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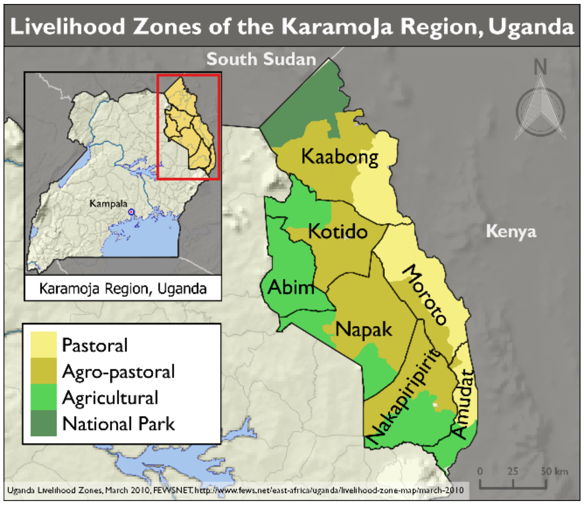
Climate Risk Profile

CLIMATE RISK SCREENING FOR FOOD SECURITY
KARAMOJA REGION, UGANDA

OVERVIEW



This climate change risk analysis is focused geographically on the Karamoja region of Uganda and technically on livelihoods and interventions associated with USAID Food for Peace (FFP) programming. The information includes an analysis of climate risks and potential impacts associated with identified risks.

The Karamoja region consists of seven districts in northeastern Uganda (Kaabong, Kotido, Abim, Moroto, Napak, Amudat and Nakapiripirit). Karamoja is classified as one of the world's poorest areas, with high rates of malnutrition and a disproportionate number of its 1.3 million inhabitants (82 percent) living in absolute poverty. Hunger, stunting and lack of access to food are prevalent, with estimates suggesting that about 100 children aged less than five die each week from preventable diseases. Food insecurity is a major and ongoing challenge and a heavy reliance on the natural resources base renders livelihoods sensitive to climate dynamics. Climate variability and change undermine the already limited resources and development in Karamoja through recurring droughts, flash floods and prolonged dry spells. High levels of variability in the climate cycle, including unpredictable rainfall patterns, already exist. Other vulnerabilities that constrain development in Karamoja stem from historical dynamics affecting current governance, including 1) private ownership of firearms, 2) cattle raiding, 3) severe environmental degradation, and 4) poor infrastructure and limited basic services delivery, both adversely affected by Uganda's civil war. (18, 19)

CLIMATE PROJECTIONS

0.3–2.8°C increase in temperature by 2050s

Increased incidence of extreme weather (dry periods, heavy rains and droughts)

KEY CLIMATE IMPACTS TO FFP PROGRAM AREAS

Agriculture Production

Crop failure, low productivity

Water scarcity and resource use conflicts

Increased fire risks and land degradation

Increased risk from pests and diseases

WASH and Health

Increased malnutrition and hunger

Reduced water availability/quality

Increased risk from vector- and waterborne diseases

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This document was prepared under the Climate Change Adaptation, Thought Leadership and Assessments (ATLAS) Task Order No. AID-OAA-I-14-00013 and is meant to provide a brief overview of climate risk issues. The key resources at the end of the document provide more in-depth country and sectoral analysis. The contents of this report do not necessarily reflect the views of USAID.

CURRENT FFP INVESTMENTS IN UGANDA

The current FFP program in Uganda aims *to reduce food insecurity among chronically food insecure households.* Under this objective, two broadly defined sector priorities are identified: strengthening livelihoods and improving nutrition among children under five. This is achieved through two programs operated by three USAID partners:

- Resiliency through Wealth, Agriculture, and Nutrition in Karamoja (RWANU) in southern Karamoja – Concern Worldwide and ACDI–VOCA
- Growth, Health, and Governance (GHG) in northern Karamoja – Mercy Corps

In addition to USAID/FFP's current partners, other organizations working in the region offer food assistance to the most vulnerable households. Cash-for-work and food-for-work programs are widespread in the region, funded through the Northern Uganda Social Action Fund (NUSAF 2) and implemented by the World Food Programme and others. Between July 2012 and August 2014, an estimated 60,000 households (with an estimated 400,000 individuals) were identified as food insecure; many of these participate in public works programs to receive conditional food or cash transfers.

KARAMOJA LIVELIHOOD ZONES

The Karamoja region covers three types of livelihood zones (agro-ecological zones) that run north to south and reflect different soils and rainfall patterns (see map on page 1):

- **Pastoral** – a semi-arid zone where livelihoods revolve around livestock production (cattle, goats and sheep) with crop cultivation in years of adequate rainfall focused on millet, cowpeas and groundnuts. Average annual rainfall is less than 300–500 mm. Soils are predominantly sandy and of low fertility. These lands have been overgrazed and shortage of pasture forces nomadic movements during the prolonged dry season (September to April), leading to competition for scarce resources and thus conflict. The pastoral zone in Karamoja is part of a cluster of pastoral and agropastoral areas that also include areas of Kenya, South Sudan and Ethiopia.

- **Agropastoral** – a zone that receives annual rainfall of 500–800 mm, with rains erratically distributed. The sandy, loamy soils support crops such as sorghum, millet, maize, beans, cowpeas and groundnuts, generally farmed on small plots of land around fenced hamlets, or *manyattas*, and settlements using intercropping techniques. Livestock production focuses on steers, bulls, sheep and goats connected to transhumant herds.

- **Agricultural** – a wetter zone of fertile, loamy soils referred to as the "green belt" in the south and west of the region, with average rainfall ranging from 800–1200 mm annually and a growing season that extends from March to October. This zone supports a wide variety of crops and can often accommodate a second and third planting of quick-maturing cash and food crops after the maize and bean harvest, such as sesame, sunflower, simsim, cucumber (adekela) and an assortment of local vegetables and fruits (mangoes, oranges, sweet bananas, passion fruit, paw paw).

CLIMATE SUMMARY

Unlike most of Uganda, which has two distinct rainy seasons, Karamoja has historically had a single long rainy period between April and November. Rainfall peaks during April and May, with a break typically in June. Rains then return in July or August and continue through November. Annual average rainfall ranges between 300 mm in the pastoral regions to 1200 mm in western areas of Abim and Nakapiripirit (figure 1a). Average annual temperatures range from 16°C in the highlands to 24°C in the rest of the region (figure 1b).

Figure 1a: Average rainfall in Karamoja, 1981–2000

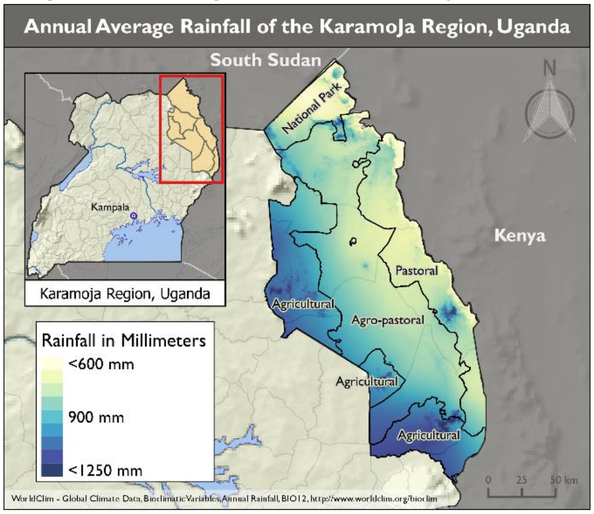


Figure 1b: Mean temperature in Karamoja, 1981–2000

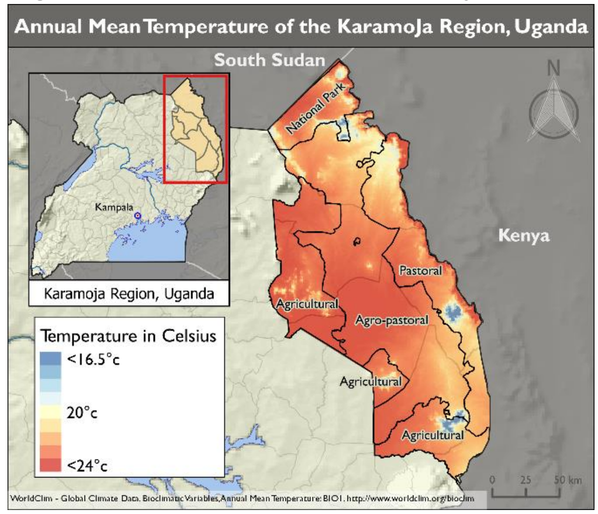
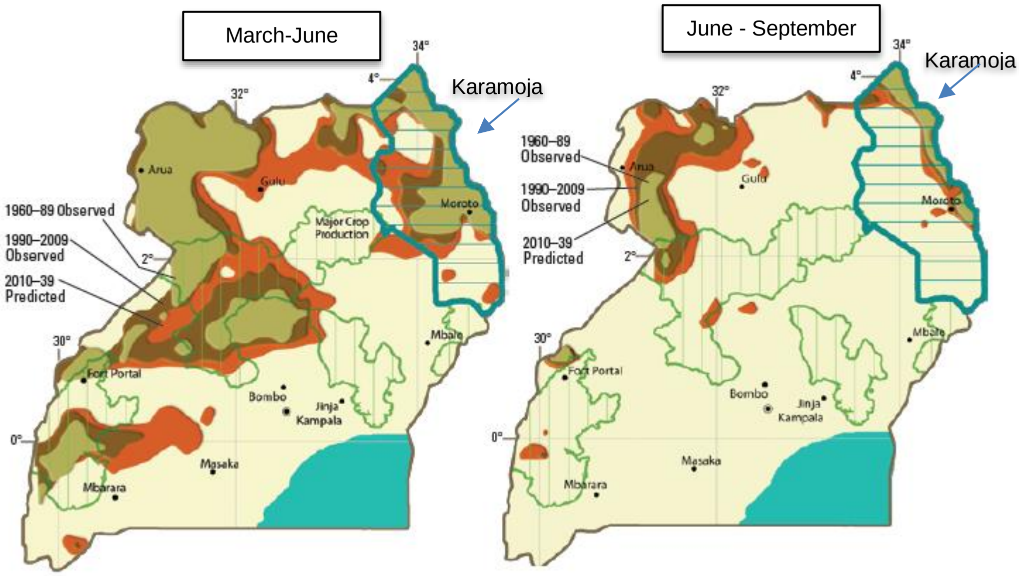


Table 1: Climate trends and projections

Parameter	Observed trends (since 1960s)	Projected changes (2040–2069)
Temperature	• Expansion of warmer regions in Uganda, negatively impacting the Karamoja region during critical parts of the year (figure 2). • Increase in average temperature of 1.3°C, with increases in both minimum (0.9°C) and maximum (1.6°C) temperatures (1975–2009). • Increase in average number of days with extreme heat ("hot" days) of 20–28 percent between 1960 and 2003, with particularly marked increases between June and August.	• Increases in minimum temperatures regionwide by 1.8–2.1°C, maximum temperatures by 0.3–1.7°C, and average temperatures by 1.2–1.5°C. • Increase in the number of days with extreme heat ("hot" days) by 15–43 percent. • Districts with the highest projected increases are Moroto, Kaabong, Amudat and Nakapiripirit (minimum temperatures +2.3–2.8°C) and Moroto and Kaabong (maximum temperatures +2.0–2.5°C). • Higher temperatures are projected for the periods corresponding to projected reductions in rainfall.
Rainfall	• Decreased reliability of rainy season – with early cessation in Kotido and Kaabong, and earlier onset/later cessation in Napak and Abim (the latter suggesting an expansion of the growing season). • Reduction in total annual rainfall of 15–20 percent, with a shorter rainy season. • Increases in June rainfall coupled with decreases in September–October rainfall.	Rainfall projections are less certain: • If observed trends continue, projections suggest reduced rainfall (50–150 mm), with pronounced variability from year to year as well as within the year. • Other models suggest that rainfall is projected to increase in total amount but with pronounced year-to-year variability.

Table 1 summarizes the available evidence base on current observed trends and projected changes for the Karamoja region of relevance to FFP programming, while impacts across sectors of interest are analyzed in the next section. While acknowledging the need for shorter-term (10–15 years) information on future climate, it is important to note that the projected changes in the table are for the period 2040–2069. This is because the high climate variability from year to year in Karamoja makes it difficult to separate out the "climate change" signal – that is, the point at which the impacts of increased CO_2 concentrations in the atmosphere will significantly alter the climate variability. This same high year-to-year variability makes forecasting from current observed trends challenging. For example, as indicated in the rainfall projections, if current trends are considered an indication of future conditions, then a 50–150 mm reduction in rainfall can be expected in the region by 2040. However, the complex climate models suggest that rains may actually increase. The geographic variability of these changes is highlighted in Annex 1. While it is difficult to say which scenario is more likely, planning for variability will build resilience against longer-term climate risks. (3, 4, 7, 9, 16, 17, 18, 19, 20, 22, 27, 28)

Figure 2: Warming trends and projections for Uganda, 1960–2039 March–June and June–September



Source: FEWS NET 2012.

Note: The left map shows March–June average temperatures of 24°C "isotherms" for 1960–1989 (light brown), 1990–2009 (dark brown) and 2010–2039 (predicted, orange). The right map shows analogous changes for June–September. Note the predicted increases in warm zones in the eastern and central regions of Karamoja. The green polygons in the foreground show the main maize surplus regions. The blue polygon in the upper right of both maps outlines the Karamoja region.

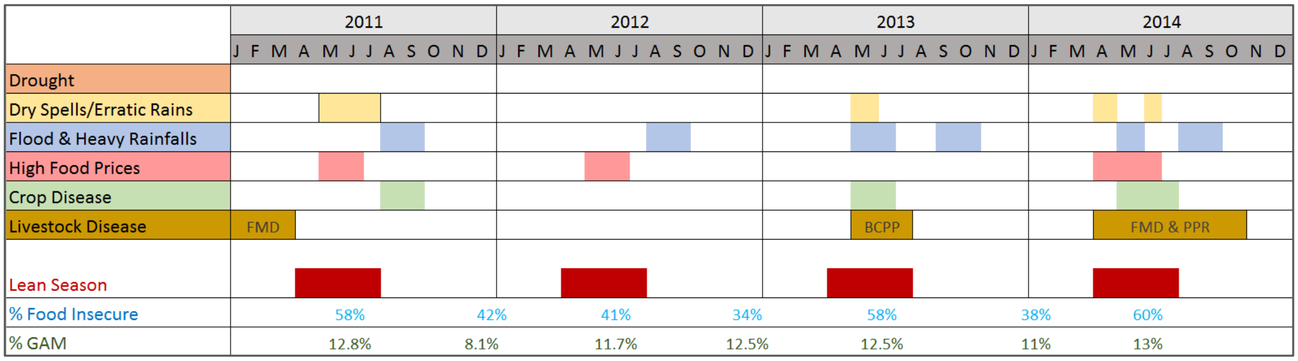
SECTOR IMPACTS AND VULNERABILITES

HOUSEHOLD CLIMATE SHOCKS

Rainfall in Karamoja is characteristically episodic, alternating with a prolonged severe dry season, and considerable variation arises from year to year. Cyclic droughts occur every two to three years. The episodic nature of these events means that most of the region's population is typically affected by a sequence of shocks that pose significant challenges to livelihood security (figure 3). The main climate-related shocks in the region include erratic and unevenly distributed rainfall, which can result in:

- Droughts *(generally between April–June)*
- Severe dry spells and erratic rains *(particularly between May–July)*
- Floods *(particularly from July–September)*
- Outbreaks of livestock disease or changing crop pest dynamics *(August–September)*
- High food prices
- Livelihood insecurity

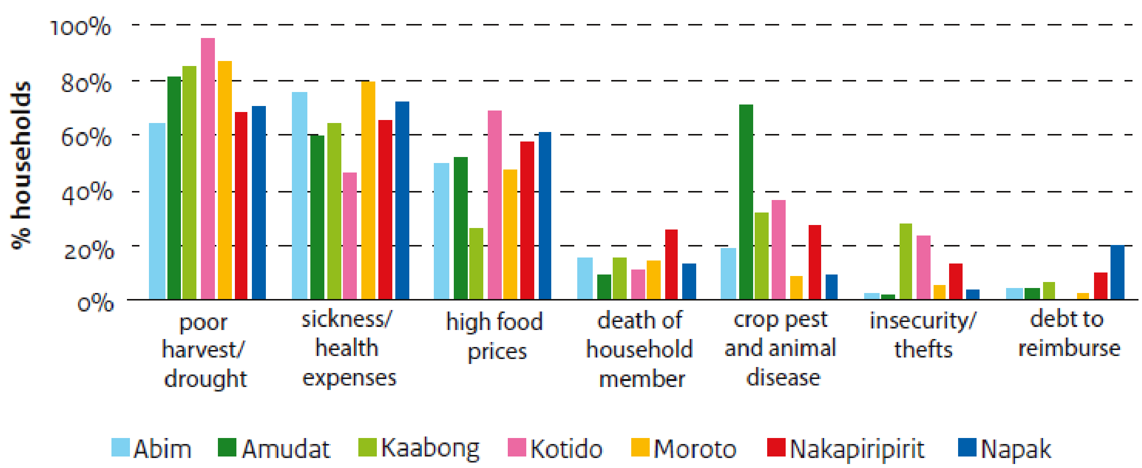
Figure 3: Shocks and stresses from 2011–2014 by month in the Karamoja region



Source: RAU 2015.

These shocks vary by district (figure 4). For example, more households in Amudat report being affected by crop pests and animal diseases than in any other district.

Figure 4: Shocks and stresses by district

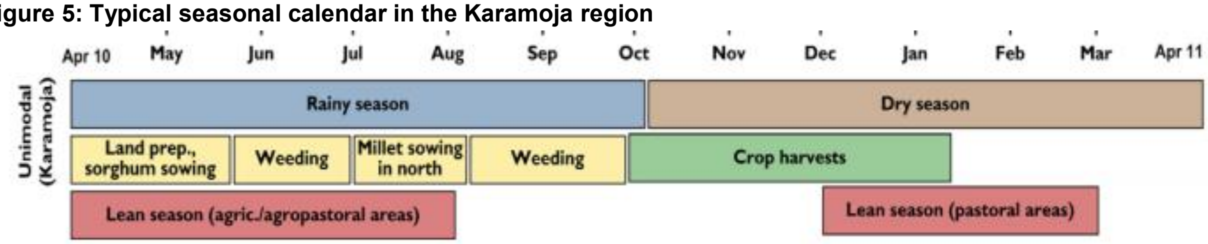


Source: World Food Programme, 2014.

CROP PRODUCTION

Crop production in Karamoja is strictly rainfed, and reliant on two principal crops: sorghum and maize. Other crops grown include beans, groundnuts, cassava and sweet potatoes. The majority of farming is of a subsistence nature, although the western region also grows vegetables for markets (e.g., cash crops). Soil fertility in most of Karamoja is poor. South Karamoja's soil types have very limited water retention capacity, cracking during the dry season and becoming waterlogged during the wet season. Soils are highly compacted in general, often forming a dense mass called hardpan. With the exception of less compacted and more nutrient-rich soils along dry river courses, most of the soils in the region are of low fertility. These poor-quality soils, which produce low yields at the best of times, make agricultural production especially vulnerable to temperature increases and drought, conditions likely to be exacerbated by climate change. Cropping cycles are defined by the onset of the rains in April (figure 5). First plantings begin in March–April, with second plantings of earlier maturing crops such as beans, sweet potatoes and millet in August/September where soil and rain conditions allow. Cassava is now increasingly being planted in the western and central districts as a cash and subsistence crop.

Figure 5: Typical seasonal calendar in the Karamoja region



Source: FEWS NET, 2016.

Poor soil fertility and soil moisture deficits are among some of the most critical challenges to agricultural productivity in this region. As soil continues to erode, farmers have fewer options and must seek out more and more marginal areas for production. In contrast to the mixed livestock/agriculture livelihoods of the past, agriculture is increasingly the primary form of livelihood in the region as household migration decreases and farming practices improve. Nevertheless, small plot sizes constrain production. Other constraints to the sector include lack of draft animals (oxen), lack of improved seeds and tools, decreased soil productivity, absence of water, transportation challenges to markets, and inefficient crop drying and storage practices.

Climate change creates numerous risks for agricultural productivity. For the Karamoja region, chief among these risks are increased temperatures and increased extreme weather events, such as intense single rainfall events and longer dry periods. Table 2 provides a brief summary of climate sensitivities for the value chain crops of relevance to the Feed the Future focal areas.

Table 2: Climate sensitivities of key crops

Crop	Climate sensitivities
Maize	• Very susceptible to rain failure. • Each "degree day" that the crop spends above 30°C depresses yield by 1 percent if the plants are receiving sufficient water. If not receiving enough water, yield reductions are higher (e.g., yield decreases by 1.7 percent for each degree day spent over 30°C).
Sorghum	• Very sensitive to moisture stress – especially a long break in the rains during the growing season that can lead to honeydew disease. • Highly susceptible to water stress during the early development stages.
Beans	• Sensitive to waterlogging from intense rainfall.

Note: A unit that reflects both the amount and duration of heat experienced by the plant.

Much of Karamoja's agricultural production is already vulnerable to changes in climate, which controls soil water availability, crop growth and productivity, and the incidence of agricultural pests (table 3). This situation is expected to be magnified in coming decades, and will be a major factor in agriculture sector productivity. Properly managed with on- and off-farm practices, agricultural productivity can be enhanced despite climate risk, improving the region's prospects and reducing many of its current food security challenges. However, a careful evaluation of current agricultural practices in light of projected climate change is required to guarantee agricultural sustainability and effectiveness in the coming decades. Table 3 highlights the current and projected impacts. Risk management frameworks should also be used to understand the implications of uncertainties about climate change impacts when informing planning, investment and operations. (2, 6, 8, 9, 10, 11, 13, 14, 15, 16, 19, 21, 24, 30, 32)

Table 3: CROP PRODUCTION – Climate stressors and risks	
Climate stressor	**Climate risks**
Higher temperatures	Soil water stress
Increased unreliability of rainfall (more variability)	Crop failure/lower productivity, leading to hunger/ food shortages/ increased food prices
Increased length or intensity of dry periods	Increased incidence of agricultural pests (e.g., weeds, insects)
Increased CO_2 and ozone concentrations	Shorter growing periods leading to decreased productivity
Increased intensity of extreme events	Waterlogging/crop damage

LIVESTOCK

Livestock rearing of sheep, goats and cattle has a long history in the Karamoja region, particularly in the pastoral and agropastoral livelihood zones. Many Karamojan households obtain a proportion of their annual income from livestock (in 2014, 40 percent owned cattle, 49 percent owned sheep and 50 percent owned poultry) (30). Traditionally, pastoralists lived in fenced hamlets called *manyattas* and, as a traditional adaptive response, travelled during the dry season to find water and grass to stock mobile enclosed cattle camps called *kraals*. However, land use and land cover change have transformed available forage resources, particularly in the grasslands. In addition, the decades of civil unrest, combined with new, more sedentary pastoralist practices imposed as part of the disarmament process that limit mobility by replacing the traditional *kraal* system with concentrated corrals next to Ugandan army camps, present substantial challenges to pastoralist livelihoods. Limiting mobility and concentrating animal shelters has led to widespread overgrazing around camps and exacerbated tensions regarding use of limited water resources. These arrangements are not well-received by the Karamojong. This practice has also been linked to increased incidence of livestock diseases and reduced reproduction rates. All of these issues combined reduce the quality of herds, render livestock more sensitive to heat and water stress, and threaten their usefulness in helping families cope with shocks.

Pasture management varies from north to south of Karamoja per climatic and soil conditions, and per the nature of relationships between tribes. Management techniques even without consideration of climate risks include: 1) movements from *kraal* to *kraal* to reduce overgrazing pressures, 2) daily migration of 12–14 km to grazing areas, 3) combination stocking (mixed numbers of cattle, sheep and goats) adjusted to available grass type at preferred sites, 4) changing watering regimes with available resources, 5) controlled burning of pasture, 6) switching to tree and woody vegetation browsing or transporting animals back to *kraals* when pasture grasses are scarce, and 7) visits to nearby mineral-rich areas.

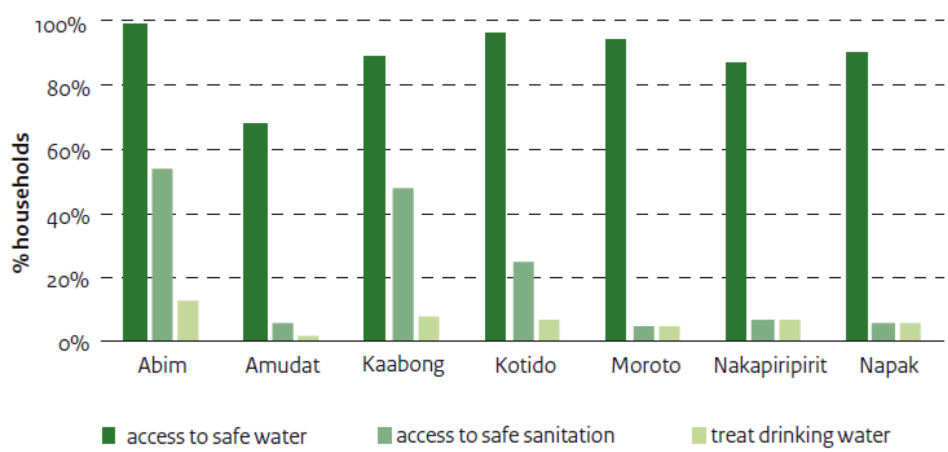
According to the Food and Agriculture Organization (FAO), of the five factors that affect livestock performance, three are linked to climate: 1) rainfall quantity and distribution along with its effects on pastures, 2) water availability, and 3) livestock diseases. Clearly, climate change, in addition to factors such as poor rangeland management, will constrain the number and type of livestock that Karamoja's rangelands can support. The main impacts on the sector are outlined in table 4. (1, 6, 11, 13, 14, 15, 16, 17, 18, 32)

Table 4: LIVESTOCK – Climate stressors and risks	
Climate stressors	**Climate risks**
Higher temperatures	Increased evaporation of water points, leading to water shortages and competition between people and livestock for limited resources
Increased unreliability of rainfall (more variability)	Increased incidence of disease outbreaks as disease vectors change and expand
Increased length or intensity of dry periods	Changing water systems, increasing the difficulty of maintaining healthy animals in a sanitary environment
	Lack of reliable markets due to poor-quality roads and conflict
Increased intensity of extreme events	Reduced forage availability
	Increased milk spoilage due to higher average temperatures

WASH AND HEALTH

Climate issues in Karamoja center in large part on access to water. From a WASH perspective, the integrated disarmament and development report for the period 2011–2015 shows that 73 percent of the region's population is located more than 30 minutes from a water source. Daily water consumption per capita is lower than the average global standards of 15 liters per person per day across all districts except Abim. Lack of access to safe water contributes to malnutrition among all groups, as does a lack of basic sanitation practices (e.g., hand washing), especially among young children. All of these issues are compounded by limited access to health services in the region. Use of improved sanitation facilities varies, with the highest rates (41 percent) in northern Karamoja and lower rates (11 percent) in the south, with the worst access rates in Moroto, Nakapiripirit and Napak (figure 6). Water resources are likely to be increasingly strained in Karamoja's future climate. While it is projected that precipitation may increase, warmer temperatures will accelerate evaporation, reducing the benefits of increased rainfall.

Figure 6: Access to water and sanitation by district



Source: WFP 2014.

As previously discussed, climate variability and change will likely exacerbate food insecurity. Other health-related issues potentially affected by climate change include malaria and diarrhea, which are endemic in Karamoja. Dehydration caused by severe diarrhea is a major cause of morbidity and mortality among young children, and exposure to contaminated water is rampant. Regarding malaria, stagnant pools of water common during the rainy season support mosquito breeding and lack of prevention mechanisms such as mosquito nets and indoor residual spraying increase human exposure. Likely climate trends may increase these problems. In addition, morbidity and mortality are likely to increase as a result of more intense heat waves. Table 5 summarizes risks and impacts to water resources, WASH and maternal and child health. (1, 2, 6, 13, 14, 19, 21, 30, 35)

Table 5: WASH AND HEALTH– Climate stressors and risks	
Climate stressors	**Climate risks**
Higher temperatures	Drying of rivers, lakes and other surface water sources (and/or reduced water quality from these sources)
Heavy rains, storms and floods	Reduced infiltration, leading to water scarcity and increased incidence of conflict over water resources
	Pollution of wells/flooding of latrines, leading to increased incidence of infectious diseases and challenges to hygiene/sanitation practices
	Shift in ranges of disease-carrying vectors to expanded areas (e.g., previously malaria-free areas)

PESTICIDE USE

Although chemical pesticide use is historically low throughout most of Sub-Saharan Africa compared to other parts of the developing world, use of pesticides, insecticides, fungicides and herbicides is becoming increasingly more prevalent in Uganda, even in remote locations. USAID/Uganda projects work across all climatic and agro-ecological zones, and pesticides released into the environment may have several adverse ecological effects in both the short and long term. In Karamoja, vulnerability to pesticide contamination is heightened since most of Karamoja has poor soils exposed to heavy rainfall events, leading to water runoff as high as 40 percent. Therefore, it is important to be aware of climate risks that may have implications for pesticide use in the agriculture sector. In addition, increased climate stress on specific crops and livestock, undercutting yields and productivity, may create incentives for farmers to increase their use of pesticides and acaricides to maintain the health and productivity of their crops and livestock. While no data exist on pesticide use in Karamoja for specific crops, donor-funded programs sometimes support pesticide use. Table 6 indicates the associated impacts and risks.

Table 6: PESTICIDE USE – Climate stressors and risks	
Climate stressors	**Climate risks**
More intense rainfall **Longer dry periods** **Increasing temperatures**	Increased surface runoff
	Increased percolation/groundwater infiltration
	Increased threat from current pests/introduction of new pests
	Reduced effectiveness of pesticides applied topically
	Reduced effectiveness of pesticides that are activated/distributed by water
	Farmers' reduced willingness to use Personal Protective Equipment (PPE) due to increased temperatures

INVASIVE SPECIES

Invasive species can reduce crop and livestock production, encroach on native biodiversity, and increase production costs. Considerable evidence suggests that climate change will further increase the likelihood of invasive species gaining a foothold and/or expanding their range in forests and rangelands. Many invasive species are, by nature, highly flexible, respond to environmental change more quickly than do natives, and are likely to thrive in a more variable climate compared to native species. Although specific information on invasive species in Karamoja is lacking, invasive plant species, including *Lantana camara, Broussontia papyrifera, Mimosa pigra* and *Senna spp,* have colonized large areas of Uganda's Budongo and Mabira Forest Reserves. In some protected areas, invasive plant species are forcing wildlife to move outside of protected area boundaries, resulting in human–wildlife conflict. Land conversion for agriculture is a major cause of invasive plant species' adverse effect on natural ecosystems (e.g., invasion of *Senna* species in tropical forests in Kyenjojo, Kyaka and Kibale Districts in western Uganda). Disturbing the natural landscape by cutting forests and other native vegetation presents invasive species with an opportunity to proliferate. Purposely bringing in non-native species of plants often has unanticipated consequences when these species multiple beyond the areas in which they are planted. Table 7 provides more information on invasive plants known to be present in Uganda. (5, 25, 28, 34)

Table 7: INVASIVE SPECIES – Characteristics and link to climate

Species	Characteristics	Link to Climate
Prosopis spp (Mesquite)	Tends to form dense, impenetrable thickets; depresses the growth and survival of indigenous vegetation around it (including agriculture crops); reduces grazing land; and is very costly to eradicate.	In South Africa, invasion of *Prosopis* followed periods of high rainfall.
Lantana camara (Tick berry)	Spreads rapidly to form extensive, dense and impenetrable thickets in forestry plantations, orchards, pasture land, and wasteland and in natural areas. In Uganda, hundreds of hectares of both productive grazing and protected grasslands/woodlands have been observed to become heavily invaded within a few years of first infiltration.	Is resilient to dry conditions and continues to spread and adapt to drier conditions; can also thrive in medium to high rainfall areas in East Africa.
Parthenium hysterophorus (Congress weed)	Unpalatable to livestock so its invasion results in grazing shortages. Produces allelopathic substances that deter other plants from germinating and growing near it – and hence can "take over" native grassland and improved livestock pastures as well as the understory in woodlands.	Can thrive in drier soil conditions that result from higher temperatures.

Annex 1: District-level overview, vulnerabilities and climate risks for Karamoja

District	Overview	Vulnerabilities	Climatic conditions	Climate risks/impacts
Abim	Agriculture with high-potential area for crop production due to good soils and higher rainfall amounts. Rainfed crop production is the norm, leaving households vulnerable in years when rains are poor.	Unsustainable use of livelihood assets with increasing levels of environmental degradation due to charcoal burning and population movements; insecurity due to raids and road ambushes.	Average annual rainfall is between 700–1000 mm. One long rainy season lasts from March/April to September/ October, with a drier spell typically occurring during June and July.	Drought; outbreaks of livestock diseases, human diseases, and crop pests.
Moroto and Napak	Agropastoral and pastoral zones. Rainfed crop production is practiced throughout the zone, although the environment and climate are more conducive to livestock rearing than crops.	Food insecurity; inter-ethnic conflict; human–wildlife conflict.	Rainy season extends from March to September and is less reliable than in western parts of Karamoja region, with an annual average of 500–800 mm.	Frequent recurrence of dry spells; late and/or excessive rains that wash away seeds and early germinating crops; plant and animal pests and diseases.
Kaabong	Rocky, mountainous landscapes with moderately low rainfall of the agropastoral zone.	Human disease outbreaks such as cholera; crop diseases; endemic livestock diseases; insecurity caused by cattle raids.	Rainfall of 500–800 mm, with rains erratically distributed.	Drought.
Kotido	Flat, plain lands with short grasses. Characterized by sandy, loamy soils with pockets of low-lying, flood-prone areas with black cotton.	Ethnic clashes between the Jie and Dodoth; animal diseases (CBPP, Brucellosis, PPR and trypanosonomiasis); high food prices due to high fuel prices.	Long dry spells and intermittent rainfall.	Increased animal diseases and plant pests like sorghum smut and Striga weed; reduced access to livestock products during dry season due to shifted grazing areas.
Nakapiripirit and Amudat	Encompass 3 livelihood zones: pastoral, agropastoral and agricultural.	The quantity of water accessed from boreholes is declining while access to unsafe water from the rivers/springs, pans and dams is increasing, putting communities at a risk of waterborne disease/infections.	Drought and high temperatures.	Increasing cases of malaria and diarrhea; crop diseases such as honeydew disease, black smut and shoot fly; maize stalk borer and Striga weed in cereals.

Source: Synthesis of results from the integrated food security phase analysis for Karamoja (IPC Technical Working Group 2011).

KEY RESOURCES

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