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Climate risk management information, sources and responses in a pastoral region in East Africa

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ABSTRACT

Pastoralists in East Africa face a range of stressors, climate variability and change being one of them. Effective climate risk management involves managing the full range of variability and balancing hazard management with efforts to capitalise on opportunity; climate risk management information is central in this process. In this study, pastoralists' perceptions of climate change, climate risk management information types, sources and attendant responses in a pastoral region in East Africa are examined. Through a multi-stage sampling process, a total of 198 heads of households in three districts were selected and interviewed using a semi-structured questionnaire. In addition, 29 focus group discussions and 10 key informant interviews were conducted to generate qualitative information to supplement survey data. Descriptive and thematic analysis were utilised in summarizing the data. Ninety-nine percent of the pastoralists noted that the climate had changed evidenced by high but erratic rainfall, occurrence of floods and variation in rainfall onset and cessation among other indicators. This change in climate had led to emergence of 'new' livestock and crop diseases, crop failure and low yields leading to frequent food shortages, water shortages, poor market access, and variation in pasture availability among other effects. Climate risk management information was received from multiple sources including; radio, diviners, community meetings, shrine elders, humanitarian agencies, and Uganda People's defence forces (UPDF). Community meetings were however perceived as most accessible, reliable and dependable sources of information. Shifting livestock to dry season grazing and watering areas, selling firewood and charcoal, seeking for military escorts to grazing areas, purchasing veterinary drugs, shifting livestock to disease 'free' areas, and performing rituals (depending on the perceived risk) constituted a set of responses undertaken in response to perceived climate risk. It is recommended that an integrated early warning system that captures the perceptions and practices of the pastoralists is implemented as this would increase the credibility of climate risk information disseminated.

Introduction

Climate risk represents the probability of a defined hydro-meteorological hazard affecting the livelihood of farmers, livestock herders, fishers and forest dwellers (Selvaraju, 2012). Managing climate related risk is at the centre of pastoralism and pastoralists in East Africa have elaborate set of practices, processes and institutions to deal with climate risks

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especially drought (Swallow, 1994; Birch and Grahn, 2007; Ericksen et al., 2011; Christensen Fund, 2015). In managing climate risk; information, information sources and its transmission to the target audience is vital. This is because climate risk management information is central to providing answers to a range of questions relating to adaptation (Wilby et al., 2009). A better understanding of what information is available and valuable is key to managing climate risks in the present and the future in any place (Hellmuth, 2015). Effective climate risk management addresses the full range of variability, balancing protection against climate-related hazards with effort to capitalise on opportunity. It also includes a culture of climate awareness as well as systematic use of climate information among a range of stakeholders (Hansen et al., 2007).

The United Nations Framework Convention on Climate Change (UNFCC) indicates that climate risk management embodies three aspects of the risk management process: (i) risk assessments for informed decision-making; (ii) risk reduction, planning and preparation; and (iii) risk sharing, pooling and transfer in the context of adaptation (UNFCC, 2011). Pastoralists in East Africa have for long executed these aspects through deliberate and/or involuntary actions. In most of the pastoral communities in East Africa, different elements of risk are closely monitored by pastoralists (Barrett et al., 2001) and, elaborate social networks based on kin, ethnicity, age and other principles are maintained to gather and disseminate information about risk. Herders are well aware of the tough decisions that have to be made from time to time and in certain years (Little et al., 2001). The Turkana, Boran, Chamus, Gabra, Guii, Rendille, and Samburu for example conduct risk assessment from time to time using village meetings, forecasts, grazing committees, elder's memories and herders who monitor grazing and watering locations (Luseno et al., 2003; Oba, 2012). Based on the information obtained, response options are enforced, these may include among others: making alliances with friendly communities, escorting and arming herders with rifles owing to perceived and/or actual security threat, sharing and hospitality, livestock tenancy arrangements, and bride-wealth (Swallow, 1994; Hendrickson et al., 1996; Christensen Fund, 2015). Further, the Maasai, Turkana, Matheniko, Gabra, Rendille and the Afar alike exercise risk reduction, planning and preparation through herd splitting and transhumant grazing leveraging on pasture heterogeneity in space and time (Oba and Katrina, 2006; Oba, 2012; Opiyo et al., 2011).

In addition, an important strategy often adopted by pastoralists in East Africa is agistment. This is an alternative strategy that incurs low capital costs, and is flexible to changing spatial rainfall patterns. The arrangement is facilitated through a network of kin, friends of friends, business partners, and adversaries; these interactions match pastoralists who have a shortage of forage to pastoralists who have an excess (McAllister et al., 2006). The Maasai of Kenya for example often practice gifting with their Tanzanian Maasai friends and kin (Galvin et al., 2004; Lybbert et al., 2004; Radeny et al., 2007). Similarly, the Matheniko and Pokot of Uganda and Turkana and Pokot of Kenya practice agistment including transfer of stolen livestock across borders in some occasions (Agade, 2010; Eaton, 2010; Lambroschini, 2011).

Effective climate risk management involves managing the full range of variability, balancing hazard management with efforts to capitalise on opportunity (Hansen et al., 2007; Elhadi et al., 2015). However, climate risk management often faces a challenge of mismatch between information provided and information needed. Critical interpretation and tailoring of climate information forecasts can improve the quality and usability of climate information (Goddard, 2010; Asrar et al., 2013). In addition, understanding the sources of climate risk information is vital in focusing adaptation efforts by identify and bridging various gaps (Senaratne, 2014). It is also essential in rallying decision makers across society to take actions that will enhance their capacity and willingness to adapt to climate change (ACCCA, 2012). One of the weaknesses of climate risk reduction efforts has been the utilisation of inappropriate sources to communicate climate risk information. This partly, arising from the limited understanding of operations and interactions involved; including the different actors, stressors, experiences and meanings operating at community level. As such, responses to climate change ought to be understood from the perspective of an ongoing process involving negotiating and aligning different constructions of risks (Granderson, 2014). Climate risk information should thus be able to support this kind of process at every level. However, this has been in short supply in East Africa particularly because climate risk information is too technical, confusing, and difficult to translate into viable actions at local level. In addition, there is limited scope and practicality of information regarding the predicted implications of climate change (Daly et al., 2010).

As already noted earlier, climate risk management is central in pastoralism and as exercised by pastoral tribal communities of East Africa. Improved risk management and attendant diversification in pastoral areas is a complex issue requiring better access to information (Little et al., 2001). For example, pastoralist risk management efforts in Kenya and Ethiopia have revealed that better access to markets and market information increased rates of livestock sales and reduced livestock losses during drought. It also provided better opportunities to re-stock when ecological conditions improved (Bailey et al., 1999; McPeak, 2001; Kirkbride and Grahn, 2008). Thus, the integration of scientific and local knowledge is essential in enhancing risk-based management approaches and adaptation by providing insight into the adaptation process, facilitating community-based learning, co-production of knowledge, and increasing the usability of climate science information (Moser and Dilling, 2007). Undertaking such integration requires a proper understanding of information sources available to pastoral communities as well as the range of responses they exude when utilised. This is particularly important because knowledge sharing mechanisms relevant to local context are key for effective communication of value-added climate information (Selvaraju et al., 2004). Therefore, this study examined pastoral perceptions of climate change, climate risk management information, sources and the attendant responses in a pastoral region of East Africa.

Materials and methods

Description of study area

This study was undertaken in Karamoja sub-region of Uganda. Karamoja is located in northeastern Uganda between 1°.4′–4.24°N and 33°50′–35°E. It is inhabited by the 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 (Fig. 1). The area is the driest region of Uganda for many months of the year (Mubiru, 2010). Climate variability and change has been observed with a persistence of high rainfall variability intensity, changes in rainfall onset and cessation and increase in temperatures (Egeru et al., 2014a,b). Rain distribution in the sub-region is generally poor thus the risk of crop failure is largely a result of poor rainfall distribution rather than the lack of rains. Because pasture and browse are not affected in the same manner as crops, livestock herding remains a better coping and adaptation strategy in the sub-region (Levine, 2010). 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., 2014c). 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., 2014c). The rangelands provide key grazing grounds but are currently minimally utilised. This is particularly attributable to security constraints, where some areas between two tribal groups are left as a 'no-man's-land' to avoid the risk of conflict (Levine, 2010). However, some locations are heavily grazed and have become degraded. This is not caused by excessive livestock numbers but because the normal herd management practices have been disrupted, especially by the 'protected kraal' system, which continues in one form or another in some areas in the sub-region (Levine, 2010; Mugerwa et al., 2014). Karamoja is generally a remote region, whose accessibility is constrained by poor road infrastructure that from time to time is made impassable by floods. The sub-region has access to a range of FM radio stations from within the sub-region and out-

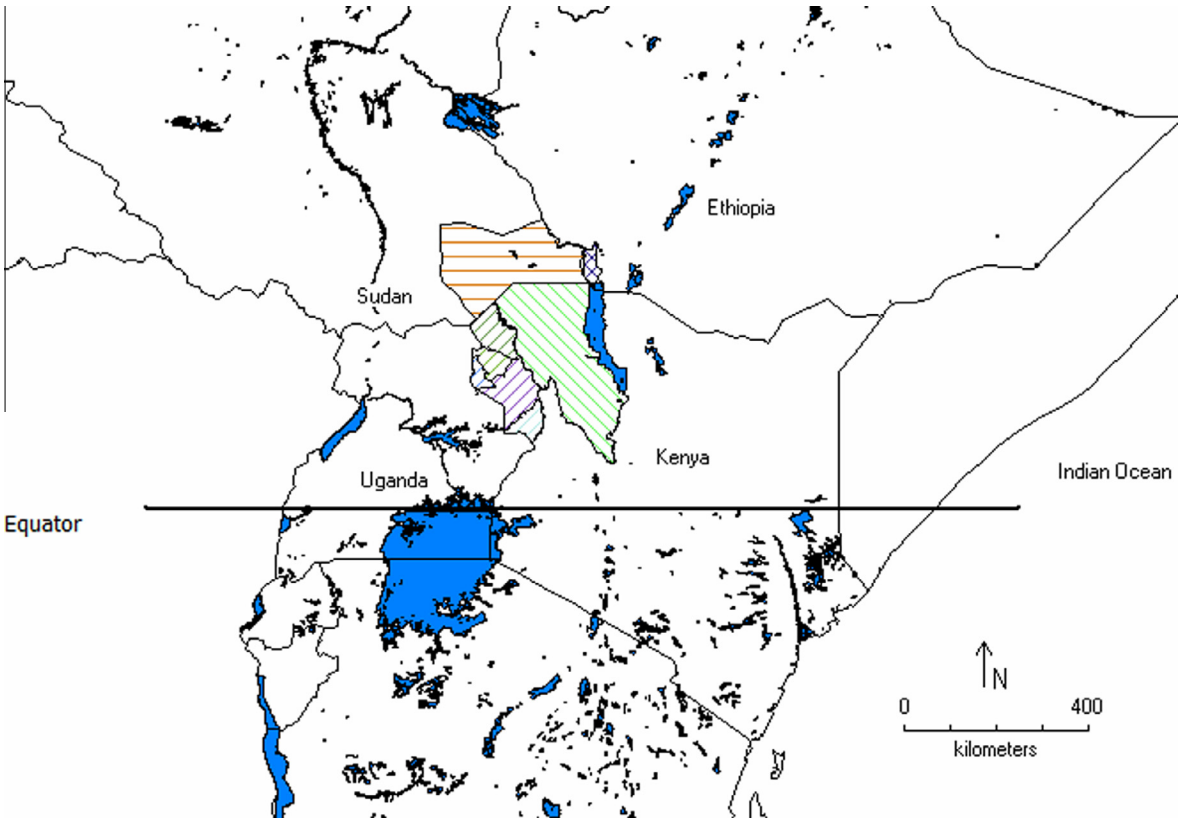

Fig. 1. Karamoja cluster geographic location in East Africa. SE Sudan, Toposa (horizontal red); SW Ethiopia, Nyangatom (criss-cross blue); NW Kenya, Turkana (diagonal green) and NE Uganda (criss-cross light blue, purple diagonal, green diagonal and criss-cross light blue); representing the Pian, Matheniko and Bokora, Jie and Dodoth, and Labwor tribal groupings respectively (Source: Adapted from Grade (2008)). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

side the sub-region (West FM, Karamoja FM, Nenah FM, Luo FM and Veritas FM). Some of these radio stations are however limited in geographical coverage with a listener preference of some sort (ACTED, 2013).

Data collection

This study utilised a multi-stage sampling procedure with a series of stages that culminated into simple random sampling, in a sample size of 207 households. Sample size was proportionately allocated based on the 2002 Population and Housing Census 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. Fifteen specially trained field assistants who had completed their Uganda Advanced Certificate of Education were utilised in the exercise, five in each district and were under daily supervision of the research scientist. The pastoralists were interviewed using a pre-tested semi-structured questionnaire whose Conrach's reliability static had been confirmed at 88.5%. The survey was conducted in January to February, 2013. Face to face interviews were preferred because they permit for longer survey time once the interviewer has gained entry and initial cooperation and acceptance from the respondent (Neuman, 2012). In addition, twenty-nine focus group discussions (Figs. 2.1 and 2.2) were held with various groups including security personnel, youth and herders, elders, and Community Animal health workers (Table 1). During the focus group discussions, additional participatory techniques such as proportional pilling, seasonal calendars and historical timelines were utilised to validate climate variability and change perceptions, information sources and responses. In addition, a total of ten key informants purposively selected were interviewed including: 3 District Veterinary Officers, 2 District Environment Officers, 1 Opinion leader, 2 Resident District Commissioners, and 2 senior security personnel of Uganda People's defence Force (UPDF).

Data analysis

In view of the objective of this study, descriptive and thematic analysis were utilised to summarize the data. Descriptive statistics were utilised for quantitative analysis supplemented by thematic analysis utilised to analyse qualitative data obtained from key informant interviews and focus group discussions. Thematic analysis involved immersion in and familiarisation with the data. This was followed by sorting, coding and categorising bodies of text, passages and sayings into representative emerging patterns. These evolving patterns were subsequently grouped into relevant and common issues they addressed and further helped to validate the survey results. The analysis at this stage subsequently became deductive; with categories derived from prior knowledge helping to guide the process, and inductive, with categories emerging purely from the data receiving categorisation and placement in their respective created groupings. Descriptive statistical analysis was conducted Statistical Package for Social Scientists (SPSS v.20.0).

Results

Pastoralist's perceptions of climate change

In order to cope and adapt to climate change, pastoralists must first perceive that there is a risk caused by changes taking place. Results of the survey and focus group discussions showed that pastoralists (99%) in the sub-region perceive that the

Fig. 2.1. FGD with the youth/herders at Lomejan Kotido district.

Fig. 2.2. FGD with the elders in Lomejan Kotido district.

climate has changed in the sub-region with increase in temperatures (72.2%) and high but erratic rainfall (94.0%). Further, 91%, 52% and 47% of the pastoralists noted that drought, floods, and hailstorms were common in the sub-region (Fig. 3). One of the key informants noted that there has been a shift in the onset period of rainfall from the 'traditional' pattern (March to April) that was known to the community to unpredictable and reliable onset and cessation. Consequently, pastoralists often say "*that is not our rain*, *we have been waiting for our rain*, *and it did not come*" he noted.

Pastoralists were asked what they thought was the cause of the change in climate in the region. In their view, climate change particularly poor rains and higher temperatures in the region were caused by destruction of vegetation cover (25.2%). Failure in rainfall was attributed to witchcraft (including practices such as slaughtering donkeys, burying pots, killing dogs, calling eagles during the rainy seasons), bush burning, shedding of innocent blood (through cattle rustling; thought as a punishment from 'godly being'), strong winds and annoying elders at the shrines. On the other hand, the existence of peace, construction of large dams, initiation of the Ngilobae (antelope) age set and natural processes were perceived as responsible for the observed episodes of high rainfall in the sub-region (Fig. 4).

A number of impacts attributed to climate change were observed to have emerged including among others: emergence of 'new' pests and diseases (for both livestock and crops), crop failure and low yields, poor market access particularly during the rainy season, occasional insecurity, human-wildlife conflicts and food insecurity (Fig. 5). Perceived severity assessment revealed that 56.5% and 26.9% believed that droughts and floods were severe in the sub-region. Forty six percent of the pastoralists believed that crop failures were very severe. Meanwhile, 63.2% perceived that the 'new' diseases for both livestock and crops were severe and destructive to crops and livestock. Pastoralists noted with concern the high prevalence of ticks in the grazing areas, Anaplasmosis (Lopid; a tick borne disease) and Foot and Mouth Disease-FMD (Ebaibai); these were perceived to have become prevalent with the change in climate in the sub-region. Sixty percent of the pastoralists also observed that food shortage was severe in the sub-region and this was also linked to disease, drought, and floods associated with climate variability and change. Forty percent of the pastoralists also noted that climate variability and change severely affected security in the region noting that insecurity was severe and moderately severe particularly during drought periods (Fig. 5).

Climate risk management information types and information sources

Overall, 58.8% of the pastoralists indicated that they received one form or another of climate risk management information (Fig. 6). Seventy-eight percent (78.5%) of the pastoralists noted that they received rainfall onset forecast information from radio (29.3%), traditional healers and medicine men (16.1%), shrine elders, indigenous knowledge through the observation of ants movements, cloud formation patterns, signs and shapes of the moon, and animal sacrifices including the reading of animal offal among other sources. Sixty-three percent acknowledged to have received forecast information on drought. Drought forecast information was transmitted through radio (26.7%), traditional healers and medicine men (15.5%),

Table 1
Number of focus group discussions by district and participant category.

District	Security personnel	Youth/herders	Elders	CAHWs	Total
Napak	2	3	2	1	8
Moroto	3	3	3	1	10
Kotido	3	3	4	1	11
Total	8	9	9	3	29

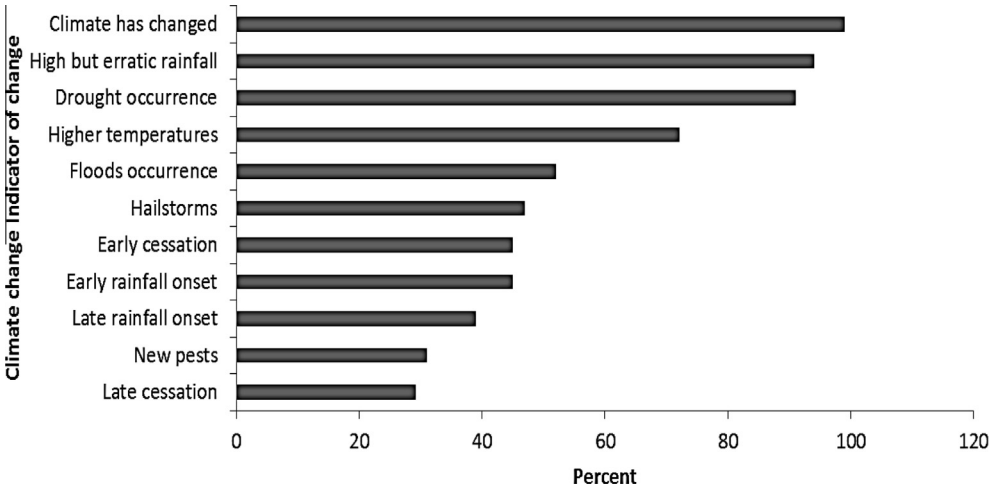

Fig. 3. Pastoralists perceptions of rainfall and temperature patterns in Karamoja sub-region.

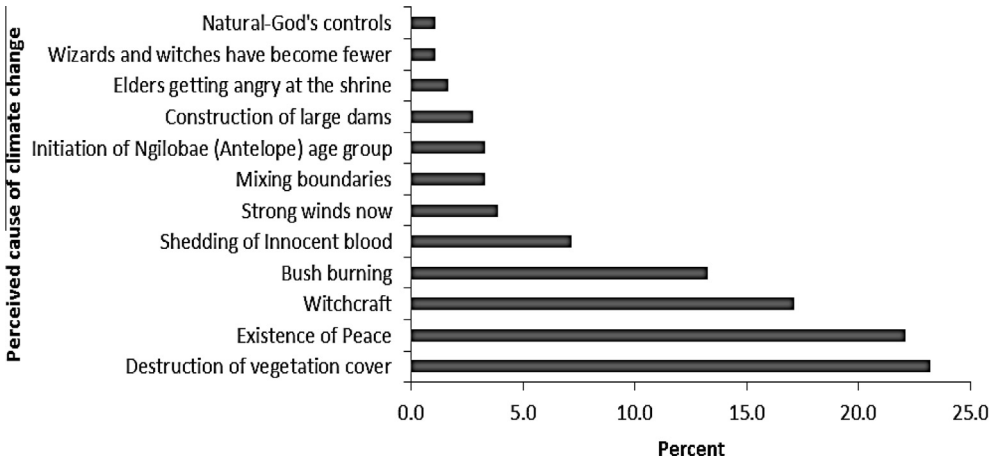

Fig. 4. Perceived causes of climate change.

community meetings (13.7%) and other sources including: neighbours, relatives, and humanitarian agencies such as NGOs. Only 48.4% of the pastoralists indicated that they received floods forecast information. This information was mainly shared through radio (26.9%) and shrine elders (21.3%). Sixty-nine percent of the pastoralists also confirmed to have received information on pests and diseases for both crop and livestock from radio (17.4%), traditional healers and medicine men (15.9%), shrine elders (12.7%) and herd's men (10.3%) among other sources.

Seventy-four percent of the pastoralists indicated that they received security alerts from the Uganda Peoples defence Forces-UPDF (27.7%), foretellers, mediums and medicine men (15.3%), shrine elders (13.8%), community meetings (11.6%), warriors in charge of security (2.9%) and peace mobilisers (1.4%) among other sources. Pasture locations and dynamics information was available to 76.4% of the pastoralists and this was provided by youth and herders (50.8%), hunters (21.1%), kraal leaders (7.8%), friends, relatives and neighbours (7.0%) and the UPDF (1.6%) and the traditional calendar (0.8%) among other sources. Further, 71.3% of the pastoralists acknowledged to receiving information on water and watering locations in the event of a drought period; this information they said was mainly provided by youth and herders (44.4%), kraal leaders (15.3%), politicians and local leaders (12.7%), hunters (10.2%) and the UPDF (2.5%) among others.

Livestock price information was available to 56.9% of the pastoralists through businessmen (71.6%), market days (10.2%), neighbours, friends and relatives (7.9%), local leaders (4.5%), local community decisions on price ceilings (3.4%) and radio (2.3%). However, sixty-four percent (64.3%) of the pastoralists noted that they did not receive information regarding when it is good to sell their livestock. Those who acknowledged receiving such information (35.7%) indicated that this information was provided by businessmen (53.3%), market days (15.6%), famine occurrence (8.8%), friends, relatives and neighbours (6.6%) and radio (6.6%) among other sources. In terms of where to obtain livestock and livestock services, 56.4% of the pastoralists acknowledged that they often received such information from different sources including: veterinary extension

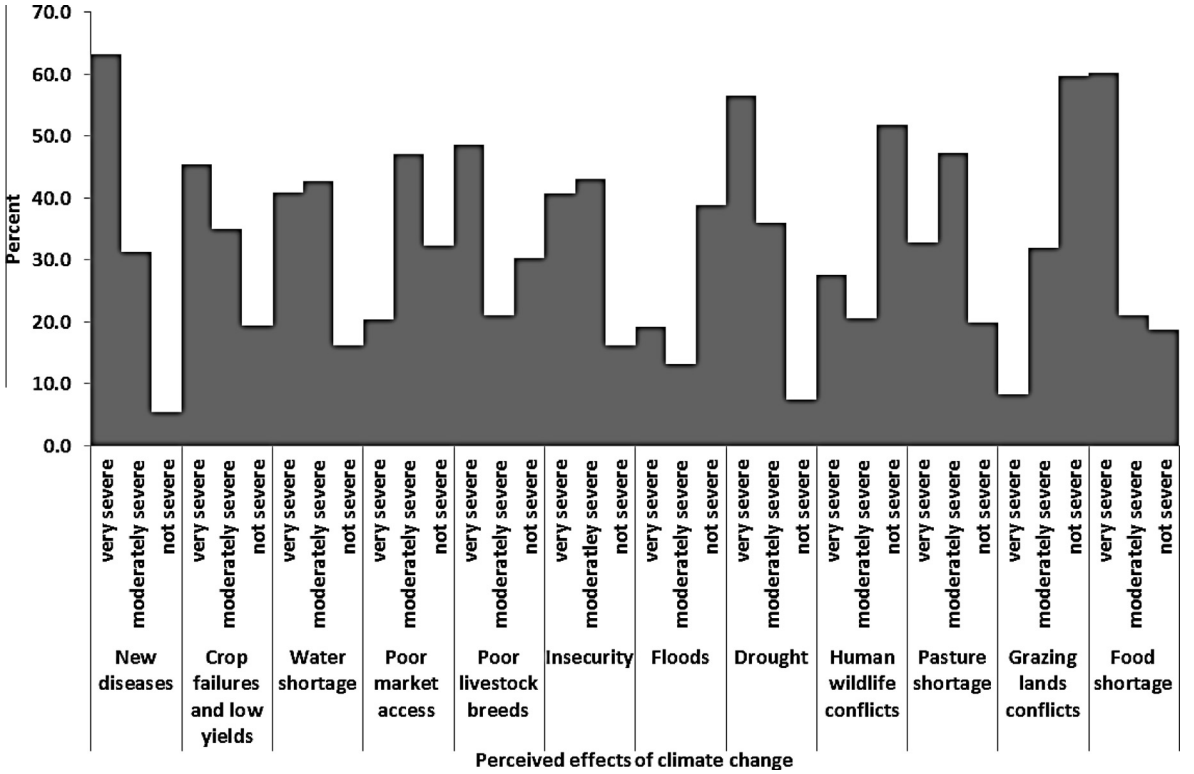

Fig. 5. Perceived effects of climate change in Karamoja sub-region ($n = 194$).

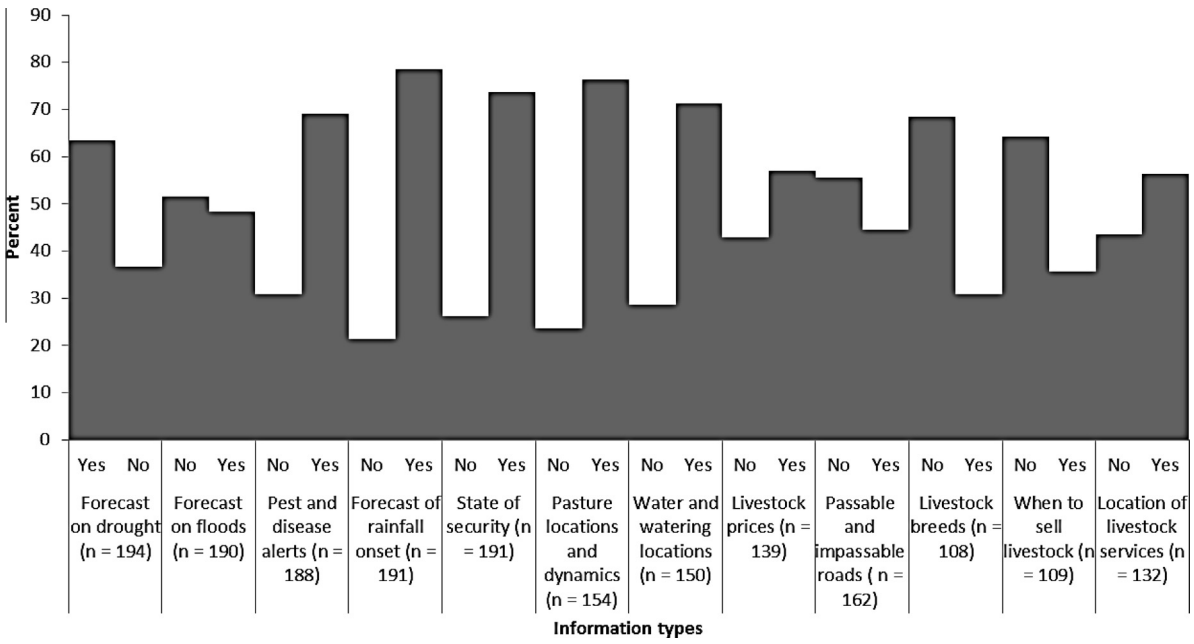

Fig. 6. Climate risk management information types received by pastoralists.

workers (45.0%), herd's men (16.3%), businessmen (12.5%), politicians and local leaders (6.3%) and Community Animal Health Workers-CAHWs (5.0%). Fifty-five percent (55.6%) of the pastoralists noted that they did not receive information on passable and impassable roads during the rainy season however those who acknowledged receipt (44.4%) of such information indicated that radio (23.1%), politicians and local leaders (16.9%), community meetings (15.4%), drivers and travellers

(15.4%), road user committees (4.6%) were some of the sources of information. Pastoralists observed that community meetings (41.6%), radio (23.9%), friends, relatives and neighbours (16.1%), humanitarian agencies-NGOs (10.4%), religious leaders (5.7%), shrine elders (0.5%) and hunters (0.5%) were the most accessible and reliable sources of information in the area.

Pastoralists' responses to climate risk information

Pastoralists receiving and/or not receiving climate risk management information elicit a range of responses to different information types. Cross-tabulation results revealed that whether a pastoralist household received information or not, a there were a set of actions taken at household level (see Appendix A: Figs. 1–12). For both pastoralists categories; those who did and did not receive floods and drought forecast information the prominent response action shifting their livestock to other locations that are with pasture and/or will be less affected by flood waters. Both pastoralist households that did and did not receive information on rainfall onset undertook early garden preparation. Uniquely pastoralists who did not receive information on the status of watering locations elsewhere deliberately contributed towards the costs of borehole repairs within their location (see Appendix A. Fig. 9). Cross-tabulation results also showed that there was particularly a pronounced number of respondents who indicated that they did not take any particular deliberate action either upon receipt of information or not (see Appendix A. Figs. 1–12).

Upon receiving drought early warning information, pastoralists typically respond by preparing and shifting their livestock to dry season grazing areas with pasture and water, performing ritual sacrifices to evoke protection against drought and storing food from their garden harvest, splitting and selling firewood and charcoal, informally sensitising other community members, and preparing to shift to other places with food and water among other actions (Fig. 7). Meanwhile, flood early warning information in the sub-region triggered responses such as creating waterways and embankments around the homesteads (22.9%), informing other community members (22.8%) and performing ritual sacrifices for protection against floods (18.8%). Other response options taken included: staying alert and identification raised areas, moving away from areas adjacent to rivers and planting crops on higher grounds among other actions. In addition, pastoralists who received rainfall onset information responded by preparing their gardens (49.9%), waiting for rainfall onset prior to cultivating (4.7%), early planting (4.7%), performing ritual sacrifices (4.7%) and borrowing seeds in preparation for planting (2.4%).

Pastoralists who received information on pasture locations and dynamics responded by moving animals to such locations with pasture (74.9%), took initiative to identify and confirm pasture availability in such locations (19.2%), participated in grazing meetings arranged by the grazing management committees (2.9%), discussed where to locate kraals (1.9%) and informed neighbours and kinsmen (0.9%). In the same vein, most pastoralists (32.7%) moved their animals to areas with water and watering locations. Others, informed elders, confirmed the availability of water by sending the youth, held access rights negotiation meetings with kraal leaders where the water is located, and sourced for protection and military escorts from the UPDF to grazing and watering locations among other actions (Fig. 8). In addition, those who received information on livestock breeds responded by negotiating for a bull from the identified kraal (10.9%) and observed the traits of the quality breed identified (6.9%) but the majority (82.2%) of whom did not take any deliberate and specific action towards livestock breeds information.

Pest and disease alerts in Karamoja made pastoralists to purchase veterinary drugs and perform livestock health protection rituals, shift their livestock to disease 'free' areas, burn bushes to 'curb' tick infestation, respond to mass livestock

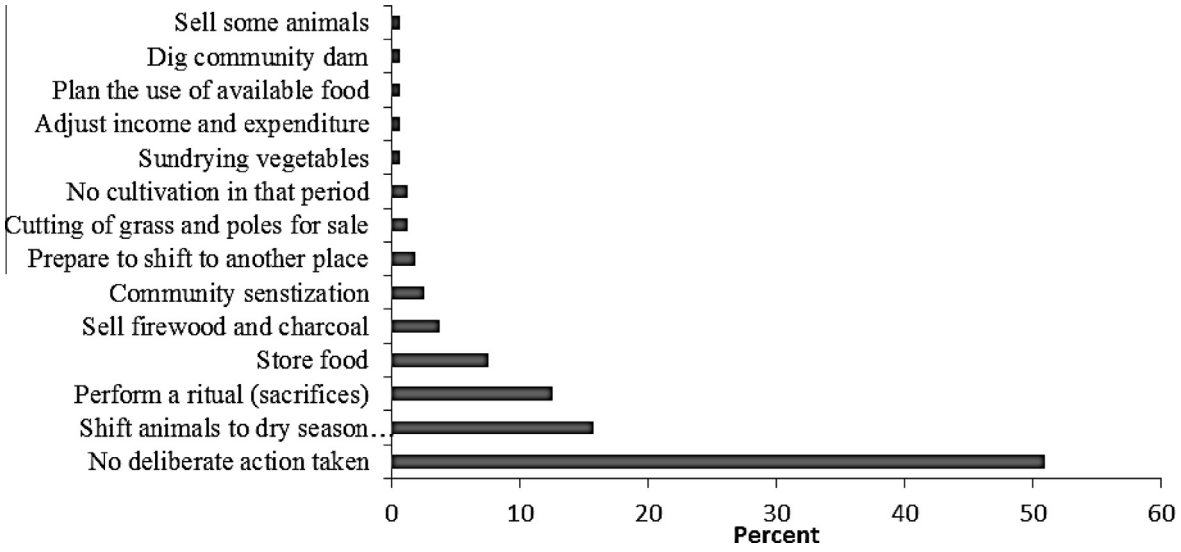

Fig. 7. Responses to drought forecast information.

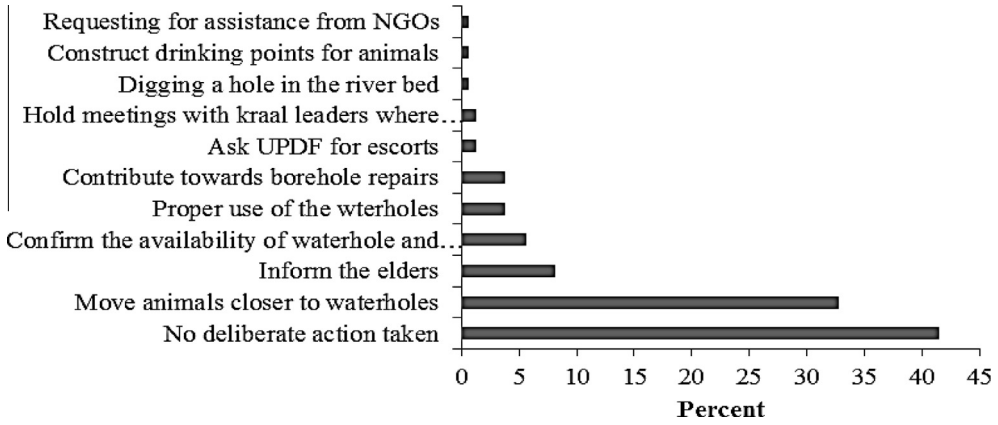

Fig. 8. Responses to water availability and watering locations information.

vaccination and obeyed quarantines imposed by the district veterinary office (Fig. 9). In addition, 36.4% of those who received information about the location and availability of livestock services purchased veterinary drugs, consulted community animal health workers-CAHWs (3.8%), moved animals for treatment (3.8%), informed other community members (2.3%), and 1.5% prepared for the next round of the mass vaccination exercise. A large number of pastoralists (70.5%) did not take any deliberate action in response to livestock market price information. However, 15.1% of the pastoralists noted that they kept their animals until such a time when prices were deemed favourable, 4.3% prepared to negotiate with the businessmen, 3.5% sold their livestock, and 3.6% planned when to sell their livestock among other actions. In terms of response to livestock off-take advisory, only 3.8% sold livestock their livestock when the demand was high, 3.6% identified markets where to sell their livestock, and 2.8% sold small stock (goats and sheep) and/or exchanged it for food items.

Pastoralists who received security alerts responded in sixteen different ways depending on the security outlook provided. For example, informed the UPDF particularly if the information alert indicated threats of impending raids, avoided enemy locations/hotspots, fenced their homesteads and prepared bows and arrows for self-defence, called for and attended a security meeting, 3.6% maintained animals in protected kraals, participated in peace meetings among other actions (Fig. 10). In the focus group discussions, it emerged that some of the pastoralists respond to security information by setting-up defences, arming with spears, bows and arrows and Ngamatida/Amatida (a locally made gun since the Uganda People's defence Forces-UPDF had undertaken a general disarmament in the sub-region. Although the participants were unwilling to further discuss this issue, the author believes that the mere fact it surfaced in the discussions is an indication that locally made guns may be surfacing in the region and the makers are within the region). Road network remains the most vital access artery linking Karamoja sub-region to the rest of Uganda as such information on the state of passable and impassable roads is an important component in the drought early warning system in the sub-region. A majority of the pastoralists (79.8%) interviewed noted that they did not take any specific deliberate action in response to information on passable and impassable roads. However, 4.4% noted that they used footpaths, 3.5% indicated that they contacted and lobbied NGOs for assistance, 1.7% noted that they participated in road repairs through food for work arrangement and others minimized their movements and addressed their concerns to the district administration officials.

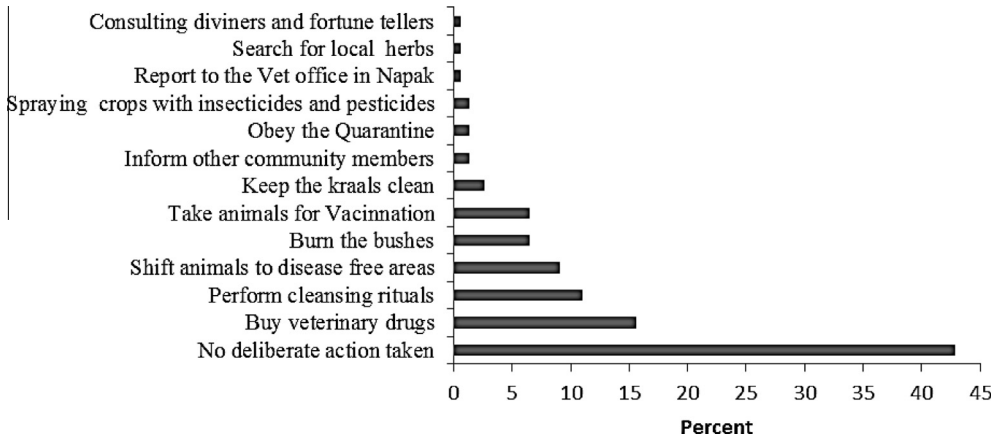

Fig. 9. Responses to pest and disease alerts.

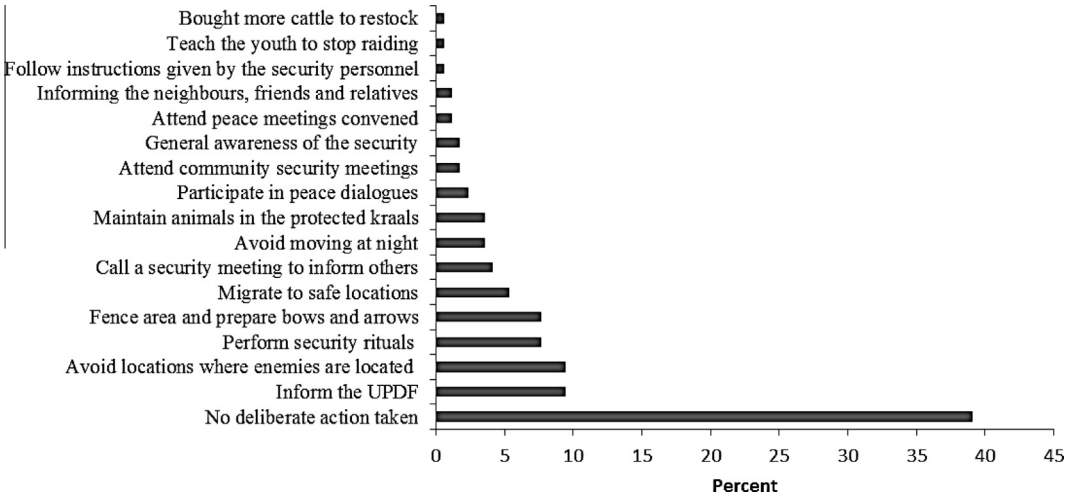

Fig. 10. Responses to security alert information.

Discussion

Pastoralist's perceptions of climate change

The results of this study showed that a majority (99%) of the pastoralists perceive that the climate in Karamoja has changed with high but erratic rainfall, floods, high temperatures, hail storms, early cessation of rainfall among other indicators. These observations made by the pastoralists corroborate some of the results earlier obtained by Egeru et al. (2014c) in analysis of rainfall records in the sub-region. According to Egeru et al. (2014c) temperatures in the region have risen over the last 30 year period (1979–2009). In addition, total rainfall also showed a progressive increase but with persistence of high inter annual and intra-annual variability intensity leading to pronounced prevalence of extreme wet events (floods) in the last decade (after the year 2000). The detail with which the pastoralists were able to provide climate variability and change information could be attributed to their lived experiences. It could also be attributed to the tendency of extreme climate events (droughts and floods) to disrupt their traditional pastoral calendar. According to Hesse and Cotula (2006) rising temperatures, longer and more frequent droughts increase the pressure on pastoral resources leading to a significant rise in destitution among pastoral groups. Meanwhile, pastoralists in East Africa have limited experience of tackling floods because this is fairly a recent challenge compared to drought that they have developed extensive mastery of tackling (Little et al., 2001; Galvin et al., 2001; Lybbert et al., 2004). This could explain why the pastoralists in Karamoja were able to closely identify flooding as an indicator of climate variability and change in the region.

A relatively high number of pastoralists (52%) identified floods as a prominent indicator of climate change in the sub-region; this could be attributed to the most recent devastating flood occurrences in the sub-region such as in 2007 (C & D, 2010), 2010, 2011, and in some months in 2012 (personal interviews). Floods however represent one of the less known pastoral risks and often pastoralists in East Africa have limited proven coping mechanisms of dealing with floods compared to droughts (Little et al., 2001a). From this documentation, it therefore appears that the pastoralist's observation of floods is related to recent flooding events in the region that is still fresh in memory. This corroborates with the findings of Bryant et al. (2000) who noted that community perceptions of climate change often relate to their recent experiences.

The global community is awash with the technical detail of the causes of climate change largely attributed to the heat-trapping of increased concentrations of atmospheric greenhouse gases emissions (WISP, 2010). The worldview of the Karamojong on one hand bears pointers to this generally accepted norm. This is because they identified destruction of vegetation cover and bush burning as causes of climate change and variability. It is generally acknowledged that deforestation has a role in climate change since it is responsible for 17% of all the annual anthropogenic greenhouse gas emissions (Gorte and Sheikh, 2010). The perceptions held by the Karamojong also corroborate with the findings of Nimussima et al. (2013) who documented similar pastoralist perceptions in Nakasongola and Nakaseke districts in Uganda. It is however not clear whether these perceptions have been formed by local historical observations or they are a result of interactions with the outside world; particularly arising from information dissemination by several non-governmental organisations in the region. According to Deressa et al. (2009) several factors tend to influence farmer's perceptions of climate conditions. In this regard, some of the conditions identified to cause climate change could help shade light while others largely come out as 'superstitious' attributions. In this discourse it is important to acknowledge the pastoralist perception that climate change is a natural process brought by 'God'. This attribution bears two perspectives; on one hand it represents the aculturalisation of a people routed in their firm belief and social setting; this is because Africans are notoriously religious. As such attribution to 'a godly

being' often comes into perspective as an explanation of man's contact with time (time is simply a composition of events which have occurred, those which are taking place now and those which are inevitably or immediately to occur) (Mbiti, 1990). On the other hand, it carries some scientific acumen when the perception of natural is held in singularity. This is because climate change can also be attributed to be caused by natural forcings arising from solar changes (IPCC, 2007); these may perhaps be way far-fetched from the pastoralists' reality but may be implied in rationality.

According to Bryan et al. (2009) in order to adapt to climate change, one must first perceive that change is taking place. In deed the survey results have shown that pastoralists are aware that changes are taking place with a range of socio-economic and environmental effects. Owing to their vast historical experience in livestock, pastoralists clearly identified the prevalence of livestock diseases in the sub-region; particularly tick borne diseases. Some of the tick borne diseases identified such as Anaplasmosis (Lopid) and Foot and Mouth Disease-FMD (Ebaibai) have previously been identified by Gade (2008) and C & D (2010) as endemic in the sub-region. Githeko et al. (2000) and Calvosa et al. (2009) have noted that higher temperatures and changing rainfall patterns have potential of leading to increased vector-borne diseases and macroparasites transmission. In Karamoja, this pattern could perhaps be attributed to the increased prevalence of bushlands that act as tick habitats and this could also explain the pastoralists' response to continuously burn bushes as a tick control mechanism. The range of other risks noted such as floods, droughts, food insecurity, market access and livestock prices have been observed in other pastoral areas of East Africa such as; Somalia, Kenya, and Ethiopia (Bailey et al., 1999; Little et al., 2001a,b).

Climate risk management information types and information sources

Information is valuable in helping people cope with uncertainty because of its potential to resolve temporal uncertainty and improve resource management (Luseno et al., 2003). In that regard, the type of information-message and source of information become important aspects of concern in dissemination. The results of this study revealed two information source pathways. Firstly, the 'modern/formal' pathway represented by radio, extension workers, humanitarian agencies, and civil administration in form of district administration officers, military personnel, church leaders and politicians. These primarily represent the conduit upon which the drought early warning system in the sub-region is nested since 2008. Formal sources of information such as radio have also been documented as important conduits for drought early warning information dissemination in the sub-region (ACTED, 2013).

The second pathway relates with the traditional information sources represented by various traditional norms and practices identified including; rain prediction through sacrifices, community meetings, and reliance on the elders, traditional healers and medicine men. These indigenous knowledge practices identified by the Karamojong are common approaches used for drought and weather prediction in most of Africa (Masinde and Bagula, 2012). While, 'modern/formal approaches to information dissemination have tremendously featured, there was still a high reliance on the informal and traditional approaches to climate risk management information dissemination. This could be attributed to the fact that within the pastoral communities the accumulated traditional knowledge of dealing with climate risk has always worked as decision makers often manage risk holistically (Meinke et al., 2006; Masinde and Bagula, 2012). It also provides the pastoralists with a sense of identity as well as a sphere of control founded on experience and familiarity spectrum.

Responses to information sources

This study has shown that there is a disconnection between receiving information and taking action in response to the climate risk information received and coping with and adapting to climate change. Whereas pastoralists received information on climate risks, there was considerably a large proportion that responded that they did not take any deliberate adaptive action. This could be attributed to lack of familiarity with the action packages often accompanying the disseminated information. Further, the pastoralists have limited financial resources to undertake the necessary investment as required in the disseminated information. The limited and/or lack of deliberate action among pastoral communities has been observed in other pastoral communities in Ethiopia and South Africa (Bryan et al., 2009). The finding that pastoralists had not taken any specific deliberate action to tackle climate risks should however not be understood from its face-value per se. This is because pastoralists address their life challenges on daily basis and as they emerge. Secondly, whether or not information is provided, pastoralists have a set of actions that they have always utilised over millennia in response to climate variability as was revealed by the cross-tabulation results. Therefore, it becomes inconceivable to place a time dimension that insinuates discreteness in the manner of adaptation yet pastoralists daily decisions are derived from a continuum and conjecture of events, experiences and predispositions that make them to address known risks on daily basis.

Secondly, there a pastoralists' familiarity in dealing with drought events in the sub-region. As such, drought occurrence does not particularly warrant any deliberate actions to adapt rather the people adjust autonomously. According to Little et al. (2001b) drought is a familiar climate risk in dryland areas of East Africa and pastoralists have developed extensive mechanisms of dealing with it. On the other hand, all the pastoralists who received flood information implemented some coping mechanisms. This could be attributed to the fact that floods are an unknown risk among pastoralists and often they are limited to the extent of risk and/or the type of behavioural responses required (Little et al., 2001b). It is therefore not surprising that some of the responses undertaken are hasty and represent autonomous adaptation strategies. Adaptation strategies are autonomous or spontaneous if that invariably take place in reactive response to perceived, anticipated and/or actual climatic stimuli (Smit and Pilifosova, 2003).

Thirdly, the limited deliberate action to adapt with regard to livestock prices, passable and impassable roads, livestock breeds, location of livestock services, and security could be arising from their inability to influence extraneous factors and processes outside their environment. Moreover, the Karamojong like pastoralists elsewhere in East Africa have different livestock production objectives. Firstly, livestock accumulation constitutes one of the strategies to risk management among the pastoralists (Little et al., 2001a). Secondly, following periods of raids and counter raids in the sub-region; livestock rebuilding is still an ongoing process and there is therefore minimal interest to participate in livestock off-take. Fourthly, following a series of focus group discussions and interviews; the pastoralists enumerated reasons why they keep livestock to include among others; paying bride price, draught power, provision of milk, meat and blood, educating children, generating income; security in times of adversity, friendship, social status and prestige, transport and performing traditional rituals and rites of passage. Livestock off-take through sale was not a pronounced response in their assessment. Meanwhile, the limited deliberate action on livestock services could be explained by the existence of substitutes inform of ethnoveterinary knowledge and remedies. Gade et al. (2009) has shown that the Karamojong have in their disposal over 209 plant species and 18 non-plant materials used in maintenance of animal health. However, it is important to note that there was a high positive response towards rainfall onset with most of the pastoralists indicating garden preparation as the immediate action. This could be attributed to the exercise of agro-pastoralism. It also shows an increasing indulgence of pastoralists in crop cultivation in the sub-region. According to Little et al. (2001a) cultivation among pastoralists is largely conducted by the poor who are 'pushed' into diversification out of necessity. In a recent study in Karamoja sub-region, Egeru et al. (2014a) have shown that subsistence cultivation over the last decade had grown tenfold and most of those adopting the practice are pastoralist dropouts.

Considering that most of the actions undertaken by the pastoralists in Karamoja could be classified under reactive strategies; most of which, take multiple forms, serving multiple interests, and are ad hoc; there is need to guide in the action implementation. Responses such as moving livestock to areas perceived as disease 'free' could potentially increase vulnerability of pastoralists as exposure and transmission of disease in a wider spatial extent is encouraged. In addition, practices such as cutting poles and grass for sale, and cutting trees firewood and burning charcoal constitute mal-adaptations. Such practices have the potential to create land degradation, endanger biodiversity, and possibly reduce their ability to respond to climate risk in the future (Ludi, 2009). Some studies in Karamoja (Quam, 1997; Egadu et al., 2007; Houdet et al., 2014) have shown that deforestation in the sub-region is already occurring with attendant effects such as soil erosion being observed. Thus, climate risk information disseminated need be followed with capacity building to strengthen adaptive capacity to undertake viable actions and alternatives within a resource constrained environment. Taking this direction will be one step towards eliminating the linear and self-limiting approach that delivers identified and discrete adaptation actions; both anticipatory and reactive that often obscures processes that shape adaptation and resilience building (Tschakert and Dietrich, 2010).

Conclusion

This study examined pastoralists' climate change perceptions, climate risk management information, sources and responses in Karamoja sub-region of Uganda. The study has shown a general agreement among pastoralists on the existence of climate change. Climate change in the sub-region is manifested through variable rainfall patterns with the existence of extreme events-drought and floods, high temperatures and variation in rainfall onset and cessation. The study has also shown that climate risk management information is transmitted through a number of information channels including: radio, community meetings, traditional rituals, friends, relatives and neighbours and through humanitarian agencies such as non-governmental organisations (NGOs) among others. While radio featured prominently, the pastoralists opined that community meetings are more accessible, reliable and dependable source of climate risk management information. Further, the study has shown that the range of actions implemented by the pastoralists in response to the climate risk management information are largely reactive and some are mal-adaptations that have potential of reducing their ability to adequately respond to climate change in the future. Therefore, there is need to logically help the pastoralists to organise their response options without seeking to transform them into an alien people. There is also need for the current drought early warning system implemented in the sub-region to incorporate the traditional knowledge of the people in prediction and weather forecasting and innovatively integrate community meetings as a medium for transmitting climate risk information as well as a source of climate risk management data. It is my hope that when this is done, pastoralists will be able to gain confidence and dependence on the climate risk information communicated from time to time thereby increasing the systems credibility. It is also important that an analysis of the choice of decision to take action be undertaken in the sub-region so as to identify the socio-cultural factors and processes that influence pastoralists' decision making in response to climate risk management information.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.crm.2015.12.001.

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