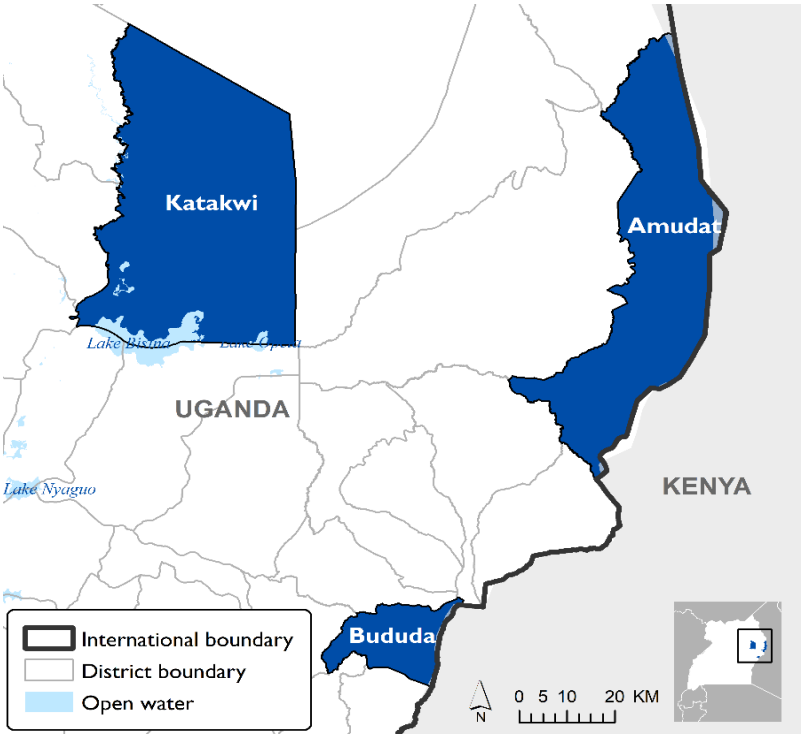
Context

Migration, environment and climate change (MECC) are increasingly becoming interlinked phenomena and are referred to as the MECC Nexus. The International Organization for Migration (IOM) implements a MECC project in Uganda working closely with Makerere University Centre for Climate Change Research and Innovations (MUCCRI), the Uganda Bureau of Statistics (UBOS), the Office of the Prime Minister (OPM), and district local government structures. One of the project's activities entails conducting research on the MECC Nexus in Uganda, aimed at deepening the understanding of environmental and climate change induced migration. Findings of this research aim to inform shorter-term humanitarian and programmatic responses, as well longer-term policy decisions on environmental migration and disaster displacement.

In order to ensure access to accurate and verifiable information on environmental migration in Uganda, the IOM DTM team, in collaboration with MUCCRI, have conducted participatory mobility mapping (PMM) which consisted of a participatory mapping exercise (PME), which is a consultative exercise that involves surveys with local stakeholders and communities. The aim of the PME is to analyze population mobility dynamics and patterns in order to define priority sites where active surveillance, risk communication strategies and disaster risk reduction responses are most urgent. The PMM approach complements traditional environment and climate disaster risk assessments, enabling more accurate prioritization of vulnerable sites and adaptation interventions to build the resilience of affected populations.



This map is for illustration purposes only. Names and boundaries on this map do not imply official endorsement or acceptance by IOM.

Methodology

In collaboration with MUCCRI and UBOS, IOM adapted and applied the Participatory Mobility Mapping (PMM) methodology in the pilot districts of Amudat, Bududa, and Katakwi to collect data regarding the effects of environment and climate change on migration in Uganda. The methodology was based on IOM's displacement tracking matrix (DTM) and past experiences of mapping population mobility within the health sectors in Uganda, Democratic Republic of Congo (DRC), and West Africa, including the recent mapping of environmental migration and disaster displacement in Kenya and Morocco.

While drawing on PMM methodology, Participatory Mapping Exercises (PMEs) were conducted with purposively selected participants, based on their positions in the local government authorities and expertise and knowledge of migration, environment and climate change in the three pilot districts of Amudat, Bududa, and Katakwi located in Eastern Uganda. The PMEs enabled collection of information on environment and climate change related human mobility profiles from key informants/ participants through facilitated group discussions. Each PME was designed to last half a day in order to keep participants focused and to avoid fatigue, while also being time efficient. Since the PMEs were conducted during the COVID-19 pandemic, COVID-19 standard operating procedures (SOPs) were adhered to, including wearing facemasks, social distancing, and hand sanitization.

Following a desk review of UBOS reports and past research findings conducted prior to the district engagement through the PMEs, the three pilot districts were selected based on their vulnerability to specific climate change and environmental change risks and disasters as shown below.

- Amudat district, Karamoja sub-region. This is found in the 'Cattle Corridor' of Uganda which is most prone to droughts (and water scarcity, hunger and food insecurity), and within it, the Karamoja sub-region is the worst hit. Amudat district from the Karamoja subregion is severely affected by drought.
- Bududa district, Mt. Elgon region. The mountain regions are prone to landslides and Mt. Elgon region is the most affected. Bududa district in the Mt. Elgon region is severely affected by landslides.
- Katakwi district, Teso sub-region. The lowlands are prone to flooding and the Teso sub-region is one of the worst hit areas by flooding in Uganda. Katakwi in the Teso sub-region is prone to flooding.

Group representatives present the results of discussions on climate change and environment issues and impacts in Katakwi district and how they relate to human mobility in the district

The PME participants were selected by IOM, MUCCRI and the districts' Chief Administrative Officers (CAOs) and Environment/Natural Resources Officers based on their knowledge and experiences of the districts and its surroundings, and the environment, climate change and migration issues in the district. The participants selected included the key district technical staff and political leaders, security officers, civil society representatives and community leaders. MUCCRI researchers facilitated the PMEs and they first presented to the participants the climate change projections (past and future climate scenarios) for the three districts. The climate projections were drawn from Baastel (2016). The facilitators further guided the PME discussions participants to identify, rank and map the areas or spaces of vulnerability (SOVs) to environment and climate change hazards and disasters where migrations take place in the last decade. The findings of PMEs lay foundation for proceeding surveys on migrants and non-migrants to extensively understand the MECC Nexus in Uganda. The rationale for inclusion of non-migrants is to capture information on their knowledge and experiences with migrations taking place in their area, and also to establish whether they have ever considered (and or considering) migrating upon being exposed to a climate or environmental hazard or disaster.

In all three PMEs were conducted attended by 60 participants (46 males and 14 females). These comprised of 55 district/local level participants, four study team members and one technical official from UBOS.

The PMEs were conducted as follows:

1. The Amudat district PME was held on 7th December 2020 at Amudat district Local Government headquarters and involved 21 participants (19 males and 2 females) comprised of 16 representatives from the district technical departments, politicians, security officers, civil society and community opinion leaders; four MUCCRI researchers and one technical official from UBOS.

II. Bududa district on 11th December 2020 at Bududa district local government headquarters and involved 24 participants (19 males and 5 females) comprised of 19 representatives from the district technical departments, politicians, security officers, civil society and community opinion leaders; four MUCCRI researchers and 1 technical official from UBOS.
III. Katakwi district on 9th December 2020 at Katakwi district local government headquarters and involved 25 participants (19 males and 6 females) comprised of; 20 representatives from the district technical departments, politicians, security officers, civil society and community opinion leaders; four MUCCRI researchers and one technical official from UBOS.

The participants who represented local government technical officers were drawn from different departments (e.g. agriculture, environment, disaster risk reduction, community development, population/migration officers, planning), political leaders, security officers, non-governmental organizations (NGOs), community-based organizations (CBOs), Sub-county/Parish/Village Opinion Leaders and community members.

All the PMEs begun with an introduction to the MECC project and objectives of PMEs, presentations and plenary discussions on environment change and climate change (scenarios and impacts) across global, national and local scales, the relationships between migration environment and climate change. Guided by facilitators from MUCCRI, the participants generated critical information on environmental and climate induced migration and displacement.

Each PME also conducted facilitated group discussions. The participants were divided into 3-4 groups, with each group comprised of 4-7 persons and making sure that each group had both male and female participants (but male participants were the majority because the men dominate technical and leadership positions in the districts or communities), and diversity of expertise i.e. each group had district technical staff, politicians, and representation of civil society and community members). Upon completion of each discussion, selected group representatives presented results to all the participants in a plenary. The participants, with guidance of facilitators, probed the critical drivers of migration, with particular emphasis how climate change and environmental stresses were causing migration.

Through the facilitated group discussions, the participants identified the major climate and environmental hazards, disasters and stresses in the districts and how they influence migration and displacement in each of the three districts. This was followed by identification of spaces of vulnerability (SOVs) in the districts (sub-counties, parishes and villages) or the areas most affected the environmental and/or climate hazards, disasters and stresses. With the use district maps, the participants identified and marked (mapped) the sites of vulnerability.

The mapping exercises were followed discussions by ranking of the five most vulnerable sites or areas in each district. The ranking was based on the participants' perceptions of the severity of environment and climate hazards and disasters, and the population mobility volumes at the SOVs (and the scale used was "High", "Medium" or "Low") i.e. the participants were probed to establish the main climate and environmental challenges and to estimate of the volume of population mobility flows either as a percentile or fractional proportion of the general population in case of a major environmental or climate hazard or disaster. A priority urgency for response rank was then assigned to each of the five SOVs identified in each district to determine areas that required immediate attention to address the challenges or vulnerabilities.

All the discussions and presentations were recorded using a voice recording device and later transcribed and analyzed using thematic content analysis on key themes including environment, climate change and migration or human mobility. The quantitative percentile or fractional estimates on population flow volumes were transformed into absolute values using the UBOS district level population data. The Key concerns that arose from participants' presentations and discussions are also highlighted. The areas or SOV identified and mapped were processed using ArcGIS 10.4 software.

Findings

The PME findings provide details on the occurrence and extent of environment and climate hazards and disaster, the associated shocks and stresses and how they relate to human mobility in the districts of Amudat, Katakwi and Bududa. Further, identification and mapping of areas or spaces of vulnerability (SOV) in each of the three districts is presented to inform selection or prioritization of flow monitoring points (FMPs) for the main field survey and detailed data collection phase.

Amudat district

Climate and environmental hazards, disasters and shocks in Amudat District

The climate change predictions for the Karamoja region, obtained from existing literature, shows a decrease in rainfall and an increase in temperature between 2010 and 2090 (Baastel, 2016) (See Table 1). The current and projected climate change in Amudat district portrays significant risks of increase in extreme daily rainfall and temperatures. In regard to rainfall variability, the percentage of rain days receiving less rain is expected to increase whereas days with higher amounts of rain (see Table 1) are likely to decrease in future. As for temperature, the percentage of cooler days (temperatures below 290C) is expected to significantly decrease and days with higher temperatures (above 290C) are likely to increase. In addition, there is a significant risk of an increase in extreme daily rainfall events and an increase in extreme daily temperature in the district (Baastel, 2016). Also, reported and projected is increased occurrence and severity of extreme weather events such as droughts, windstorms, erratic rainfall, and flash floods

Table 1: Projected climate change for Amudat District

Amudat District		2010	2030	2050	2070	2090
RCP[1] 4.5	Rainfall (mm)	648.6	623.0	562.0	562.8	543.9
	Temperature (0◦C)	24.5	25.6	26.4	27.1	27.6
RCP 8.5	Rainfall (mm)	648.6	613.2	572.3	537.8	530.8
	Temperature (0◦C)	24.5	25.8	26.8	28.2	29.8

Source: Baastel, (2016)

The prevailing climate and environmental shocks in Amudat district include:

- Increased occurrence and severity of dry periods, droughts, flashfloods and windstorms.
- Desertification is also significant and will worsen with the widespread environmental destruction activities like deforestation, draining of wetlands, overgrazing, charcoal burning and brickmaking.
- The main environmental challenges identified through the Focus Group Discussions were prolonged droughts, riverbank degradation, windstorms, soil erosion, land degradation, and of recent the locust invasions. Land degradation is resulting from unsustainable land use practices like charcoal burning, brick laying, overgrazing and mining is also a serious environmental challenge.

Extreme temperatures/heat, prolonged dry periods, and droughts lead to water shortage, crop failure/losses, shortage of pastures, and impoverishes livestock which all negatively affect livelihoods and human welfare e.g reduced food and water availability, reduced incomes and ill health.
Loro and Karita sub-county chiefs revealed that impacts of climate change and environmental challenges are serious constraints in Achorichor and Lokales parishes.

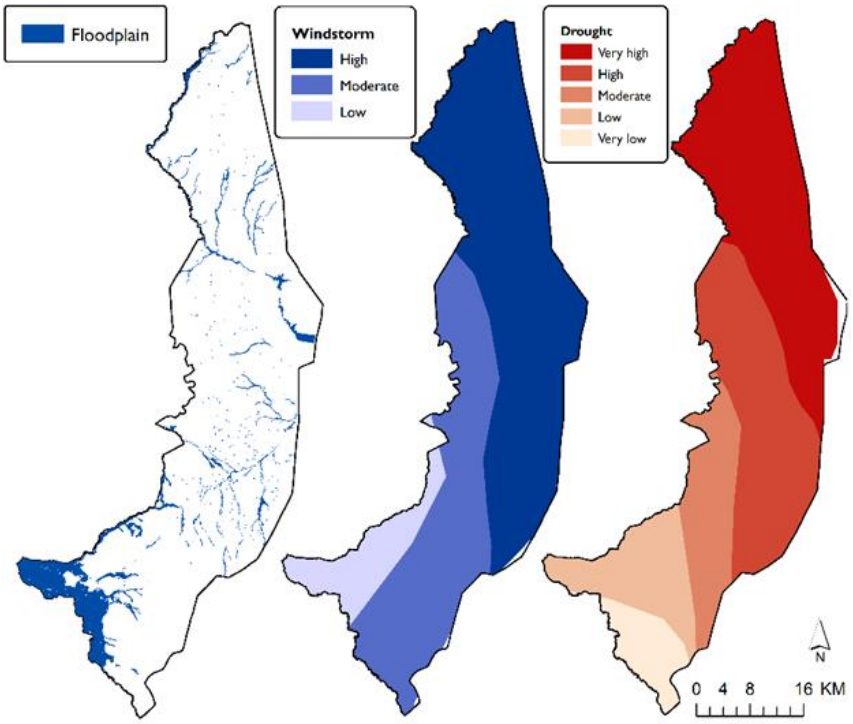
[1] A Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory adopted by the IPCC. Four pathways were used for climate modeling and research for the IPCC fifth Assessment Report (AR5) in 2014. The pathways describe different climate futures, all of which are considered possible depending on the volume of greenhouse gases (GHG) emitted in the years to come. The RCPs – originally RCP2.6, RCP4.5, RCP6, and RCP8.5 – are labelled after a possible range of radiative forcing values in the year 2100 (2.6, 4.5, 6.0, and 8.5 W/m2, respectively.

"Drought, floods, hot temperatures and erratic rainfall are the commonest effects of climate experienced here. Also, the invasion of locusts, deforestation, riverbank destruction and land degradation are the most serious environmental challenges that communities face across Amudat district" (Loro and Karita sub-county chiefs).

Poverty and food insecurity are very serious livelihood challenges in Amudat mainly attributed to desertification, soil infertility and climate variability and change. The vulnerability of Amudat district to climate change and environmental shocks is attenuated by the dominance of nomadic pastoralism, cattle raids, and the prevalence of both internal and cross-border movement. An elder/cultural leader from Achorichor stressed the effect of extreme heat and drought on livelihoods.

"The extreme heat and drought conditions have led to the outbreak of diseases like acute headaches in humans, and foot and mouth diseases, anthrax and nagana in livestock, as mobility of livestock keepers in search for pasture and water resources. In addition, hunger and malnutrition is on the rise due to crop failure during the dry season and droughts. Snake bites are also on the rise that have claimed lives as people search for water around the spatially scattered water points".

During the group and plenary discussions, it was further revealed that poverty and livelihood challenges in the district are further worsened by widespread high dependence on natural resources (especially water, pastures and of recent rainfed farming). Rapid population growth and increase in livestock numbers increases pressure on natural resources which in turn increases resource conflicts (especially over water and pastures). Overgrazing is another challenge that is a driver to land degradation. Flash floods and windstorms have reportedly destroyed infrastructure including roads and schools, and soil erosion increasingly makes valley dams silted. Further, droughts have recently escalated the encroachment on protected areas like game reserves in search for pastures, and human-wildlife conflicts have increased.

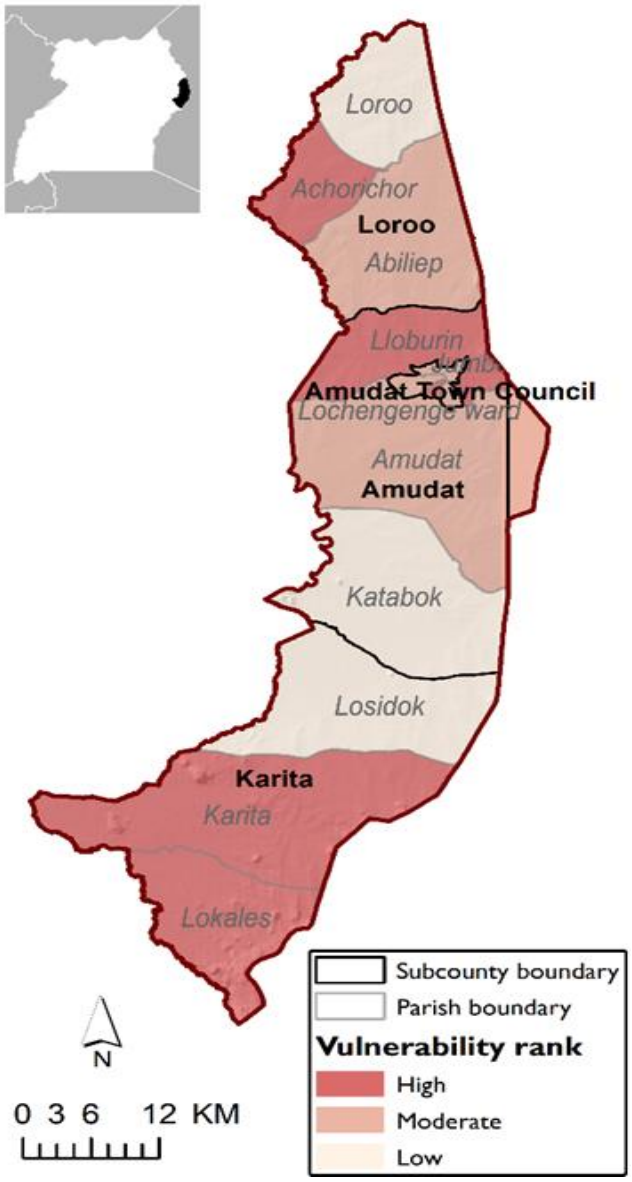


Left – Facilitator presenting to participants at Amudat district headquarters (Council Hall). Right - The "Environmentalist Group" discussing MECC linkages in Amudat district

Migration, environment and climate change nexus in Amudat district

The PME group discussions in Amudat districts revealed the existence of linkages between migration, environment and climate change. For the pastoralists, migration is a coping mechanism to environmental and climatic stresses. It was reported that seasonal migrations take place among pastoralists during droughts, prolonged dry periods and extreme/hot temperatures that hit the district. Drought deprives pastoralists of green pastures and water for their herds of cattle, compelling them to move towards Nakapiripirit, Napak and Katakwi districts in search for water and pasture. Such mobility often leads to resource conflicts (as water and pastures become more scarce) amongst the pastoralists and host community populations across almost all the Karamoja region and some parts of Teso region. The worsened drought conditions have also led to cross border pastoral community migrations from north-western Kenya (the Turkana) to Karamoja (Uganda) which leads to cattle rustling amongst the pastoral communities. The drought induced migrations in the Karamoja region have resulted in unprecedented land degradation (overgrazing, charcoal burning, brick laying, soil erosion). Further, pests and animal diseases are often on the rise during periods of mass human and cattle migrations within the district and the whole Karamoja region.

The combination of intermittent droughts, windstorms and flash floods have reportedly reduced the fertility and productivity of soils, and increased crop failure and food insecurity, which compels people to relocate to other areas with fertile soils where crop growing could flourish. The floods have reportedly led to the displacement of communities and destruction of infrastructures like roads near riverbanks in Amudat district leading to the migration of people to neighboring districts like Nakapiripirit, Moroto and Napak. The discussions indicate that internal and out-migrations (seasonal and permanent) take place during stressful seasons following severe droughts, floods, windstorms and locusts' invasion, and the population relocates (temporary or permanent) to neighboring communities within Amudat but also to neighboring sub-regions of Karamojong, Teso and Acholi. It was also revealed that due extreme livelihood constraints most especially, severe food insecurity and hunger, extreme poverty, lack of alternative job opportunities, some people (especially youths) permanently relocate to different urban centers within the district/Karamoja region for example Amudat, Karita and Moroto as well as to cities across the country like Soroti, Mbale, Jinja, Lira and Kampala in search for alternative livelihood opportunities. Group discussions revealed that urban centers are perceived by the younger population as potential sources of jobs to garner better incomes to support livelihood demands.



The identified areas/SOVs where environment and climate change induced migrations are reported to occur significantly include: Katumwok, Alakas, Kamkon/Natira, Loburin, Naporokocha, Katabok, Chepkararat, Lokales and Achorichor sub-counties.

Main areas/points of vulnerability in Amudat District

During group discussions, participants engaged in participatory mapping through which the main or priority points/sites were selected from the identified spaces of vulnerability (hot spots) in Amudat district. District maps were provided to each group, and the participants used the maps to identify and locate climate/environment hotspot locations and attached them to specific shocks/stress that drive migration and human mobility.

Table 2 summarizes the five major or priority sites/points identified that include: Naporakocha, Katabok, Chepkararat, Lokales and Achorichor areas. The prioritization was based on observed or dominant environment and climate change hazards and disasters, population flows, and estimated mobility flow volumes or number of people on the move presented in quartiles or percentiles and actual statistics derived from the national census data.

Table 2:Priority points/sites of vulnerability in Amudat district

	Ranking is 1-5, where 1 is highest priority and 5 is the least priority					
Site/Point Name	**Administrative unit**		**Population Flow**		**Estimated mobility flow volumes[2] during a climate hazard or disaster in the last decade**	**Observed environment and climate change related shocks and stresses, and their effects on livelihoods in the last decade**
	Parish	**Sub-county**	**(High, Medium, Low)**	**Rank**		
Naporokocha	Karita parish	Karita Sub-county	Low	5	3/4 of the population **(9132 of 12176 persons)**	Floods, charcoal burning, food insecurity, land use conflicts
Katabok	Katabok Parish	AmudatSub-county	Medium	3	3/4 of the population **(8678 of 11570 persons)**	Floods, drought Water scarcity and soil erosion
Chepkararat	Lokales parish)	Karita Sub-county	Low	4	1/3 of the population **(3787 of 11360 persons)**	Drought, mining, land and soil degradation, land use conflicts Food insecurity and charcoal burning
Lokales	Lokales Parish	Karita Sub-county	High	2	20% of the population along the river **(2272 of 11360 persons)**	Floods, drought, deforestation, charcoal burning, food insecurity, water shortage, land use conflicts
Achorichor	Achorichor Parish	Loroo Sub-county	High	1	3/4 of the population **(5002 of 6669 persons)**	Floods, drought, food insecurity, water shortage, deforestation, locust invasion, land use conflicts, windstorms

[2] Estimated population volumes are triangulated with official statistical population data from UBOS accessed at https://www.ubos.org/explore-statistics/20/

Katakwi district

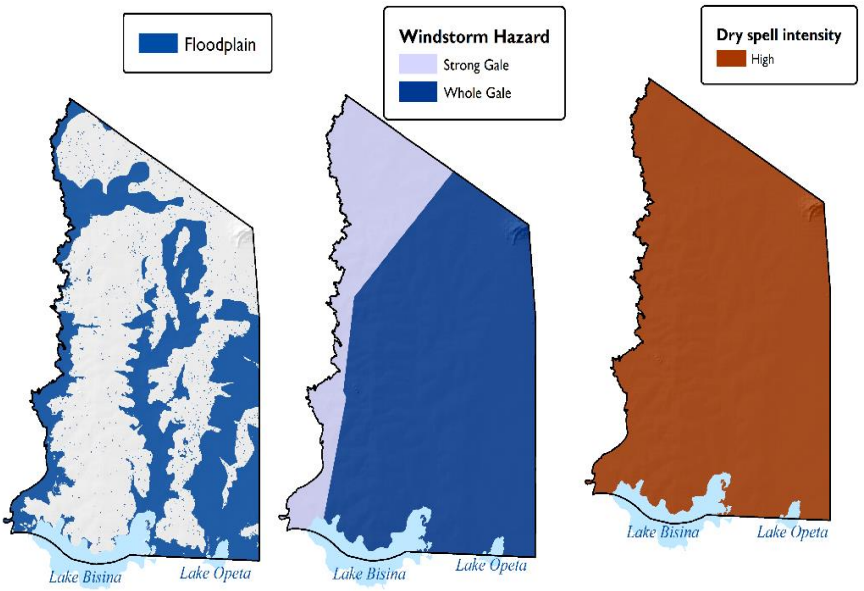
Climate change and environmental hazards, shocks and stresses in Katakwi District

Climate projections, obtained from review of literature, for the Teso sub-region in which Katakwi district is located indicate that the region will have a decrease in rainfall and an increase in temperature between 2010 and 2090 (Baastel, 2016) (see **Table 3**). The predicted climate indicates a likely increase in rain days receiving less rain, and days with larger amounts of rain might decrease in future. Temperature projections portray that the percentage of cooler days is expected to decrease significantly whereas the temperature range might shift towards days with higher temperatures. Extreme weather events will increase i.e. droughts likely to becoming more frequent, and heavy rainfall events increasing and causing flooding.

Table 3: Projected climate change for Katakwi district

Katakwi District		2010	2030	2050	2070	2090
RCP 4.5	Rainfall (mm)	1291.7	1211.6	1160.1	1145.7	1107.8
	Temperature (0°C)	23.4	24.3	25.2	26.0	26.5
RCP 8.5	Rainfall (mm)	1291.7	1231.0	1170.8	1115.6	1104.7
	Temperature (0°C)	23.4	24.4	25.6	27.1	28.5

The PME group and plenary discussions also revealed that the location of Katakwi in the lowlands of Teso sub-region make flooding the predominant environmental and climatic hazard, and flooding has become more severe, frequent and disastrous across the district. The relief of the area slopes westwards and thus receives discharges from surrounding uplands and highlands in Sebei and Karamoja that cause flooding which leads to submergence of farmland and infrastructure accompanied with human deaths. Other climate and environmental shocks experienced in Katakwi include windstorms, droughts and hailstorms. Prolonged dry spells also largely manifest as a challenging climate related and environmental hazard, which cause crop failures, food insecurity and deprives soil fertility hence affecting agro-pastoral activities in the district. Hailstorms and windstorms have reportedly damaged crops and led to the destruction of housing units. Land use practices like overgrazing, deforestation for charcoal burning and source of wood fuel, bush burning, encroachment on wetlands and rice cultivation have degraded the environment and ecosystem, which also have negative implications on livelihoods e.g. reduced water quality and availability, reduced soil fertility and crop yields, food insecurity, poor health, shortage of pastures and soil erosion.



> *"Flooding is the main climate hazard as most of the rivers in the Elgon mountain region pour their waters in the low-lying areas of Katakwi that become waterlogged for a longtime limiting farming and causing displacement of people. …… but variations in climate extremes experienced also vary. The Akuro area is most hit by drought, Omasia and Ngariam are repeatedly affected by flooding and water logging. Deforestation, wetland degradation are the most pressing environmental challenges" (Katakwi district Environment officer).*

The adverse effects of climate change and environmental degradation cause reductions in crop and livestock production, which in turn cause rising food insecurity and rising poverty. Flooding reportedly leads to reduction in soil fertility due to soil nutrient losses, and windstorms allegedly blow away soils hence derailing productivity.

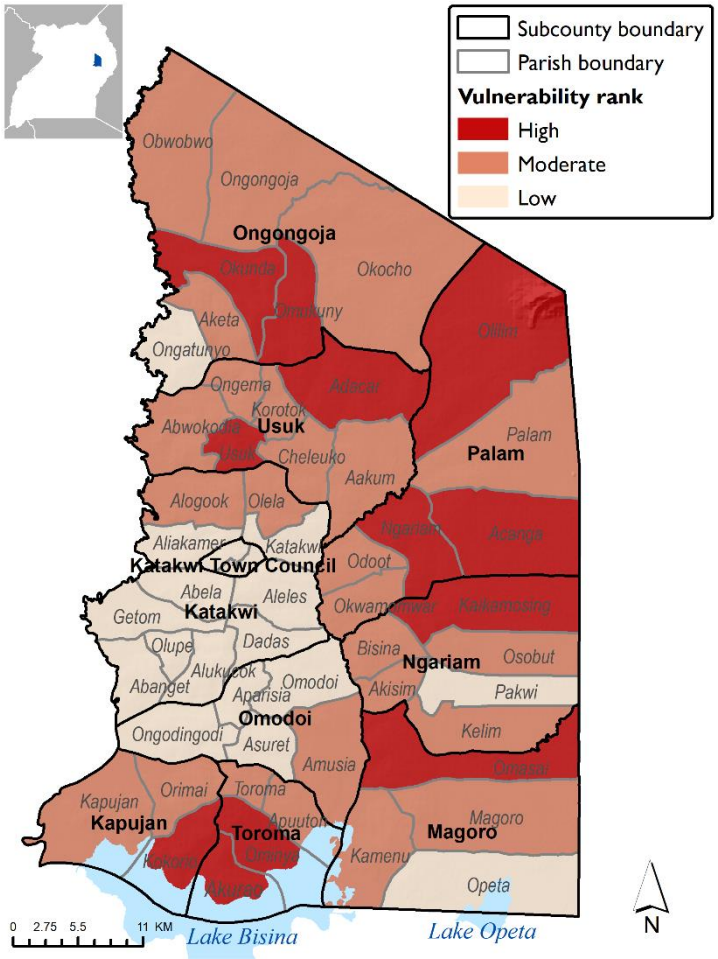
Further, flooding results in the destruction of crop fields, loss of animals, emergence of waterborne diseases and increased livestock pests and diseases, hence leading to food insecurity in the district. The windstorms and hailstorms also lead to the destruction of crops and tree cover. Finally, flooding destroys social infrastructure like roads and health centers, which affects movements and access to healthcare respectively, and leads to the destruction of people's housing units, resulting into homelessness and displacement. Environmental and climatic shocks and stresses have reportedly led increased family break-ups, malnutrition in children and teenage pregnancies.

> *"The environmental and climate related disruptions increase food insecurity and malnutrition, shortage of water and pastures, disease outbreaks like malaria and diarrhea, death of people and livestock, but also emotional stress and family break-ups". (District Councilor of Toroma Sub-county).*

The participants however raised concerns on the lack of a weather station to capture accurate data on climate, since the currently used Soroti district station provides generalized changes in Amudat district, which in turn compromises the accuracy and availability of locational specific data to inform policy directions. In addition, delayed assessments of flood hazards by Office of the Prime Minister (OPM) has reportedly misguided response strategies, given the spatial and temporal dynamics in the occurrence of droughts.

Migration, environment and climate change in Katakwi district

As already mentioned, heavy rainfall events in Katakwi leads to flooding and water logging in different areas. Flooding reportedly induces migration and displacement of people to different areas of Teso region and further to other areas in Eastern Uganda. During floods, people always temporarily relocate to education institutions and religious premises, but deaths are also reported to have occurred. The group discussions revealed that floods displace people who relocate to urban areas within and outside Katakwi district (e.g. to Katakwi municipality and others have relocated to Soroti and Mbale cities). Drought conditions in the Karamoja region have forced Karamojong pastoralists to migrate to the Teso region causing natural resource conflicts (land, pasture and water) amongst the Karamojong and Itesot peoples. Water logging has often forced people to move to drier areas for resettlement. These climate and environmentally induced movements are commonly observed in areas like Akurao parish (in Toroma sub-county), Ominya parish (in Toroma sub-county) and Aelanyang village (in Katakwi sub-county), as people move to look for land and clean water to sustain their livelihoods.



The identified points/spaces of vulnerability to climate change and environmental shocks in Amudat district include; Akurao (in Toroma sub-county), Ominya (in Toroma sub-county), Aelanyang (in Katakwi sub-county), Acanga (Palam sub-county), Aiti village (in Olilini parish, Palam sub-county), Kokorio (Kapujan sub-county), Adacar village, Okuda village, Guyaguya village (in Usuk sub-county), Omukunyu village (Ngariam sub-county), Kakikamosing (Ngariam sub-county) and Omasia (Magoro sub-county).

Main areas/points of vulnerability in Katakwi District

During the group discussions participants engaged in participatory mapping and identified areas or spaces of vulnerability in Katakwi district. The participants identified such points/spaces on maps and attached the prevalent environment and climate change shocks to the priority sites selected. In all, five priority sites/points were identified including Akurao, Omasia, Kokorio, Acanga and Olilim parishes in Toroma, Magoro, Kapujan and Palam sub-counties respectively. Such areas were characterized based on the dominant environmental and climatic hazards/shocks, administrative units, population flow, estimated mobility flow volumes.
Table 4 summarizes the priority points/sites as spaces of vulnerability to environment change and climate change in Katakwi district.

Table 4:Priority points/sites of vulnerability in Katakwi district

Note: Ranking is 1-5, where 1 is highest priority, and 5 is the least priority						
Site/Point Name	**Administrative unit**		**Population Flow**	**Priority Rank**	**Estimated mobility flow volumes[3] during a climate hazard or disasters in the last decade**	**Observed environment and/ or climate change related shocks and stresses and their effects on livelihoods in the last decade**
	Parish	Sub-county	(High, Medium, Low)	Rank (1-5)		
Akurao	Akurao parish	Toroma sub-county	Low	1	5% of the population **(121 of 2419 persons)**	Drought, hailstorms, floods, heavy rainfall, Water logging, food insecurity, windstorms, hailstorms, pests and diseases, deforestation
Omasia	Omasia parish	Magoro sub-county	Medium	2	15% of the population **(732 of 4879 persons)**	Water logging, flooding, Food insecurity, wetland degradation, soil infertility, windstorms and hail storms,
Kokorio	Kokorio parish	Kapujan sub-county	High	3	5% of the population **(210 of 4208 persons)**	Floods, wildfires, windstorms, wetland degradation, pests and diseases
Acanga village	Acanga parish	Palam sub-county	High	4	15% of the population **(240 of 1601 persons)**	Floods, water logging, hailstorms, windstorms and food insecurity.
Olilim	Olilim parish	Palam sub-county	High	5	20% of the population **(687 of 3437 persons)**	Floods, water logging, dry spells, heavy rains and lightning.

[3] Estimated population volumes are triangulated with official statistical population data from UBOS accessed at https://www.ubos.org/explore-statistics/20/

Bududa district

Climate change and environmental hazards, shocks and stresses in Bududa District

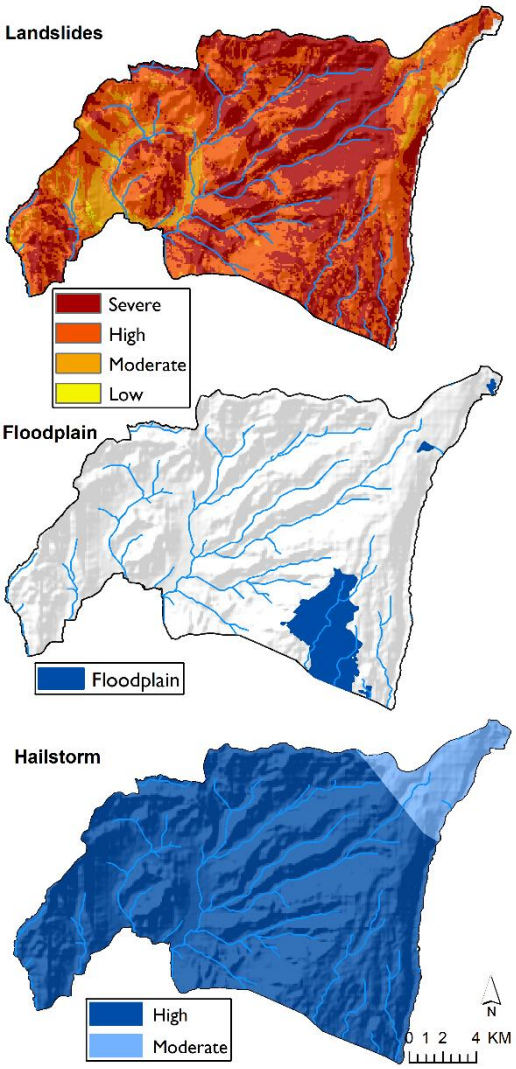
The projected changes in climate for Bududa district reveal a likely a decline in rainfall and an increase in temperature between 2010 and 2090 (Baastel, 2016) (see **Table 5)**. As for rainfall, the percentage of rain days receiving less rain is expected to increase while the days with larger amounts of rain might decrease in the future. For temperature, the percentage of cooler days is expected to decrease significantly, whereas the temperature range might shift towards days with higher temperatures. Heavy rainfall, flooding and hailstorms are likely to increase across Bududa district.

Table 5: Projected climate change for Bududa district

Bududa District		2010	2030	2050	2070	2090
RCP 4.5	Rainfall (mm)	1241.2	1208.2	1159.7	1146.3	1132.6
	Temperature (0°C)	19.8	20.7	21.4	22.1	22.5
RCP 8.5	Rainfall (mm)	1241.2	1212.5	1172.8	1117.3	1100.3
	Temperature (0°C)	19.8	20.8	21.8	23.1	24.4

Discussions indicated that key climate change concerns in Bududa districts include heavy and erratic rainfall which has triggered severe and intense hailstorms, landslides, mudslides, rockfalls, flash floods and flooding. The group discussions further revealed that the climate change related hazards in Bududa are increasing in frequency, severity and intensity, and characterized by rising temperature and extreme weather events.

The main environment and climate challenges in Bududa district are landslides and soil erosion that are likely to exacerbate amid projected changes in climate. It was revealed that about 80% of Bududa district is prone to landslides. The other environmental shocks experienced in Bududa include rainstorms, flash floods, rock falls, lightning strikes, prolonged dry spells, slope failures and soil fertility loss. Bududa is experiencing severe environmental/land degradation that driven by deforestation, encroachment on protected areas and wetlands, riverbank degradation and unsustainable farming practices like steep/fragile slopes cultivation that increase the vulnerability of the district to landslides and other environmental stresses.



Landslides, floods and mudslides and pose negative implications in Bududa district including destruction of infrastructure, displacement of people, loss of lives and property, emergence of pests and diseases, crop destruction, reduced soil productivity and contamination of water.

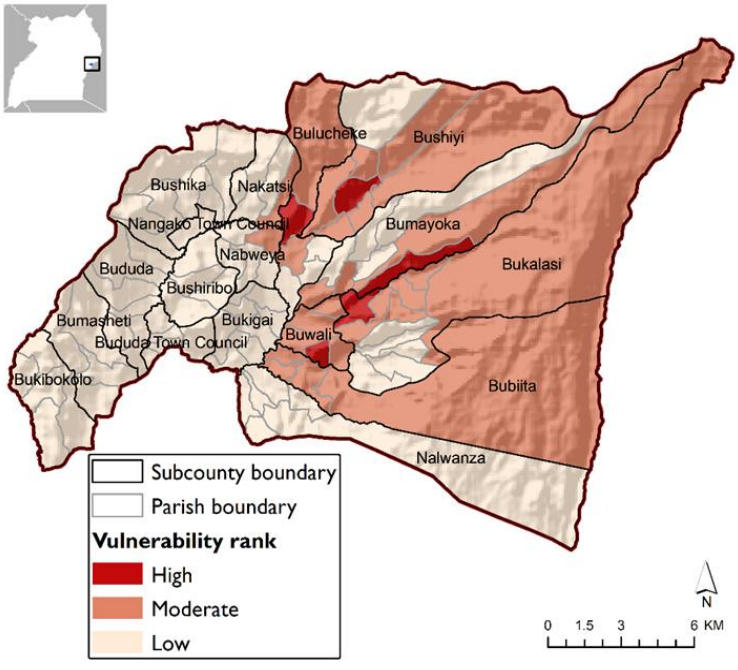
Group discussions revealed the recent flash floods that occurred in June 2019 affected over 100 households in Bumayoka sub-county. Landslides reportedly destroy infrastructure including roads, bridges, schools and health centers hence constraining access to basic social services. It was revealed that the 2010 landslide completely swept away a health center which has never been restored to-date.

"Landslides and mudslides are the main and most common hazards in the district. The worst landslide event happened in 2010 that killed many people and livestock, destroyed a health center, school, gardens, and damaged housing in Nametsi. In 2019 a mudslide at Bufutsa claimed about 25 lives in 2019 and destroyed crop fields". (Bududa Environment Officer).

The 2010 landslide in Bududa district, that was triggered by heavy rains lasting over three months, buried three villages, killed over 400 people and displaced 5,000 people (Atuyambe et al., 2011; Mugagga et al., 2012; Vision Reporters, 2010). Floods and landslides often lead to emergence of waterborne diseases and create conditions for livestock pests and diseases outbreaks. In addition, landslides often carry away gardens and crop fields leading to food insecurity. The devastating impacts of landslides and floods inflict psychological trauma due to rampant losses of lives and property amongst several families.

Migration, environment and climate change in Bududa District

Heavy rainfall events (rainstorms), coupled with land degradation, often trigger landslides in Bududa district. The discussions revealed that landslides always lead to migration and displacement of people from areas affected and/or highly prone to the disaster. It was indicated that the widespread land degradation through deforestation, uncontrolled and unsustainable farming practices across steep slopes, population and human settlement explosion as well as encroachment on protected areas, is increasing the susceptibility of Bududa to soil erosion, run-off, flooding and landslides that initiate displacements and migration. Landslides in often destroy human settlements and people are forced to migrate to other areas. Temporary migration also occurs when landslides destroy infrastructure like roads, bridges, schools and health centers. Further, mandatory migrations occur for people to migrate from high risky slope areas to more stable slopes where their safety is guaranteed.
The government has in the past resettled people displaced by landslides in Kidyandongo district and recently in Bulambuli district. It was established that the prevalence of landslide scars across different areas in Bududa increase certainty of future migration or displacement arising from prevailing climate variability and environmental shocks. Despite these government resettlement programmes to Kiryandongo district, resettled people often return to their regions due to unfavorable conditions in areas where they are resettled.



"The people of Nametsi and Bufutsa were resettled in Kilyandongo and Bulambuli districts respectively. However, due to the unpleasant conditions at the resettlement areas for example poor soils, crop failure, food insecurity and land shortage, the resettled people usually return during the wet seasons to plant crops (March to May) and when they are ready for harvest (August)". (Bududa Environment Officer).

Climate change and environmental change induced mobility is most prevalent in the sub counties of Bumwalukani, Bushika and Nakatsi. The identified spaces of vulnerability to climate change and environmental shocks in Bududa district include; Bushika, Bumwalukani, Bundensi, Buwali, Mabono (Bukibokolo sub county), Nakatsi village (Bushika sub county) and Bushiyi Sub County.

Main areas/points of vulnerability in Bududa district

Through group discussions, participants were engaged into participatory mapping to identify priority areas or points of vulnerability in Bududa district. The participants identified such spaces on maps and attached the prevalent environment and climate change shocks particular to the priority sites selected. In all, five priority sites/points where identified including Bufutsa, Bunakasala, Nametsi, Namasheti and Bukobelo areas. Such areas were characterized based on administrative units, population flow, estimated mobility flow volumes and predominant observations of climate change and environmental change patterns. **Table 6** summarizes the priority points/sites as spaces of vulnerability to environment change and climate change in Bududa district.

Table 6: Priority points/sites of vulnerability in Bududa district

Note: Ranking is 1-5, where 1 is highest priority, and 5 is the least priority						
Site/Point Name	**Administrative unit**		**Population Flow**	**Priority**	**Estimated mobility flow volumes[4] during a climate hazard or disaster in the last decade**	**Observed environment and of climate change related shocks and stresses and their effect on livelihoods in the last decade**
	Parish	**Sub-county**	**(High, Medium, Low)**	**Rank (1-5)**		
Bufutsa	Bufutsa parish	Bushika sub-county	Medium	2	15% of the population **(690 of 4597 persons)**	Landslides, heavy rainfall, soil erosion, hailstorms and rockfall
Bunakasala	Bunakasala parish	Buwali Sub county	Medium	3	25% of the population **(440 of 1761 persons)**	Heavy rainfall, flush floods, landslides and riverbank degradation
Nametsi	Nametsi parish	Bundesi* Sub county	High	1	80% of the population **(581 of 726 persons)**	Landslides, mudslides, heavy rainfall, river bank degradation and flash floods
Namasheti	Namasheti parish	Bundesi* Subcounty	High	4	60% of the population **(749 of 1248 persons)**	Flash floods, heavy rainfall and landslides
Bukobelo	Bukobelo parish	Bulucheke Sub county	Low	5	3% of the population **(110 of 3660 persons)**	Landslides, rockfall, soil erosion and heavy rainfall

Discussions in the Bududa District PME

[4] Estimated population volumes are triangulated with official statistical population data from UBOS accessed at https://www.ubos.org/explore-statistics/20/

Comparison of climatic and environmental challenges, and their effect on livelihoods and migration in the pilot districts.

Climate and environmental risks and their effects on livelihoods, and displacement or migration vary across the three pilot districts. Flooding and intense rainfall are major climate hazards across the three districts. However, extreme temperatures/intense heat, drought, windstorms are main climatic hazards for Amudat and Katakwi districts but are not main challenges in Bududa district, although Bududa district is also the only pilot district that affected by landslides and mudslides.

Regarding environmental challenges, all the three pilot districts experience water related challenges. For Amudat and Katakwi districts the challenge is severe water shortage when prolonged dry seasons and drought occur, but for Bududa water quality is the main problem that occurs when water sources are contaminated by flooding and mudslides. Deforestation, soil erosion and declining soil fertility are serious challenges in all the pilot districts, but wetland degradation is a major challenge only Katakwi district where rice cultivation is on the rise and occurs in reclaimed wetlands. Cultivation of steep slopes and encroachment on protected areas is a widespread environmental challenge in Bududa district but it is not experienced in Amudat or Katakwi.

The main climate/environment related challenge in Amudat and Katakwi is food insecurity driven by reduction in crop and livestock production caused by drought and water shortage, which is not the case in Bududa. The destruction of homes, gardens and infrastructure due to flooding is more experienced in Bududa and Katakwi than it is in Amudat, but landslides also destroy these livelihood assets in Bududa, but landslides rarely occur in Amudat or Katakwi. All the districts are experience declining household incomes and rising poverty mainly driven by reduction in agricultural production.

While floods are major cause of displacement and migration in Bududa and Katakwi districts, drought, water and pasture shortage, and food insecurity are drivers of mobility in both Amudat and Katakwi but not in Bududa. Landslides drive displacement and mobility in Bududa district but this is not the case for Amudat and Katakwi. In Bududa, government is engaged in the resettlement of displaced persons to other districts (Bulambuli and Kiryandongo) but not in the other two districts. Katakwi district experiences migration from the Karamojong (including those from Amudat district) and Bahima cattle keepers (from Masindi and other parts of western Uganda) searching for water and pasture for their animals and this often results in conflicts over natural resources like land, water and pastures. Amudat (Karamoja) also experiences migrants from the other districts in Karamoja (e.g. Moroto and Napak) as well as the Turkana from Kenya which also cause natural resource conflicts.

The PMEs and the findings further demonstrate that understanding environment and climate migration and addressing it requires multi-stakeholder engagement (the communities, migrants, central and local governments and civil society). Conducting environment and climatic disaster risk assessment and management through coproduction of climate information and adaptation knowledge is crucial to inform both short term and long-term multi-scalar responses based on evidence generated at all levels of governance.

Such information is significant to multi-national agencies, humanitarian actors, district local governments and local communities in preparing comprehensive area specific assessments so as to better enhance understanding of climate change and environmentally induced mobility and migration and the design of targeted responses to severely affected communities and populations.

Conclusions and Recommendations

Conclusions

The relationship between migration, environment and climate change is increasingly becoming a concern to the local and central governments, civil society and international organizations in Uganda. And for the Amudat, Bududa and Katakwi districts in Eastern Uganda, environment and climate shocks and stresses drive migrations that are a serious livelihood and development concerns and require urgent attention. While drought, windstorms and flooding are the main drivers of displacement and migration in Amudat and Katakwi district, the main drivers of displacement and migration in Bududa are heavy rainfall/rainstorms, landslides and flooding. The projected change in climate and the high likelihood of its impacts/hazards on communities, amidst widespread environmental degradation, is likely to increase climate migrants in the future. Addressing the challenge of environment and climate migrations requires research to generate evidence-base to inform inclusive resilient response planning, strategies and interventions.

However, like elsewhere across the globe, migration, environment and climate change nexus is not yet well contextualized and conceptualized in Uganda mainly due inadequate empirical data and or information. This again calls in-depth research to deepen understanding of the nexus between environmental change climate change and migration and inform climate change and migration policy and practice.

Table 7 below summarizes the findings of the PMEs conducted in Eastern Uganda i.e. the key priority areas and/or spaces of vulnerability to environmental and climate change shocks and stresses that induce human mobility and migration.

District	Two priority areas or Spaces of Vulnerability (SOVs)	Climatic and environmental challenges	Impact on livelihoods	Migration and displacement
Amudat district - The Cattle Corridor	i. Achorichor, Loroo sub-county ii. Lokales, Karita sub-county	**Main climatic challenges:** extreme temperatures/heat, drought, floods windstorms, pest and diseases. **Main environmental challenges:** Overgrazing, deforestation, and soil erosion and reduced soil fertility, Drying water sources (rivers and springs, locust invasion).	• Severe water shortage for crops, livestock and domestic use. • Reduced crop and livestock productivity (caused by droughts, water shortages and poor soils) • High food and insecurity • Wood fuel shortage (firewood and charcoal) • Reduced household incomes and rising poverty • Natural resource conflicts, mainly over pastures and water.	• Floods cause seasonal displacement people • Severe food insecurity, poverty and unemployment drive migrations to surrounding Teso and urban centres like Soroti, Mbale, Jinja and Kampala. • Seasonal migration of pastoralists to areas with water and pastures within the Karamoja sub-region and to neighbouring Teso, and Bulambuli and Kween districts.

Bududa district - The Highlands	i. Nametsi, Bundesi sub-county ii. Bufutsa, Bushika sub-county	**Main climatic challenges:** Heavy rainfall/rainstorm, hailstorms flooding, landslides and mudslides, pests and diseases **Main environmental challenges:** Deforestation, encroachment of protected areas, cultivation on steep/fragile slopes, wetland degradation, riverbank degradation, soil erosion and reduction in soil fertility	• Water contamination / shortage of clean water caused by rainstorms, flooding and landslides • Destruction of homes (landslides and floods) • Destruction of physical and social infrastructure (roads, bridges, education and health facilities) by landslides and floods. • Destruction of gardens/crops by floods, hailstorms, extreme heat, and landslides • Reduction in crop production that reduces food availability and household incomes.	• Floods and landslides cause displacement and migration. • Government has resettled people displaced by landslides in Bulambuli and Kiryandongo districts.
Katakwi district - The Lowlands	i. Akurao, Toroma sub-county ii. Omasia, Magoro sub-county	**Main climatic challenges:** Extreme temperatures/heat, prolonged dry spells, drought, windstorms, rainstorms/hailstorms, flooding windstorms, pest and diseases **Main environmental challenges:** Overgrazing, deforestation, wetland degradation, soil erosion and declining soil fertility, drying water sources	• Widespread water shortage for crops, animals and domestic use. • Destruction of homes, and gardens caused by floods. • Declining crop and animal production (caused extreme heat, drought, floods, poor soils and pest and diseases). • Rising food insecurity and hunger. • Reduced household incomes and rising poverty • Increased conflicts over natural resources (water and pasture) especially with Karamojong in-migrants.	• Flooding cause displacement and migration to other areas in Teso, urban centres and other regions. • Food insecurity, poverty and unemployment drive out-migration to urban areas e.g. Soroti, Mbale and Kampala. • District experiences in-migrants from neighbouring Karamoja searching for water and pasture, often resulting in violent resource conflicts.

The identified spaces of vulnerability to climate and environment shocks and stresses are critical for in-depth surveys and research to generate evidence on the nexus between migration, environment change and climate change in Uganda.

The findings from the PMEs conducted further demonstrate that a deeper understanding of the migration, environment and climate change nexus, and response interventions to address the barriers and needs, and build resilient communities requires multi-stakeholder engagement (migrant source and destination communities, the migrants themselves, the central and local governments, civil society and donor community). For example, in Katakwi district, a less inclusive flood hazard assessment conducted by OPM designed a flood response intervention that was launched when the same communities were facing drought. In Bududa, the many actors helping communities to cope up with the disaster, are constraining the communities from building endogenous resilience. Besides building resilience is hindered by lack of data on climate, environment and adaptation. Therefore, conducting environment and climatic disaster risk assessment and management through

coproduction of climate information and adaptation knowledge is crucial to inform both short term and long-term multi-scalar responses based on evidence generated at all levels of governance.

Such information is significant to multi-national agencies, humanitarian actors, district local governments and local communities in preparing comprehensive area specific assessments so as to better enhance understanding of climate change and environmentally induced mobility and migration and the design of targeted responses to severely affected communities and populations.

Recommendations

Embrace adaptation knowledge co-production and sharing

The PMEs findings reveal that climate related impacts (intense heat, drought, prolonged dry periods, rainstorms, windstorms, floods, landslides) are increasing, and adversely affecting the livelihoods of communities and households, but also causing displacements and migration. The affected communities and the decision makers still lack evidence base, knowledge and ability to address the challenges. Therefore, the co-production and sharing of climate information and adaptation knowledge is necessary to build awareness and for identification of appropriate adaptation options for the origins and destination of migrants. The knowledge co-production should involve the generators and users of the knowledge (climate scientists, communities/farmers, civil society and central and governments, and private sector). In addition, research is necessary to generate evidence-base to inform the identification, prioritization and implementation of adaptation options that foster local development and build resilience in migrants' origins and destinations. The evidence base would also inform long-term policy on humanitarian response planning, implementation, monitoring and evaluation, and decision-making processes by the government, UN agencies, the private sector and civil society programmes linked to adaptation, disaster risk reduction, livelihood transformation and overall resilience development. Importantly, adaptation knowledge co-production should be gender sensitive and highly inclusive with participation of local communities to incorporate local/indigenous knowledge and practices (e.g. traditional weather forecasting, early warnings systems and coping). For example, the formation and or scaling up of farmers associations and farmers associations, farmer field schools would provide an entry point. But to succeed, local government structures especially the local councils are critical and should facilitated and empowered to collect, analyze and transmit locally contextualized data using scientific tools to aid bottom-up response strategies. Further, local governments should take a lead in mobilizing local ownership of such information and knowledge with the central governments, academia and development partners providing a facilitating role. Evidence based community-based adaptation approaches should be strengthened e.g. community resource mapping and management, community vulnerability/risk assessments, application of nature-based solution for adaptation and livelihood transformation, farmer field schools, exposure visits and experiential learning will be crucial in addressing the drivers and adverse effects of environment and climate induced migration and building resilient communities and ecosystems.

Sensitization of communities to engage in adaptive livelihoods

The rates at which communities are degrading the environment will further exacerbate climate change vulnerability, reduce land productivity and adversely affect livelihoods. But local communities still lack adequate information and knowledge on the impacts of their activities on the environment (e.g. overgrazing, deforestation, charcoal production, encroachment on wetlands, riverbanks and fragile slopes). They also lack access to alternative sustainable and resilient livelihood activities (e.g. water security, affordable clean modern energy services, inputs to improve land productivity, off-farm employment and income generating activities). There is thus a need to raise public awareness on matters related to climate change and environmental

degradation and the appropriate strategies to protect and sustainably utilize natural resources and ecosystem as pathways to building community resilience. Practices such as application of nature-based solutions (restoration, rehabilitation, protection and sustainable utilization of landscapes, natural resources and ecosystems), as well climate smart agriculture, water harvesting and storage, and livelihood diversification) should be strengthened. Such efforts are have potential to reduce the adverse impacts of climate and environmental shocks and stresses that often induce human mobility.

Conducting vulnerability, risk and adaptation assessments

The dynamic and complexity of environmental and climate change shocks requires vulnerability, risk and adaptation assessments on a continuous basis (the challenges have socio-economic and spatio-temporal dimensions). This is important to inform efforts of building adaptive capacity of the communities to enable early detection and effective response. To be effective, such assessments/studies should be designed and conducted in a collaborative manner, with participation of the academia and researchers, local governments, the affected communities, civil society and donor community. It is important that such studies involve communities (e.g. farmers associations and farmer field schools as platforms) and compute the cost of inaction, incorporate cost-benefit analyses of adaptation options to come up with options that are economically and technically feasible, socially acceptable, build resilient ecosystems and communities, and foster livelihood transformation as these are crucial pathways to mitigate climate migrations.

Strengthen climate information services and early warning systems

The complex and dynamic nature of climate change shocks and stresses requires a robust climate information service and early warning system. All the three pilot districts did not have weather stations implying that there is no collection of information on local climate parameters, and thus Uganda National Meteorological Authority (UNMA) should install weather observatory stations in the districts. Although UNMA provides weather forecasts, disseminated via radio, participants in PMEs revealed that the forecasts are not reliable, are not well targeted to users' needs (farmers and pastoralists), are produced in a technical language that is not easily understood by the users/communities, are rarely translated in local languages. Therefore, the forecasts and early warnings should be made more accurate and reliable, tailored to address users' needs, and also translated in local languages. It is essential that community development officers and agricultural extension workers (in districts and sub-counties) are retooled in climate change and disaster risk management to advise famers and communities on climate smart and environment resilient community production systems and livelihoods. Introducing and strengthening weather index insurance and social protection systems will help farmers and communities to reduce losses from disasters and recovery from disasters, which build resilient communities that mitigate climate migrations and their effects.

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