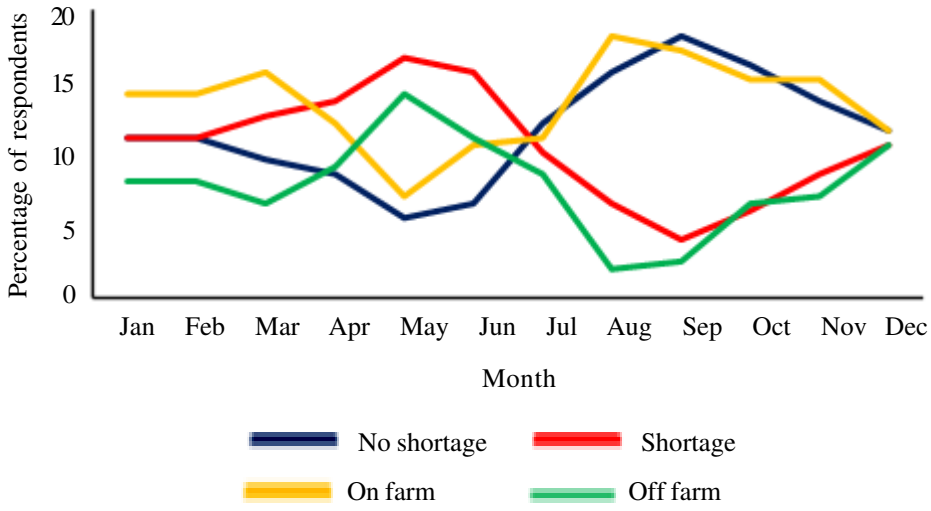

Figure 3.3. Food availability and source of food in Moroto district across the year.

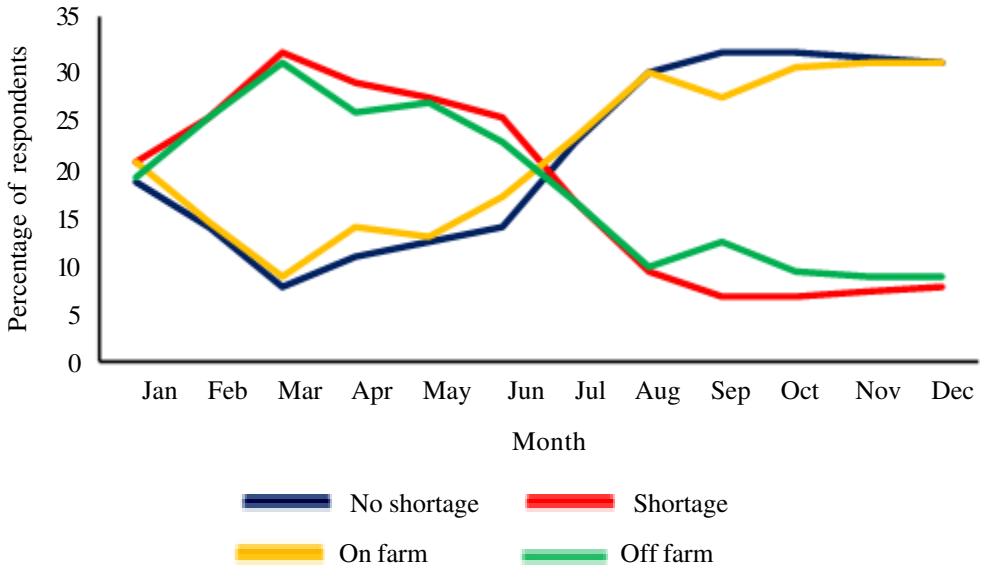

Figure 3.4. Food availability and source of food in Kotido district across the year.

cohesion and informal social safety nets. Twenty seven percent of the respondents received security information from the national army, the Uganda Peoples Defense Forces (UPDF), foretellers, mediums medicine men (15.3%), shrine elders (13.9%), community meetings (11.7%) and relatives and community members (10.2%). They also implemented a number of actions in response to security information; collectively informed the Uganda Peoples Defense Forces-UPDF (15.5%), avoidance of locations where enemies have been sited (15.5%), performing rituals-peace sacrifices (12.6%) and 12.6% fence off their

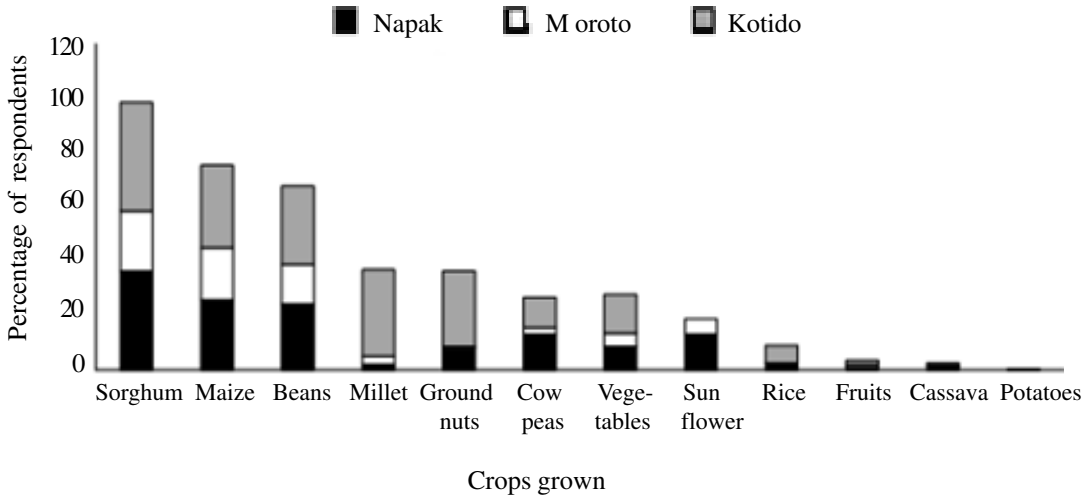

Figure 4. Most commonly grown crops in the Karamoja sub-region, Uganda.

TABLE 2. Livestock herd composition by household gender groups in Karamoja sub-region, Uganda

Livestock type	Total herd size Mean±SD	Male Mean±SD	Female Mean±SD	Juvenile Mean±SD	Sub-adults Mean±SD	Adults Mean±SD
Cattle	10.2±16.5	3.4±6.1	6.1±10.5	2.2±4.6	2.2±6.2	5.4±7.7
Goats	12.6±17.6	3.9±6.1	8.5±12.3	2.9±5.1	2.2±5.4	7.2±11.6
Sheep	11.9±14.5	3.4±4.9	8.1±10.6	2.8±4.3	1.2±2.8	7.0±9.5
Camels	0.7±5.5	0.2±1.5	0.5±3.9	0.04±0.3	0.1±0.3	0.1±0.5
Donkeys	1.1±1.4	0.4±0.7	0.6±0.9	0.2±0.4	0.1±0.4	0.7±0.9

homesteads and prepare defense equipment. Information on pasture locations; availability and quality was primarily provided by youth and herders (50.8%), hunters (21.1%), kraal leaders 7.8%) and friends, neighbors and relatives (7.0%). They primarily (73.8%) responded to pasture information by moving their livestock to locations where pastures were identified, but a reconnaissance team would often be sent to confirm the presence of adequate pastures. Meanwhile, information on watering sources was mainly provided by herdsmen and youth (46.9%), kraal leaders (15.9%), local leaders/politicians (13.3%) and hunters (10.6%). In response, they either moved their livestock closer to the waterholes (55.9%) or informed the elders (14.0%) among others actions. In addition, 97.5% reported owning land on customary basis and 43.8% belonged to a savings group and/or a loans scheme at community level with US$3.3±1.2 in monthly savings deposits.

Coping strategies. Adaptation to extreme events can either be autonomous or anticipatory and the strategies utilised in the process are part of the indicators of the household and/or community's absorptive capacity. Respondents profiled a number of extreme events in their communities to include; climate variability; droughts and floods, livestock disease outbreaks, crop failures, water shortage, low livestock yields and performance, poor livestock breeds, insecurity, poor veterinary services, grazing lands conflicts and human-wildlife conflicts

TABLE 3. Disintegrated livestock herd composition by districts in Karamoja sub-region, Uganda

Livestock type		District		
		Napak	Moroto	Kotido
	Herd	Mean±SD	Mean±SD	Mean±SD
Cattle	Total herd*	7.4±16.4	35.6±55.9	15.3±15.9
	Males	1.8±3.2	7.6±10.8	2.6±2.8
	Females	2.9±6.1	12.2±18.4	5.4±5.3
	Juveniles	1.2±4.1	4.8±7.4	1.6±1.9
	Sub-adults	0.4±0.7	6.3±11.9	1.5±2.3
	adults	3.3±5.3	9.6±11.9	4.9±5.6
Goats	Total herd	9.5±29.7	38.2±43.2	22.2±29.8
	Males	1.9±5.3	7.4±7.9	3.7±4.8
	Females	4.3±10.4	15.3±14.1	7.9±11.2
	Juveniles	1.5±5.9	5.1±4.6	2.9±4.3
	Sub-adults	0.5±11.1	6.3±9.6	1.9±2.8
	adults	5.2±14.2	10.1±10.9	7.1±9.5
Sheep	Total herd	6.2±20.5	18.3±20.3	29.2±30.2
	Males	1.0±1.8	3.6±4.6	4.8±5.8
	Females	4.4±11.9	6.9±5.6	10.7±11.1
	Juveniles	1.3±4.2	3.0±2.9	3.5±4.6
	Sub-adults	0.3±0.7	2.9±3.6	2.5±2.7
	adults	4.2±9.8	5.5±6.5	9.3±10.0
Camel	Total herd		2.2±8.6	
	Males		0.8±2.9	
	Females		1.9±7.6	
	Juveniles		0.2±0.5	
	Sub-adults		0.2±0.6	
	adults		0.4±0.9	
Donkeys	Total herd	0.4±1.4	1.3±2.3	
	Males	1.3±0.6	0.5±0.7	
	Females	2.0±1.0	0.4±0.9	
	Juveniles		0.2±0.4	
	Sub-adults	1.0±1.4	0.2±0.6	
	adults	2.0±0.0	0.5±0.8	

*Significant differences ($p<0.05$) were observed across the districts

and livestock rustling (Table 5). The use of improved seeds and animal breeds (19.8%), use of livestock manure (18.4%), providing casual labour (7.6%), selling charcoal (7.6%) and planting fast maturing crops (7.6%) were identified as some of the response actions towards low livestock yields. Planting trees (27.5%), moving to areas with pasture and water (16.2%), selling firewood and charcoal (11.3%) were key actions in response to drought. In response to livestock diseases during a drought period, respondents indicated that the key actions included purchasing animal drugs from veterinary shops (34.7%),

TABLE 4. Household livestock ownership in the sub-region by household gender group in Karamoja sub-region, Uganda

District	Livestock type	Household member		
		Father (%)	Son (%)	Woman (%)
Napak	Cattle	26	2	6
	Goats	23	0	7
	Sheep	17	1	6
	Camels	0	0	0
	Donkeys	2	0	0
Moroto	Cattle	18	0	0
	Goats	19	1	1
	Sheep	17	0	2
	Camels	4	11	0
	Donkeys	6	0	8
Kotido	Cattle	32	0	1
	Goats	32	0	6
	Sheep	32	0	6
	Camels	0	38	0
	Donkeys	17	0	21

vaccinating livestock (32.0%) and treating livestock (11.6%). Meanwhile in the event of floods, respondents indicated that; shifting homesteads to higher grounds (20.0%), creating water control channels (13.9%), plough on raised land (13.9%), and set up kraals on raised land (11.9%) were the key actions implemented. As it is a common occurrence with during the dry spell and/or drought period, that the sub-region experiences water shortage, respondents indicated that; trekking to dams and boreholes in distant locations (34.8%), rely on boreholes around the community-manyattas (32.2%) and lobbying for more boreholes (11.3%) were the major responses that they often executed to cope with water shortages (Table 5).

Adaptive capacity

Livelihood sources, livelihood assets and associated income. Respondents were observed to participate in at least 14 sources of livelihood earning with agriculture enterprises including; livestock, crop production, charcoal and firewood production and trade being the most important livelihood sources (Table 6) in both seasons and collectively. Respondents also benefit from social support programmes and trade activities for their livelihood in all seasons. Formal employment, bee keeping and cattle milk marketing were the least important livelihood options (Table 6), especially since milk was mostly for consumption and not for sale. These livelihood sources varied in relative importance by season and by district. While crop production was important during the wet season, firewood/charcoal trade and social support programmes from non-governmental organisations and aid agencies such as World Food Programme were the most important sources of livelihood during the dry season. Livestock production, crop production and social support programmes remained as the main sources of livelihood in both seasons (Table 7).

TABLE 5. Response actions to perceived extreme events associated with climate variability and change in Karamoja sub-region, Uganda

Response to Low livestock yields	%	Responses to drought	%	Response to livestock diseases n drought	%	Responses to floods	%	Responses to water shortage	%
Improved seeds and animal breeds	19.8	Planted some trees	27.5	Buying livestock drugs from Vet shops and market	34.7	Shifting homesteads to higher grounds	20.0	Trekking to dams and boreholes	34.8
Use livestock manure	18.4	Move to areas with pasture and water	16.2	Vaccination	32.0	Creating water contro channels	13.9	Use boreholesl around the community	32.2
Selling charcoal and firewood	7.6	selling firewood and charcoal	11.3	Treating livestock	11.6	Plough on raised land	13.9	Lobbying for boreholes	11.3
Providing casual labour	7.6	Timely planting	9.7	Spraying to avoid ticksc	5.5	Set Kraals on raised ground	11.9	Rehabilitation of the watera tchments/points	9.6
Plant fast maturing crops	7.6	Dams have been created and are being created	6.5	Bush burning	4.0	Digging dams	11.9	Dam and borehole construction and rehabilitation	7.8
Practice crop rotation	6.1	Purchased feeds for calves and small stock	6.3	Livestock quarantine	3.4	Dams and channels have been constructed	8.1	Digging the river bed to trap water	4.3
Buy other foods	6.1	Sell some animals	6.3	Moving animals away to new and safer areas	2.7	Wait for rivers to recede	4.0		
Spraying animals	4.5	Grow enough during the wet season for dry season sue	5.0	Seek advise from the Vet Doctor	2.6	Don't happen here	4.0		

TABLE 5. Contd.

Response to Low livestock yields	%	Responses to drought	%	Response to livestock diseases n drought	%	Responses to floods	%	Responses to water shortage	%
Sell some livestock	3.1	Collect any edible stems for livestock	3.2	Deworming	1.3	Seek advice on how to avoid floods	4.0		
Take animals to areas with pasture and water	3.1	Plant drought tolerant crops	3.2	Treatment from NGOs	0.7	Avoid settling on slopes	4.0		
Formed groups to obtain training from NGOs	3.1	Depend on wild fruits	1.6	Sell small stock for buying animal drugs	0.7	Leaving the areas likely to be affected	2.0		
Cross breeding	3.1	Seeking for government help	1.6	Seeking for assistance from friends and relatives	0.7	Plant of raised ground	2.0		
Introduction of artificial fertilisers	3.1	Planted early	1.6						
Raid some livestock	1.8								
selling building materials	1.4								
Dig a dam	1.4								
Administer a local herb (Legelea) to induce milk	1.4								

TABLE 6. Seasonal importance of economic activities in the Karamoja sub-region, Uganda

Livelihood source	Seasonal importance		
	Wet (%)	Dry (%)	Both (%)
Livestock production	20	13	29
Traditional medicine	2	2	2
Bee keeping	1	1	0
Cattle milk marketing	4	1	4
Firewood/charcoal trade	13	8	10
Social support programs	9	5	14
Formal employment	0	1	0
Gums and resins	0	1	2
Casual labour	4	6	5
Mining and quarrying	4	4	5
Art and crafts	3	2	4
Trade	5	3	10
Crop production	20	12	28
Remittance	4	2	4

A diversity of income earned from the various sources of livelihood the respondents engage in existed in both dry and wet seasons. There were more income sources during the dry season compared to the wet season and earnings with respect to source and season were variable. Livestock production was the main source of income in both the dry and wet season though more income was on average generated during the wet season from this economic activity. Other main wet season income sources also included trading, remittances, mining and crop production respectively (Table 7). Other than livestock production, other major dry season income sources included; sale of traditional medicine, crop production, mining, trading and sale of cattle milk. Income sources namely; bee keeping, processing and sale; art and crafts and marketing of gums and resins were only explored during the dry season in the study area.

Human capital and access to basic services. There was a high illiteracy rate in the sub-region as shown in Table 8. A limited number of individuals had attained formal education and even those that had attained, only spent on average one year in school. Kotido district had the highest percentage of individuals without formal schooling in the study area; whereas Moroto district had the lowest share. Napak district had the highest percentage (20.3%) of individuals with formal schooling at primary level. On average, a household in the study area had above 5 members that contributed to the labour force in the sub-region (Table 8). Services were fairly accessible to pastoralists and agro-pastoralists in Karamoja (Table 8). Markets, primary schools and medical facilities were the most accessible services; whereas secondary schools are the least accessible services in the region (Table 8).

Transformative capacity

Network and structures, governance and institutions. Results revealed that the agro-pastoralists and pastoralists fairly had access to information in the study area. Early warning on pests and diseases, as well as forecast on

TABLE 7. Seasonal importance of livelihood source by district in Karamoja sub-region, Uganda

Livelihood source		District		
		Napak (%)	Moroto (%)	Kotido (%)
Wet season	Livestock production	9	6	5
	Crop production	14	7	2
	Remittances	9	3	0
	Trade	2	3	1
	Mining	1	3	0
	Casual labour	7	2	0
	Social support programs	2	0	1
	Firewood/charcoal trade	2	2	2
	Cattle milk marketing	1	3	0
	Bee keeping, production and marketing	0	1	0
	Traditional medicines	0	2	2
	Art and crafts	0	1	0
Dry season	Livestock production	4	5	5
	Crop production	11	7	7
	Remittances	2	3	0
	Trade	0	2	2
	Mining	5	4	1
	Casual labour	7	2	3
	Social support programs	7	11	7
	Firewood/charcoal trade	17	11	4
	Cattle milk marketing	0	2	0
	Bee keeping, production and marketing	0	3	0
	Traditional medicine	1	2	0
	Art and crafts	5	2	1
	Gums and resins	3	0	3
Both	Livestock production	3	8	18
	Crop production	8	7	22
	Remittances	1	3	1
	Trade	1	4	9
	Mining and quarrying	3	4	0
	Casual labour	1	2	2
	Formal employment	1	1	1
	Social support programs	5	3	11
	Firewood/charcoal trade	5	4	4
	Cattle milk marketing	0	3	1
	Bee keeping, production and marketing	2	0	0
	Traditional medicine	0	0	1
	Art and crafts	1	4	1
	Gums and resins	1	0	0

TABLE 8. Household access to services by different districts in Karamoja sub-region, Uganda

Variable		Kotido	Moroto	Napak
Education level				
No formal education (%)		84.8	86.3	78.4
Primary level (%)		13.9	2.3	20.3
Secondary level (%)		0.0	11.4	1.4
Tertiary level (%)		1.3	0.0	0.0
Average no of years in school		0.8	1.6	1.8
Average no of household members		8.7	12.0	11.3
Access to services	Service sought	Napak	Moroto	Kotido
Access to services (%)	Markets	35	17	33
	Primary schools	26	21	33
	Secondary schools	15	9	15
	Medical facility	31	20	39
	Traditional healer	27	12	29
	All weather road	24	13	36
	Nearest town	27	18	39
Distance to services (km)	Markets	3.1	4.9	4.2
	Primary	1.0	1.2	4.2
	Secondary	2.6	4.9	17.6
	Medical facility	3.3	3.4	1.1
	Traditional healer	1.4	0.8	0.9
	All weather road	4.3	5.1	1.7
	Nearest town	8.9	5.9	12.7

TABLE 9. Information access in Karamoja sub-region, Uganda

Information type	Napak (%)	Moroto (%)	Kotido (%)
Forecast on drought	18	20	25
Forecast on floods	14	16	16
Forecast on pest or disease outbreak	20	22	24
Forecast on start of rains	29	20	27
Forecast of weather for the next 3 months	4	16	12
Status of security in the area	19	21	31
Livestock prices	7	17	26
Livestock services	8	15	24

onset of rainfall were the most accessible information in the study area. Information on livestock prices and services, as well as weather forecast for the next 3 months, was the least accessible (Table 9). Further, 43% of respondents belonged to a savings and/or loans group. Of these, 14, 5 and 24% were from Napak, Moroto and Kotido districts, respectively. About 11% received information from Non-Governmental Organisations (NGOs) and 10% received information from local leaders/politicians and 31.6% received livestock services from veterinary extension workers (Community Animal Health Workers). In terms, of governance, the community relied on traditional justice system and conflict resolution mechanisms for example; 73.1% relied on mediation meetings and negotiations by elders to solving pastures and grazing lands conflicts within and with neighbors.

DISCUSSION

Absorptive capacity. This study has presented adaptation range profile of pastoral and agro-pastoral communities in Karamoja corresponding to adaptive capacity, absorptive capacity and transformative capacity. We take this approach because for semi-arid regions and Karamoja sub-region in particular that is susceptible to stochastic extreme climate events such as drought and/or floods. In such areas, adaptation actions that lead to attaining resilience in ways that absorb shocks and maintain form and function can be challenging (Brand and Jax, 2007; Brand, 2009). Thus, it is critically important to have sound knowledge, information on the dynamics and capacities relevant for resilience building. Land as observed in this study was primarily owned through customary tenure, it was inherited by individuals and bequeathed to the future generations through lineage arrangements. Customary tenure rights and management systems have existed in pastoral societies for generations (Robinson, 2019). While they have existed, they have traditionally been devoid of individual ownership arrangements but rather a communal mode. This could be signaling shifts in land tenure arrangements evolving among pastoral communities. These patterns could be driven by sedentarisation of pastoralists (Byakagaba *et al.*, 2018).

This study has also observed that there is a significant emphasis of crop production as indicated by 98% of the respondents that confirmed that a portion of land they owned was used for crop production. In the post-disarmament era (after 2007), a strong emphasis by Government of Uganda and hundreds of non-governmental organisations and community based organisations in the sub-region was put on promoting cultivated agriculture as an ingredient for the region's food security. It thus appears that this has become 'a success' amidst pastoral and agro-pastoral communities. As observed by (Nakalembe *et al*., 2017) a significant increase in cropland from 2000 to 2011 was registered but this was not matched with any significant increase in crop production or food security as food aid continued to be critical amidst crop failures. Similarly, this study observed food shortage windows that correspond to the drought episodes within the sub-region. (Stoudmann *et al.*, 2019) observed similar patterns in the Alaotra, Madagascar where hunger corresponded with the period within which crops were growing.

On average, the livestock asset holding per household in the sub-region is small compared to what traditionally has been known of pastoral communities. This, however, varied with a tribal grouping with the more pastoral communities in Moroto district (Matheniko) having higher livestock herd size, followed by Kotido district (Jie) and Napak district (Bokora). This pattern was similar for all livestock species expect sheep whose herd size was larger in Kotido district. National, historical, local to external dynamics have shaped the observed patterns. First, Napak district is generally wetter than both Moroto and Kotido districts; as such there is

considerable sedentarisation to crop cultivation in this district. Second, during the disarmament period, Napak (Bokora community in Bokora Iriri, Bokora East and Bokora West) district was the first to respond to voluntary disarmament. However, other neighboring communities such as the Pian in Nakapiripirit district, Matheniko, and Jie had remained armed. This exposed this community to livestock rustling of epic proportions within a short time interval, subsequently reducing the livestock herds in the area to decimal proportions. Between 2007 and 2008; this area was the locus of livestock raiding accounting for 40% of all the incidents in the sub-region and leading to about 57% loss in all the total livestock herd with an average of 39 cattle-equivalent lost per household in 2008 (Knighton, 2010). Yet their ability to undertake counter raids for herd reconstitution had been constrained by the disarmament exercise (Knighton, 2003; Knighton, 2010).This could perhaps explain why Napak district has remained with low livestock populations since the threat of raids was constantly real that even rebuilding the herd through long-term restocking and breeding became uncertain.

Conversely, these patterns have influenced the livestock herd size, livestock species mix (cattle, goats, sheep and camels) and gender based livestock assets ownership. Mixed species livestock herds are often kept by pastoral and agro-pastoral communities as a traditional risk escaping and survival strategy to frequent stochastic and extreme weather events especially drought (Shiferaw *et al.*, 2014; Rojas-Downing *et al.*, 2017). While the camel herd size observed in this study is relatively small, it is nonetheless an important observation because traditionally, the Karamojong have been cattle, goats and sheep keepers as such camels are relatively a new phenomenon in the sub-region. This was similarly observed by (Salamula *et al.*, 2017) with diverse sources of initial stock including inheritance, purchase, receiving from bride price payment and receiving as a gift from the Turkana and Pokot kinsmen from Kenya. However, the patterns of camel ownership in the sub-region are likely to exacerbate inequality in the long-term especially for those that will not be able to participate in the market (Galvin, 2021). Further, the limited livestock ownership by women has potential to tilt the balance of the pastoralist's household subsistence value if the livestock is sold by the male owners. This could offset the household food and nutrition security status.

Results of this study revealed a positive perception in the sub-region in terms of access to both productive and non-productive assets. Access to water and pasture was observed to be normal with the only constraint being increased distance (6 to 23 Km) during the dry season. Traditionally, pastoral and agro-pastoral communities in the region exercise transhumant grazing practices as strategy to opportunistically exploit water and pasture resources occurring across the heterogeneous landscape (Egeru *et al.*, 2014). Such a practice of season-distance interface mobility is not only unique to Karamoja sub-region but to several other pastoral and agro-pastoral groups in Africa; Maasai in Kenya (BurnSilver *et al.*, 2004), Fulani in Sahel (Sakamoto, 2016), and Borana of Ethiopia and Kenya (Robinson *et al.*, 2017). This is one of the important adaptation strategy pastoralists use to cope with environmental variability regardless of the environmental uncertainty across the landscape (Gillin, 2021). Respondent's perceptions on access to non-productive assets such as education, health, roads and markets was incredibly high. This pattern could be a result of recent efforts by Government of Uganda to construct more primary and secondary schools, construct markets in most of the districts, and upgrade roads including feeder roads. These results are in contrast with those of the repeated barrage of non-access to infrastructure in the pastoral areas (Pavanello, 2009; Datzberger, 2017). Consequently, a shift of the narrative now ought to happen with regards to access to these

assets from merely access to effective utilisation to generate the espoused net benefits out of these assets. In addition, taking into consideration perception and motivational aspects that influence response towards particular adaptation actions will be critical as often the adaptors psychology leads to dynamic processes and decisions (del Pozo *et al.*, 2019).

Multiple coping and adaptation strategies in the sub-region depicting attributes of purposefulness and timing as well as aspects of reactiveness and anticipation were observed. Use of improved seed and animal breeds, application of livestock manure, and planting early maturing crops are aspects that reflect the regions' actions towards strengthening planned adaptation options to climate variability. This can be attributed to focused efforts by Government of Uganda and Non-Governmental Organisations in the region to provide appropriate agricultural inputs for the sub-region. Under Karamoja Development Programme and Northern Uganda Social Action Fund (NUSAF); specific actions towards seeds and planting equipment were implemented. These actions also represent an effort at facilitating realisation of both incremental and transformational adaptation (del Pozo *et al.*, 2019). While these adaptation options are reported to be taking place, the rate of crop failure estimate at 70% potential annually still persists in the sub-region. This could be partly because additive incremental actions such as those in use in the sub-region often run the risk of path-dependent decisions that lock the pastoral and agro-pastoral communities into sub-optimal trajectories. This because providing early agricultural inputs inform seeds alone is not adequate to addressing the challenges imposed by climate variability and change such as moisture deficits. Instead more robust proactive and ambitious actions are required such as providing water for production to support irrigation in combination with seeds and fertilisers among other inputs. Meanwhile, maladaptation options were also reported in particular selling of firewood and charcoal. This response action is reactive in particular during the drought episodes and such practices are likely to worsen the vulnerability conditions and negative impacts of climate variability and change (Kimaro *et al.*, 2018). Reliance on charcoal in the sub-region could also be attributed to northward trajectory of the expanding charcoal belt in Uganda. According to (Fazey *et al.*, 2011) such narrow economic vested interests often lead to maladaptation at some level of society as a whole and will likely exacerbate the effects of climate variability on the communities (Wise *et al.*, 2014; Kimaro *et al.*, 2018).

Adaptive capacity. Livelihood sources, livelihood assets and associated income observed in the sub-region reveals pastoral and agro-pastoral adaptive capacity range. According to (Adger, 2006) adaptive capacity represents the ability of a household or community to adjust to changing social, economic and environmental conditions including climate variability and extremes to moderate potential damages, and take advantage of opportunities, or to cope with the consequences thereof. We have been able to observe two key groups of strategies; those that represent shifts to non-pastoral practices for example harvesting of gums and resins, reliance on remittances, mining and quarrying and trade (both in terms of livestock sales and retail). It has been observed that non-livestock livelihood strategies have particularly been growing among the non-livestock owning households and poorer herders (Iyer *et al.*, 2017) in the post-disarmament period as livestock concentrated more among more wealthier owners (Stites *et al.*, 2016). Adoption of camels, spraying livestock, selling livestock, early planting and planting of early maturing crop varieties in part represent the adjustments in pastoral practices. (Galvin, 2021) documents that livestock trade and livestock markets have been on the increase in the sub-region with good performance

supplying livestock both within Uganda and to the neigbouring countries; Kenya and South Sudan. Livestock markets in addition to other interventions have particularly had a positive impact on the resilience of the people of Karamoja (Akabwai, 2021). These patterns have previously been observed among the Borana pastoralists of South Ethiopia (Berhanu and Beyene, 2015). These actions are part and partial of the actions that pastoral and agro-pastoral communities in the sub-region are taking to diversify their livelihood sources. Previous studies (Sujakhu *et al.*, 2019; Choko *et al.*, 2019) have shown that social groups that engage in diverse livelihood activities are less vulnerable due to a cushioning and ameliorative effect that alternative sources bring to group in the event of a shock such as a drought.

Transformative capacity. This study identified existence of networks and structures, as well as observed access to information, availability of formal safety nets, and improvement in communication and membership in social groups among pastoral and agro-pastoral communities (Matheniko, Bokora and Jie) in studied. According to (Béné *et al.*, 2012; Ifejika *et al*., 2014; Opiyo *et al.*, 2018) access to livestock services, access to market and private sector institutions, improvement in communication, access to communal natural resources, availability of formal safety nets, and membership in social groups are some of the key outcome indicators for transformative capacity of relevance. These indicators were observed in this study at varying levels. Uganda Peoples Defense Forces (UPDF) effective deployment in the sub-region is on the key transformative capacity indicators that is rarely discussed and is often wished away. However, the UPDF represents a governance unit in the governance mechanism capacities that has helped to pacify the sub-region. Prior to voluntary and forceful disarmament and the subsequent intensification of UPDF operations in the sub-region; formal governance mechanisms including administration were virtually existent in the sub-region. Karamoja was at war with itself, with its neighbors and with central government. Civil unrest had reigned in the sub-region since the 1970s during the collapse of Iddi Amin's regime; a time when the Karamojong gained access to guns and that marked a shift in the dynamics of relationships within the tribal groupings in Karamoja as well as with its neighbors. (Krätli, 2010) posits that disarmament is one of those system blind interventions that were pursued in Karamoja, exacerbating and expanding rather than reducing the challenges but it was necessary to bring civil order to Karamoja, otherwise moving from the technical knee jerk solutions to understanding the pastoral production system 'as a working model' would have been a difficult step to take.

Network structures have particularly been identified as important in resilience building because of their capacity to mobilise resources and avail information that would otherwise not be available at individual level (Gotham and Powers, 2015). Indicator outcomes of network structures including availability of formal and informal social safety nets, access to communal natural resources in particular water and pasture as well as bee hives, quarries, gums and resins, shrubs for traditional medicines and for fire and charcoal were identified in this study. Communal natural resources form a foundation of pastoral transitions and livelihood diversification and as this happens the stock of natural resources and social capital and networks that set rules for access of these resources and define how they can be managed remains critical (Galvin, 2008). The role of network structures has played in providing a supportive transformative capacity among the Borana pastoralists has been previously documented (Ambelu *et al.*, 2017; Birhanu *et al.*, 2017). In particular, they note that network structures are critical in supporting enabling environment for resilience elements including governance, peace and

security. Considering that grazing of livestock outside Karamoja was restricted following the disarmament, the pastoral households experienced a sort of localised heightened grazing pressure leading to localised degradation (Egeru *et al.*, 2015). Despite this perceived shrinkage in pasture resources, the pastoralists have expanded and reconfigured their grazing territories and landscapes through new interconnections and networks founded reciprocity and peaceful co-existence within the sub-region.

CONCLUSION

In this study, we apply the integrated analytical framework for resilience indicators analysis to identify the range of adaptation options and actions in response to perceived climate variability and change among the pastoral and agro-pastoral communities of Karamoja sub-region, Uganda. We characterise the adaptation range into three broad groups in relation to respective capacities; absorptive, adaptive and transformative capacities and use the indicators within the respective capacity group to provide the adaptation options and actions. We find that there is a strong perception among the pastoral and agro-pastoral communities in the sub-region of climate variability and change evidenced by the existence of extreme weather events including: floods and drought, variability in rainfall onset and cessation, hailstorms, and emergence of 'new diseases and pests' for both humans and livestock. While there are actions in the region's transformative capacity, the communities' actions are fundamentally within the absorptive capacity by large revealing their intent into maintenance of stability and seeking behaviour to fortify their ability to buffer the impacts of shocks and stresses on their livelihoods caused by the perceived climatic variability and change. We also find the communities undertaking actions that increase their flexibility. In particular, we note the exploration of alternatives such as harvesting of resins and belonging to savings and cooperative society. In terms of institutions, the traditional justice systems through the elders as custodians and negotiators of peace and rights of access to grazing and watering sites still remains critical in the sub-region. In spite of this, other mechanisms that facilitate the region's motion towards change are taking shape for example their ability to access early warning information on pests and diseases constitutes a key part of the network structures. In this regard, adaptation and resilience programming efforts in the sub-region need to undertake a reconsideration to critically examine their priorities to target strengthening adaptive and transformative capacities of the communities whilst building on the communities' absorptive capacity.

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