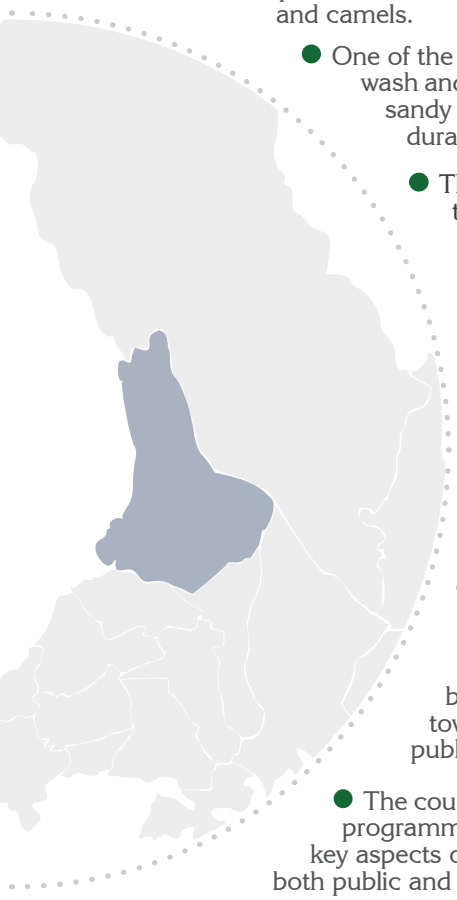
Kenya County Climate Risk Profile Series

Climate Risk Profile West Pokot County

Highlights



- The agricultural and livestock sector is the most important segment of West Pokot's economy. On average, 65% of the entire farm produce is sold, and 83% of households derive at least part of their income from on-farm activities. In 2012, income from the main crops totaled KES 3.2 billion, with maize and beans alone accounting for 96% of the value. In comparison, the livestock sector contributed KES 29.6 billion, 93% of which was from trade in cattle, goats, sheep and camels.
- One of the most apparent effects of climate change observed by farmers is the occurrence of floods that wash and contribute to soil erosion in the lowlands. West Pokot is especially vulnerable since its soils are sandy and generally have low fertility. Climate models predict increasing variability in the onset and duration of rains with significant increases in the risk of floods.
- The late onset of rains and unpredictable rainfall lead to more frequent and extreme droughts that greatly impact productivity of rain-fed crop systems as well as quantity and quality of pastures. Increased drought stress and heat are projected to continue between 2020 and 2060.
- Water harvesting and irrigation have proven successful in improving productivity of certain crops and have transformed the transition zone between highlands and lowlands in Ortum. Within ten years of the introduction of irrigation, West Pokot has become a major producer of onions nationally; there are plans to increase water harvesting and irrigation on individual farms in the coming years.
- The county government's efforts to vaccinate livestock have quickly and successfully combated the spread of diseases in West Pokot. Vaccination is important in the county, in view of the high rates of animal migration from neighbouring Turkana and Baringo counties and Uganda.
- Agricultural extension services in the county have limited reach; county government extension officers, while well trained and experienced, are too few to effectively cater to the needs of producers in the county. In addition, county budget allocation for new hiring and support for field activities remains low. In the face of this challenge, there has been notable collaboration between public, private, and non-governmental bodies, ranging from direct financial support towards field expenses of extension officers to secondment of fully-renumerated technicians at publicly-funded facilities.
- The county government is finalising a policy document on coordination, harmonisation, and funding of programmes. The document is targeting the agricultural sector, with major focus on activities that address key aspects of climate change adaptation and preparedness. The county should work with stakeholders in both public and private sectors and donors to improve services.

KAPP Kenya Agricultural Productivity Programme
Republic of Kenya
WORLD BANK GROUP

List of acronyms

ASDSP	Agricultural Sector Development Support Programme
ACF	Action Against Hunger
CIAT	International Center for Tropical Agriculture
EWS	Early Warning Systems
GEF	Global Environmental Facility
KACCAL	Kenya Adaptation to Climate Change in Arid and Semi-Arid Lands
KALRO	Kenya Agricultural and Livestock Research Organization
KAPP	Kenya Agricultural Productivity Programme
KES	Kenyan Shillings
KMD	Meteorological Department
KRCS	Kenya Red Cross Society
ICIPE	International Centre of Insect Physiology and Ecology
LPD	Livestock Production Department
MoALF	Ministry of Agriculture, Livestock and Fisheries
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
NCPB	National Cereals and Produce Board
NDMA	National Drought Management Authority
NEMA	National Environmental Management Authority
REWAS	Revised Early Warning & Analysis System
SCCF	Special Climate Change Fund
VCC	Value Chain Commodity
WB	World Bank
WFP	World Food Programme

Foreword

Climate change is becoming one of the most serious challenges to Kenya's achievement of its development goals as described in Vision 2030. Kenya is already extremely susceptible to climate-related events, and projections indicate that the impacts are likely to affect the country even more in the future. In many areas, extreme events and variability of weather are now the norm: rainfall is irregular and unpredictable; some regions experience frequent droughts during the Long Rain season and others severe floods during the Short Rains. The arid and semi-arid areas are particularly hard hit by these climate hazards thereby putting the lives of millions of households and their social and economic activities at risk.

In 2010, Kenya developed a National Climate Change Response Strategy (NCCRS) which recognized the importance of climate change impacts for Kenya's development. This was followed by the National Climate Change Action Plan (NCCAP) in 2012. The focus of these initiatives has been the national level. Therefore, there is a need to mainstream climate change perspectives in programmes and development plans at the county level.

In an effort to help reduce the near-, medium- and long-term vulnerability to current and future climate variability, the Kenyan Government, through the Ministry of Agriculture, Livestock and Fisheries (MoALF) is implementing the Kenya Adaptation to Climate Change in Arid and Semi-Arid Lands (KACCAL) project, with a grant from the Global Environmental Facility (GEF)/ Special Climate Change Fund (SCCF) through the World Bank (WB). The present study is part of the KACCAL project. It aims to inform the county government and other stakeholders on the climate change risks and opportunities for agriculture so that they are able to integrate these perspectives into their development plans and processes. The 15 participating counties include: Busia, Embu, Garissa, Homa Bay, Kilifi, Kwale, Makueni, Meru, Nakuru, Nyandarua, Nyeri, Siaya, Taita Taveta, Tana River, and West Pokot.

Presented here is the County Climate Risk Profile for West Pokot County, where climate variability has been accompanied with a significant increase in risks. In 2013, the county suffered massive flooding triggered by torrential rains and aggravated by degraded watersheds. The resultant excessive surface runoff displaced more than 35,000 people and submerged untold hectares of maize, millet, and sorghum . In response to the devastation, the national government and humanitarian relief organizations distributed more than 4,000 bags of maize, 14,000 bags of rice, and 6,800 bags of beans, among other necessities[1]. This flood, and a subsequent one the following year, has been followed by years of extreme drought. In 2015 and 2016, 600,000 residents have been facing acute hunger as the maize crops withered and livestock starved under extreme heat and lack of rainfall in the Long Rain season[2]. The situation is particularly acute for the county's pastoralists, who have been urged by the national government to combat drought by building pan dams, storing hay, and ensuring that animals are vaccinated. The magnitude and severity of these climate hazards make identification of impending climate risks urgent, alongside measures that ensure resilience.

The remainder of this profile is organized into six main sections, each reflecting an essential analytical step in studying current and potential adaptation options in key local agricultural value chain commodities. The text first offers an overview of the county's main value chain commodities key to food security and livelihoods, as well as major challenges to agricultural sector development in West Pokot. In the next section, the main climate hazards are identified based on the analysis of historical climate data and climate projections. Then it continues with an analysis of the vulnerabilities and risks posed by the hazards deemed to be potentially most harmful to the respective value chains. Based on these vulnerabilities, current and potential on-farm adaptation options and off-farm services are discussed. The text also provides snapshots of the policy, institutional and governance context that can enable adoption of resilience-building strategies. Finally, it presents potential pathways for strengthening institutional capacity to address potential future climate risks.

1 According to the online newspaper Daily Nation (2013).

2 As reported by the World Food Programme (2015) and the online newspaper Daily Nation (2016).

Agricultural context

Economic relevance of farming

The agriculture sector is the most important segment of West Pokot's economy, contributing to about 84% to household incomes (GoK, 2013). A household baseline survey conducted by ASDSP in 2014 reported that 41.8 and 23.2% of all female- headed households cited crop farming and livestock rearing respectively as their primary occupation (GoK, 2014a). Only 3.6% of youth-headed households named farming as their main occupation. In general, females and youth dedicate 4 and 5.9% of their land to commercial farming respectively, compared to 3.2% for males (GoK, 2014a).

Most agricultural activities in West Pokot are subsistence; on average, 62% of the household produce is used for consumption purposes and approximately 16% for market purposes (ACF, 2012). This is particularly the case for maize, mangoes, bananas and kales. In 2012, the main crops and livestock generated KES 3182.4 and 29,563.9 million shillings respectively with the largest contributions coming from dry maize and zebu cattle (GoK, 2014a).

People and livelihoods

The population of West Pokot is 631,231 growing at a rate of 5.2% per year (GoK, 2013), almost double the national growth rate of 2.9%. The higher growth rate may be explained by economic factors (great wealth held in livestock), cultural factors (relatively early age of marriage among women) as well as the high degree of rural residency in the county. Based on the 2009 census, the urban population accounted for only 8% of the total population in the county, making West Pokot one of the least urbanized counties in the county (GoK, 2012). The county has 93,777 households each with an average of 7.1 members GoK, 2013).

The value of cattle, goats, and other livestock types constitutes up to 40% of the average household wealth. The importance of livestock varies with gender and age of farmers. On average, livestock comprises 41%, 52% and 40% of male-, female- and youth-headed holdings respectively. Household income (obtained through on-farm and off-farm activities) contribute 34%, 38%, and 24% of the total wealth of male-, female-, and youth-headed households respectively. In daily per capita terms, male-, female-, and youth-headed households earn KES 91, KES 124 and KES 83 respectively. The performance of female-headed households may be attributed to greater livestock and land resources, and smaller household size (6 compared to an average of 7.1).

Sixty-nine percent of the population live below the poverty line (GoK, 2013), whereas almost an equal proportion (approximately 70%) experience food and nutrition insecurity (Ibid). Families are generally able to have three meals a day during peak food seasons. However, 93% report inadequacy of food to meet household needs during off seasons, typically between January and August (Ibid). Factors that contribute to food insecurity include the seasonality of production, post-harvest losses, and size of household relative to its productivity.

In general, female-headed households demonstrate greater dietary diversity than male- and youth-headed households; they consume more than three food groups in a given period. However, according to guidelines for recommended caloric intake as a measure of food security, the food does not meet the minimum threshold for the households to be considered food secure at all times of the year.

Along with food security, access to resources and services presents a great challenge to the population of West Pokot. Approximately 17% of the population has access to potable water and 9% has access to piped water. Only 2.6% have access to electricity. Only 31% of all household heads have attained primary school education and just 8.8% have secondary school education. None of the female heads of households surveyed have received formal education. Similarly, 55% of the population have not been formally educated (KNBS, 2013).

Agricultural activities

West Pokot covers 9,169 square km, of which 41% is arable (Gok, 2013). The agricultural activities undertaken in the county correspond to the three main agro-ecological zones highlands (Lelan), mid-lands (Kapenguria) and lowlands (Kacheliba) (Jaetzold et al, 2010). In the highlands, where it is wetter and cooler, the main activities are dairy farming, sheep rearing, and cultivation of potatoes and pyrethrum. The midlands have moderate rainfall and temperatures and are ideal for mixed farming. Households in this zone grow maize, beans, and onions, and keep poultry and goats. The lowlands are drier and support bee-keeping and the rearing of indigenous cattle, goats and camels, mostly by grazing on communal land. With increasing irrigation, the lowlands are evolving into an important producer of fruits and vegetables, such as bananas, mangoes and onions.

It is common for households to own or have access to more than one parcel of land between family members. In general, most of the land is under natural pastures. Among male- and youth-headed households, subsistence farming and homestead take second and third place in land allocation. Female-headed households allocate the second- and third-largest land to commercial and subsistence crops respectively. Farm parcels can be as far as 7.8km from the primary homestead and so it is conceivable that land parcels span across agro-ecological zones.

Overall, 46% of the households have rights to use communal land while 32% own land but do not have formal ownership documents (GoK, 2014a). 15% own land and have formal documents while 1% lease land. Significantly, youth-headed households exceed all others in holding land titles while female-headed households have the least. The latter may be a consequence of the low level of formal education among female heads of households.

All farmers use improved seeds in the production of annual food crops such as cabbages, sweet potatoes, and tomatoes. Seventy percent of the farmers often use local seeds for growing Irish potatoes, onions, and sorghum. A major factor contributing to the high degree of adoption of improved seeds, e.g. onions, is the difficulty in propagating such crops locally and the increasing commercialisation of agriculture in the county.

The use of production inputs by West Pokot farmers varies by commodity and type of farmer. Sixty percent of households use organic manure. However, only 33, 15.5, and 1.4% use basal, top-dressing, and foliar applications respectively. The low rate of adoption of fertilisers could be explained by their relatively higher cost compared to the readily available and inexpensive organic manure obtained from own or neighbours' farms. Moreover, compost manure may be preferable to fertilisers as it improves soil structure and enhances soil moisture retention capacity.

Pesticide use is generally low. Storage and field pesticides are used by 14.2 and 2% of all households respectively (GoK, 2014a).

Irrigation is used by just 1.4% of the households. This may be due to low investment in irrigation infrastructure and the difficulty of reaching rural homes, which are remotely dispersed across the county. In addition, irrigation is mainly carried out in the lowlands where pastoralism is the main activity and there has been limited conversion to crop farming. Irrigated farming has benefits and drawbacks: it could potentially improve crop productivity, but at the same time it could pose a serious threat to the water supply of downstream communities, especially during dry periods. This problem could be addressed and potentially mitigated by regulating water extraction from rivers.

Agricultural value chain commodities

Across Kenya, several value chains have been prioritized for development interventions by different government organizations and programmes such as the Agricultural Sector Development Support Programme (ASDSP), the Kenya Agricultural and Livestock Research Organization (KALRO) and University of Nairobi survey, and the Kenya Agricultural Productivity Program (KAPP). For the development of this County Climate Risk Profile, four major value chain commodities (VCCs) in West Pokot were selected for in-depth analysis,

Livelihoods and agriculture in West Pokot

Demographics

2% Of Kenya´s population

631,231 inhabitants

77% Live in rural areas

50% 50%

Access to basic needs

69% of the population lives in **absolute poverty**

Potable water	17%
Electricity for cooking	1%
Electricity for lighting	3%
Education (youth literacy rate)	37%

Food security

70% of the population suffers from **food poverty**

ND of household **income spent on food**

ND People **undernourished**

28% Children **stunted**

3% Children **wasted**

ND: No data

Infographic based on data from the County Integrated Development Plan (GoK, 2013), the Agricultural Sector Development Support Program (GoK, 2014), and Kenya National Bureau of Statistics (KNBS, 2015)

West Pokot

Farming

County´s farming area

373,587ha 41%

92% of the population employed in agriculture production

11% of farmers have title deeds

ND% are women

Farming activities

Food crops 5%

Cash crops 1%

Of county´s agricultural land

Livestock

16 Group ranches

ND Company ranch

Farming inputs

Water uses

ND ND ND

Fertiliser types (% of households)

40% Organic manure

33% Basal fertiliser

16% Top dress fertiliser

Pesticide types (% of households)

2% Field pesticides

14% Storage Pesticides

4% Herbicide

based on their productivity characteristics, economic importance, and contribution to food security. These VCCs have been selected from a list compiled from the above-mentioned documents, using the following prioritization indicators: harvested area (hectares), production (90 kg bags), variation in production (in the past five years), value of production (KES/bag), dietary energy consumption (Kcal/ capita/day), protein content (g of protein/100 g of product), iron content (mg of iron/100 g of product), zinc content (mg of zinc / 100 g of product), and Vitamin A content (IU Vitamin A / 100 g of product). The VCCs selected in West Pokot are: maize, goat milk, dairy cattle, and bulb onion. Maize was selected mainly for food security reasons, whereas goats, cattle, and onions were selected for their economic importance.

Maize

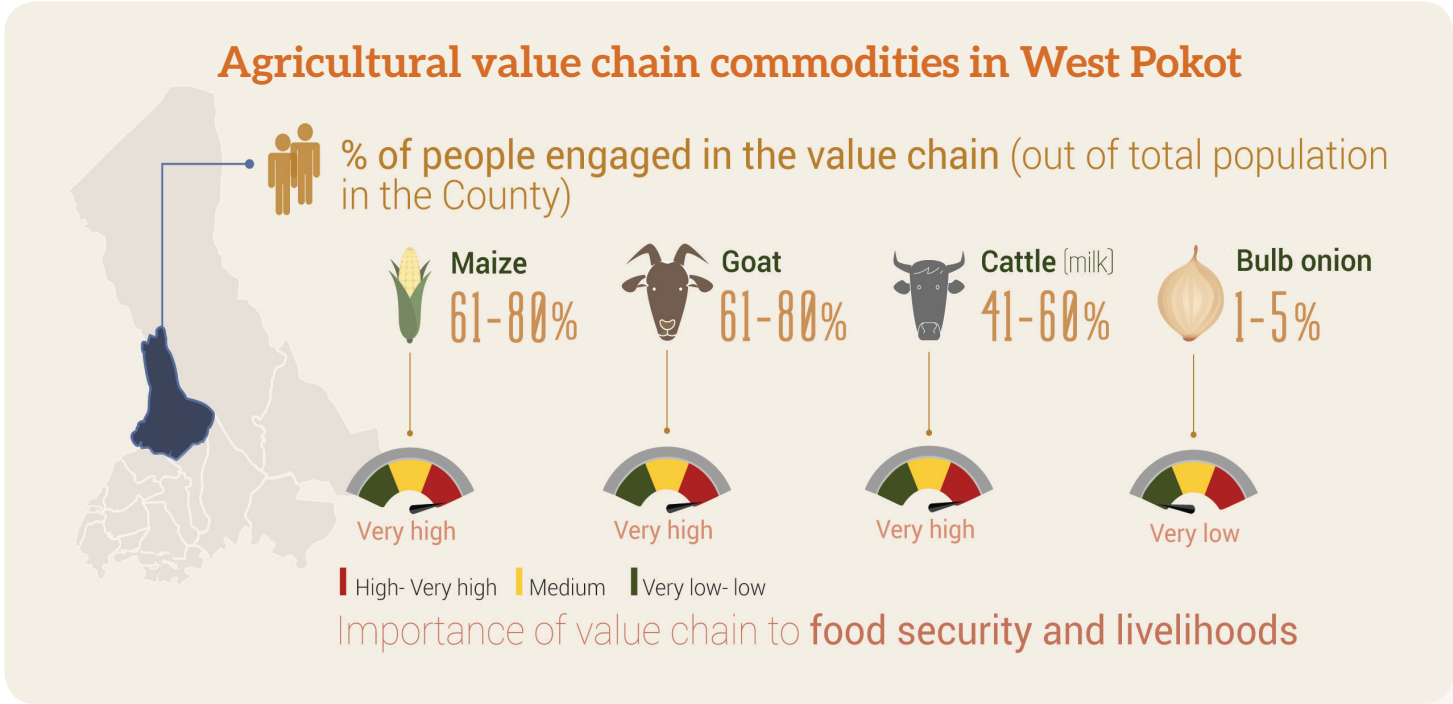
Maize is grown throughout the county in areas with sufficient rainfall. Major maize growing areas are Makutano, Cheptuiya, Kanyarkwat, Kacheliba, Chepnyal, Ortum, Chepareria, Sigor, Tamkal, Chesta, Kapenguria, Sioi and Kasei. An important staple, maize is primarily produced by small-scale farmers; 71% of households grow maize during the First season, which results in 64% of the annual production. In 2012, West Pokot County sold 1,254,805 90-kg bags of dry maize valued at a KES 2.9 billion.

Men are typically considered the main decision-makers with regards to maize production. Seventy percent of the maize is sold, rendering it important for household income. Female-headed and male-headed households producing maize seed have 40% and 37.5% rate of participation in contractual marketing arrangements respectively. For crops, marketing agreements are entered into by individual households with traders (66%) or individual consumers (27%).

Maize farmers use both their own and leased land and obtain inputs, mainly fertilisers and seeds, from agro-dealers. Labour is provided by members of the farmer's household, non-household labourers, or contractors (machinery). After harvesting, farmers may store the produce on the farm or alternatively, they may begin processing. The National Cereals and Produce Board (NCPB) and traders provide large-scale maize storage and perform bulking services. Marketing activities are mainly undertaken by traders or the farmers themselves, the latter especially for green maize.

Cattle (milk)

Cattle produce 56.4% of West Pokot's total milk production. The dairy cattle are mainly raised in the highland areas of Kapenguria, Lelan, and Tapach, where production is by small-scale farmers who own five to ten cattle per farmer on average. In 2012, the income generated from income generated from cattle milk was Ksh. 134 Million for 4.8 million liters. County Government Veterinary Services and the Livestock Production Department (LPD) are the most important



suppliers of extension, veterinary and breeding services. While farmer cooperatives participate in the value chain as collection and transportation agents, marketing is undertaken by both farmer cooperatives and processors.

During the dry season, male-headed households obtain the highest yields using cross and exotic cattle breeds, producing an average of 4.8 litres per animal per day. Female-headed households achieve the highest yields of 8.0 litres per animal per day with exotic breeds. During the wet season, daily production per cow increases by between 0.3 and 2 litres. Compared to the dry season when the average number of cattle kept is three, the number goes up to 81, 39 and 9 for local, cross- and exotic breeds respectively.

Value-adding activities such as fermenting and boiling are undertaken by 7.1% of female headed and 92.9% of male headed. Only 18.9% male headed and 22.2% female headed sell their milk under contractual arrangements.

Bulb onions

Bulb onions are an important source of income in West Pokot. They are grown in the highland areas of Ortum, Muino, Chesta, Parua, Sina, and Chepararia. In 2012, Production totalled 2 million kg valued at KES 100 million. Small-scale farmers cultivate onion since the producing areas are densely populated and experience frequent water shortages.

Agro dealers supply certified seeds, fertiliser, and pesticides. Labour for on-farm activities may be provided by the household, hired workers, or through communal arrangements. Individual households store produce at the farm and market it independently. Farmer groups and cooperatives also store, bulk, and market produce, sometimes after determining the value-added processes. The Ortum Farmer Cooperative provide credit facilities to members to settle school fees for their dependants at local learning institutions.

Goat (meat)

Goat rearing is a common practice in West Pokot, employing an estimated 61–80% of the county's population. Goats are produced mainly in Konyao, Kacheliba, Kishaunet, Cheptuya, Lomut, Sigor, and Chepareria. Herds range from 100 to 500 animals. They are mostly raised on large scale and graze on communal land. In 2013, West Pokot earned KES 5.5 billion from the sale of 551,596 goats.

The land on which goats are raised is usually adjudicated by clans or the local community. Households rely on family and hired herdsmen for labour and private consultants and government staff for veterinary services. The Veterinary department under the Ministry of agriculture oversees slaughtering and value-addition services. Post-harvest handling includes collection and transportation while marketing includes linking producers to the market, setting prices, and selling. Individual owners, middlemen, or farmer cooperatives market the goats.

Agricultural sector challenges

The agricultural sector faces several challenges related to natural resources including climate, as well as human capital and livelihood factors. Access to land and soil quality often limit agricultural production. Terrain in the highlands is hilly and the soils are sandy. They are therefore loose and susceptible to erosion and nutrient leaching. Torrential rains have led to formation of deep gullies on roads, inhibiting migration and delivery of produce to markets.

Although the average wealth per household is relatively high (cultural significance of large livestock and land holdings), the corresponding average income is quite low. This finding is consistent with the reported poverty rate of 69% in the county, highlighting the importance of on-farm and non-farm activities for daily income. With few alternative opportunities for earning daily income in the lowland areas, many residents have taken up charcoal-burning, resulting in clearing of shrubs and forested areas. Environmental degradation is also exacerbated by the limited implementation of land management systems such as paddocking and crop rotation. This has had an adverse effect on soil moisture, soil fertility, and productivity.

Most of the population of West Pokot are historically nomadic pastoralists. While farming is now commonplace in the highlands, the sector could still be considered quite nascent. There is an opportunity to increase productivity across all value chains. Access to regular extension services by crop farmers and livestock keepers in the county is scarce.

Climate change-related risks and vulnerabilities

Climate change and variability: historic and future trends

West Pokot has a moderately warm and moist climate throughout the year. The average annual temperature ranges quite a bit throughout the county from around 15°C in the south to above 25°C in areas in the northeast of the county. There is a strong south to north gradient of decreasing precipitation with southern parts of the county receiving greater than 1500 mm of precipitation per year, whereas areas is the far north of the county receive less than 250 mm. A majority of the county receives between 500-1000 mm of precipitation. Due to these strong gradients in both temperature and precipitation throughout the county, flooding, dry spells, and heat stress, are all hazards that contribute to agricultural risk in the county.

Historic analysis of weather in West Pokot show that dry spells are greatest and most variable in second half of the year, ranging between approximately 65 and 80 consecutive number of moisture stressed days. The first half of the year (January-June) consistently experienced 60 to 65 consecutive days of moisture stress. Extreme precipitation and flood risks[3] have tended to increase. While this extreme precipitation occurs throughout the year, it tends to occur more during the first half of the year, for which about 60% of the years had at least one day with greater than 20mm/day of precipitation. The records also suggest that there has been increasingly greater variability in the start and end of rainfall, and thus more variable cropping seasons.

Climate has been observed to only change very slightly in the county. Since 1981, the first wet season no significant changes or detectable trends in either temperature or precipitation. The second wet season experienced a very mild (~0.2°C) increase in temperature, and a slight tendency for increasing precipitation.

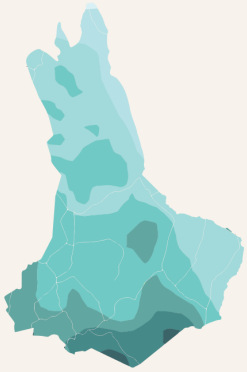
Looking to the future in the years of 2021-2065, both extreme precipitation and prolonged moisture stress are projected to occur, but the changes are different during different seasons. Within 30 years (by the early 2040's) temperature is projected to increase by 0.5°C, with the first wet season projected to experience even greater changes. And by this time, precipitation is projected to increase by 2% in the first wet season, and 3% in the second wet season. Consecutive days of moisture stress is projected to increase throughout the year, with the first half of the year projected to experience the number of consecutive moisture stress days increase from around 60 days per season to 70-75 days, and the second half of the year increasing from approximately 70 consecutive days to close to 80 days (under the higher greenhouse gas emissions. Extreme precipitation is projected to remain approximately unchanged or slightly decrease during the first half, and the second half of the year projected to only slightly increase These projections of future climate change under the two climate scenarios—RCP 2.6 and RCP 8.5[4]—show some small differences, but generally show the same future projections, suggesting climate change impacts will be fairly similar during this time frame no matter the greenhouse gas emissions that occur.

3 Refers to the wettest 1-day event (mm/day) indicator in the infographic.

4 The two RCPs, RCP2.6 and RCP8.5, are named after a possible range of radiative forcing values in the year 2100 relative to pre-industrial values (+2.6 and +8.5 W/m2, respectively). The pathways are used for climate modelling and research. They describe two possible climate futures, considered possible depending on how much greenhouse gases are emitted in the years to come. RCP 2.6 assumes that global annual GHG emissions (measured in CO2-equivalents) peak between 2010 and 2020, with emissions declining substantially thereafter. In RCP 8.5, emissions continue to rise throughout the 21st century.

Past and future impacts of climate hazards in West Pokot

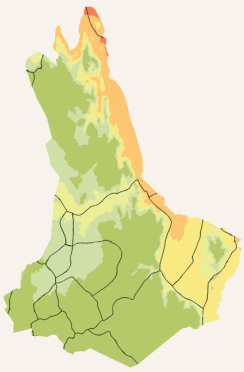
Historical annual mean precipitation (mm/year)



Legend
- Road
- <250
- 250-500
- 500-750
- 750-1000
- 1000-1250
- 1250-1500
- 1500-1750

Data sourses
Precipitation: CHIRPS (1981-2015)
Roads: Digital Chart of the World

Historical annual mean temperature (°C)



Legend
- Road
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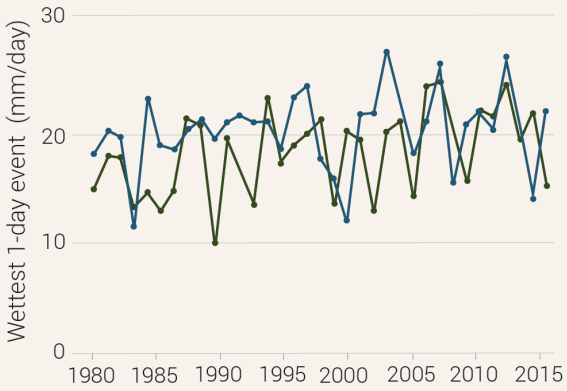
- 21 - 22
- 22 - 23
- 23 - 24
- 24 - 25
- 25 - 26
- <26

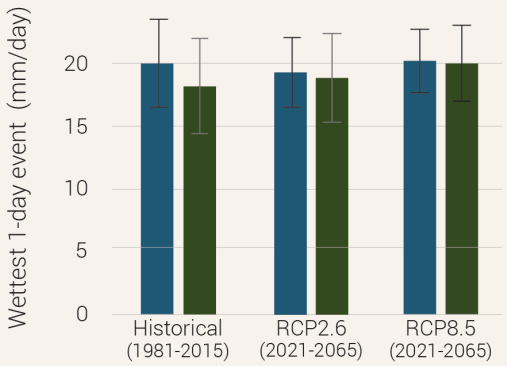
Data sourses
Temperature: WordClim (1970-2000)
Roads: Digital Chart of the World

Flood hazards

Historical extreme flood events

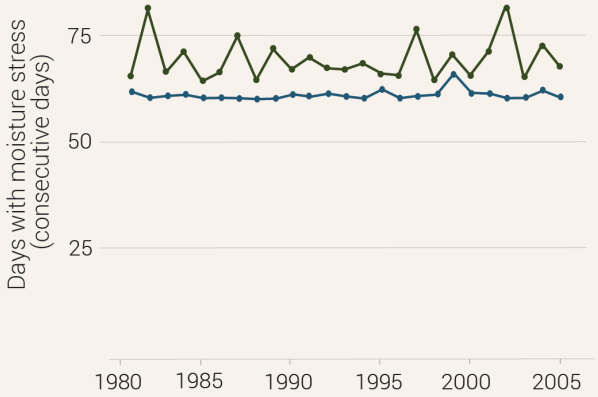


Historical and expected extreme flood events

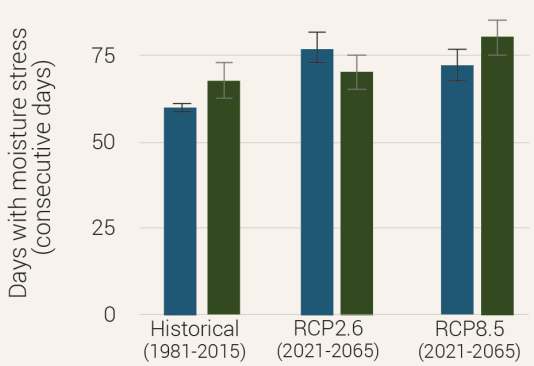


Drought hazards

Historical drought stress events



Historical and expected drought stress events



January - June July - December

The climate from farmers' perspectives

Farmers in West Pokot County can identify the impact of climate shocks and changes across the entire county, with different effects according to the production system and commodity. One of the most commonly cited changes observed by farmers is the occurrence of torrential rains, which results in soil erosion and washing away of fertiliser. In addition, soils in West Pokot county are prone to leaching and soil erosion. This in turn results in poor quality crops, particularly for potatoes, and can increase production costs as farmers are required to apply more fertiliser. Consumption costs too may go up, as the low production leads to shortages and spikes in demand.

Farmers also observed that increasingly, rains fall continuously rather than intermittently. Since radiation during the rainy period is inadequate, crop growth stagnates. In addition, the onset of the first growing season delays and starts in late April rather than in mid-March, which delays planting. This tendency is tied to the new phenomenon of unpredictable rainfall that disrupts farmers´ ability to plan their crop cycles. For example, little planting was carried out in November 2015 even though rains were sustained up to February 2016. Farmers also note that there is a longer gap between the First and Second rains within the same season, thus longer dry spells. Finally, farmers report lifestyle changes due to changes in climate. In general, the population now wears lighter clothing compared to the late 1980s.

Vulnerabilities to climate change across agriculture value chain commodities (VCCs)

Three key climate hazards - drought, floods, and heat stress were identified as most problematic by stakeholders. Drought was expected to affect all four value chains, floods were expected to affect maize, onions, and goats, while heat stress was expected to affect cattle.

Maize

Drought is expected to have a major impact on the supply of inputs for maize production, causing a decline in demand for inputs and an increase in cost of land mechanisation services from contractors. However, the demand for drought-resistant seeds would then be likely to increase. At the on-farm production stage, this would lead to severe crop failure, higher disease incidences, and a moderate decrease in crop production. After harvest, drought is likely to contribute to a major incidence of pests and a minor increase in theft of maize. The market is likely to experience a moderate increase in maize prices and contractual feuds.

Floods are expected to result in major incidences of soil erosion, formation of gulleys on farms, water-logging, and overall loss of soil fertility. At the post-harvest stage, there would be a moderate incidence of fungal and bacterial diseases and maize rot, and a likely increase in the costs of transportation due to washed-out roads. The quality of maize and access to the maize and animal feed market would decline moderately.

Cattle (milk)

Drought has a major adverse effect on availability of pasture and water. Additionally, while incidences of milk spoilage and the cost of transportation increase moderately, there is a major increase in the cost of operations and maintenance. Drought conditions are associated with a moderate decline in milk production, which precedes a major reduction in the number of transporters and underutilisation of transport facilities. This in turn means that the market experiences a moderate fall in milk volumes and quality and a major increase in the price of milk.

Heat stress reduces the quality of pasture and volume of water sources moderately. Conversely, it results in a moderate increase in demand for extension services. At the same time there is a major decline in milk production and a moderate increase in the probability of milk spoilage which results in a major increase in production costs. In the market, there is a moderate fall in the quality of milk and a major reduction in milk supply, leading to a spike in milk prices.

Bulb onion

Drought has a severe effect on demand for seeds, fertilisers, and agro-chemicals, leading to a minor decline in their prices. However, drought typically leads to a moderate increase in demand for drought-resistant seeds. There is a major decline in the quantity of onions produced and there can even be crop failure in severe cases. Drought induces a major fall in the quality (small sizes) and shelf-life of onions. There is also a moderate reduction in volumes of bulked produce leading to a major reduction in price at the point of sale.

Flash floods have a severe impact on accessibility of farms due to damage to roads, a major problem for farmers attempting to bring onions to markets. They cause a major decline in sale of inputs and delay in planting time. On the farm, there is a major decline in productivity from incidences of soil erosion, and a severe loss of crop. There is also likely to be a major increase in transportation costs and post-harvest losses, leading to a moderate increase in cost of onions.

Goat (meat)

Drought causes a major increase in demand for labour for goat rearing and a moderate increase in demand for animal drugs to control pests and diseases. Even more significantly, there is a major reduction in the amount of crucial inputs, including water, feeds, and pasture. There would predictably be a moderate increase in demand for vaccination and a moderate decline in the rate of reproduction. Droughts lead to a major drop in the number of animals available for sale and the market exhibits a major reduction in prices and sales.

Floods result in a major decrease in the grazing land available and a moderate loss of goat-rearing structures. In flood conditions, there is a major increase in demand for veterinary services. On the production side, there is a major loss of vegetation/pasture and a major increase in the need for vaccination services. To a moderate extent, there is also a decline in production from loss of animals. On the market side, there is a major increase in cost of sales and a moderate reduction in prices.

Farmers that are most vulnerable to the projected climate hazards do not have alternative livelihoods, have no access to water for irrigation, do not have adequate capital for installation of irrigation equipment, and may lack knowledge on adapting to the climate hazards. In some areas in the county, Early Warning Systems (EWS) do not exist. This situation applies especially to farmers living in the lowlands, which are not well drained, and where the main (and usually only) economic activity is livestock keeping. At the same time, maize is the most vulnerable value chain in West Pokot, given its importance to food security, high contribution to income, limited production area in the county, and dependency on rain water. Further, the frequency of droughts has increased from once every seven years to once every three years, putting pressure on production resources in the county. Regions most at risk of low production and food supply are ASAL zones in North Pokot, parts of South Pokot and Pokot Central.

Adaptation to climate change and variability

In response to the above threats, farmers in West Pokot have adopted various strategies to cope with the effects of variations and changes in climatic conditions on agricultural production and food security. Results from the ASDSP survey of 2013 showed that at least 11% of the farmers use both on-farm and off-farm adaptation strategies. At least 13% of male-headed households, 7% of both female- and youth-headed households have applied some adaptations to climate change. Male-headed households are more likely to apply climate change adaptation strategies on their farms given their higher access to productive resources, extension and training, as well as their higher decision-making power on household resource utilization compared to female- and youth-headed households. Some adaptations are specific to certain value chains whereas others cut across the value chains.

On-farm adaptation practices

Households in West Pokot respond to climate hazards according to the severity of the threat and their ability to manage the challenge. Traditional fermentation is often used to process cattle milk, especially when supply chains are disrupted during drought and flood conditions. Similarly, onion growers use curing as a way to preserve onions to increase their shelf life during drought. Value addition at the post-harvest stage is the most commonly used adaptation strategy, adopted by

71.6% of all households, most of them male-headed. Farmers use a variety of strategies to transform or develop their products to increase the market value. Amongst the most common practices are techniques that improve the appearance of the product (dehulling root crops such as cassava), simplify handling processes (chopping and baling fodder), and increase shelf-life (drying fruits and cereals).

The use of proper storage facilities was cited by maize and bulb onion farmers as an effective measure during droughts and floods. Storage helps to maintain the condition of the produce and protects it from the elements and pests before it reaches the market. Use of food storage facilities is practised by 54.1% of households, 87.5% of them being female-headed. However, there is still a lack of knowledge on on-farm implementation and access to off-farm facilities. This suggests a training need for extension services on the proper storage techniques, especially during drought and flood seasons, as well as organizational training on how to access off-farm storage.

In livestock production, adaptation strategies against drought include conservation of feeds to improve the quality of the animals' diet and abate the risks associated with reduced food and fodder during droughts and floods. Another common adaptation practice is changing livestock breeds to those better-adapted to droughts, while maintaining high production levels. Additional support is needed to help farmers identify the sources of material for making silage and learn the most effective techniques for preparing and storing silage. Training should also be provided on a regular basis to ensure that farmers and communities are retaining the knowledge transmitted.

Off-farm adaptation practices

The main off-farm adaptation strategies pertain to services provided by extension and veterinary officers, as well as institutional solutions by key players in the value chain. The provision of modern vaccination for dairy cattle and goat value chains guards against diseases. This service cuts down on the costs of production and improves productivity. Veterinary service staff should train farmers on selection and application of drugs to improve trust and relations with the community. In the past, fraudulent operators failed to provide services commensurate with the fees charged, resulting in a lack of trust on these services.

The provision of modern preservation methods such as refrigeration and packaging helps to maintain the quality of the produce, especially milk and meat. Packaging also increases the market value of the product. The service may be provided by the processor (e.g. Kenya Meat Commission or Kenya Cooperative Creameries) or farmer cooperatives. Farmers and farmer groups need support to improve market linkage services to establish better relationships with service providers.

The formation of farmer associations for collection, bulking, and selling of produce helps members to obtain a relatively higher price compared to individual sellers. With a strong income, farmers would be able to adapt faster to emerging challenges in the business environment. Extension service staff could train small-scale farmers on proper group organisation and governance, as well as how to operate a business.

Provision of weather climate information from the Kenya Meteorological Department (KMD) helps both small-scale and large-scale farmers to plan on-farm activities so as to maximise sales or save on costs. In the goat value chain, weather information would help farmers to know the right time to sell. Dissemination of the data done through faith-based organisations, radio programmes, and public barazas.

Adapting agriculture to changes and variabilities in climate: strategies across major value chain commodities

Maize

	Provision of seeds and other inputs	On-farm production	Harvesting storage and processing	Product marketing
Floods	Inaccessibility to inputs (fertilisers, seed); lack of credit facilities; low use of mineral fertilisers	Soil erosion; formation of gulleys; water logging; poor stand establisment; stunted and weak plants; high pest and disease incidence; difficulties in field agronomic activities (preparation, tilling)	Poor quality and quantity of harvested produce; increased seed spoilage (rots/aflatoxins); poor household food security; increased transportation (farm to storage) and harvest labor costs	Market inaccessibility; scarcity of animal feed byproducts
Magnitude of impact	Major	Major-Moderate	Moderate	Moderate-Minor
Farmers' current strategies to cope with the risks	Use of certified hybrid seeds; moisture-tolerant variaties; reliance on informal seed systems (commmunity); non-use of organic/inorganic fertilisers; use of open polliated maize varieties	Early/late planting; staggered cropping; Use of FYM and compost manure; intercropping; agroforestry; establishment of water harvesting structures; enterprise diversification (business; holticulture production)	Reparation of damaged stores and silos; construction storage facilities; farm gate sales (to avoid transportation and storage costs); crop residues fed to livestock; low supply of processing material by millers	Small-scale milling; sale of produce (at farm-gate/locally); low market activity and loss of job opportunities by traders
Other potential options to increase farmers' adaptive capacity	Promotion of moisture-tolerant varieties (geographical niches); upscale use of open pollinated varieties; County support for provision of inputs	Upscale of conservation agriculture; development of drainage structures	Land reclamation from floods; County support for shared storage facilities (in croplands)	Improved roads linking farmers to markets; online marketing
Droughts	Increased demand fpr drought-tolerant seeds; high costs of mechanized equipment for production	Increased incidence of crop failure and pests and diseases; low crop productivity	High incidence of rodent and storage pests; increase in produce theft, due to scarcity	Increased maize price; abrogation of contractual agreements (due to profitable market prices)
Magnitude of impact	Major	Severe-Moderate	Minor	Moderate
Farmers' current strategies to cope with the risks	Use of certified hybrid seeds; drought tolerant variaties; use of open pollinated maize varieties	staggered cropping; use of small-scale conservation agriculture; irrigation	Storage facilities farmer owned; small scale milling; storage pest control (chemicals/local resources)	stablization of maize prices (through created maize reserves); form farmer associations/unions to aid produce bargains
Other potential options to increase farmers' adaptive capacity	Promotion of certified drought-tolerant maize varieties; use of compost and farm manure; use of open polinated varieties	Upscale of conservation agriculture (zero tillage), drip irrigation (drip), water harvesting technologies (band, troughs, pans)	Upscaling of modern silos and plant clinics; use of IPM practices	Grain reserves for dry season milling and processors; associations to link farmers to markets and to improve their arket accessibility; online marketing/trading platforms

Goat

	Provision of inputs	On-Farm production	Harvesting storage and processing	Product marketing
Floods	Low pasture access (flooding of pasture/grazing fields); loss of vegetation cover; structure destruction (sheds/access routes); inaccessibility to inputs (salts/supplements/drugs)	Increased demand for veterinary services (high pest and disease indidence); high mortality rates; reduction of goat population	Reduction in harvested milk and meat (goat) quantities; increased incidence of milk and meat products spoilage (due to lack of refrigeration facilities); destruction of storage infrastructure	Low products supply on the market; low market activity (loss of incomes for traders; job opportunities); high market prices
Magnitude of impact	Major-Moderate	Major-Minor	Major-Moderate	Major-Moderate
Farmers' current strategies to cope with the risks	Use of locally-available materials to construct goat sheds; local sourcing of goat breeding stocks; use of alternative feed (harvested crop residues); use of improved goat breeds; forage production and conservation	Tree planting to supplement pastures; migration from flood-prone areas; use of traditional herbs to treat diseases/pests; reliance on indigenous pastures; chemical control of pest and diseases; culling and vaccination of sick animals; livestock diversification (cattle, poultry)	Use of traditional methods of meat preservation (smoking); use of refrigieration facilities; value addition of stored milk products (fermentation)	Reliance on traditional weather forecasts to sell old and buy new breeding stock; community efforts to improve damaged infrastructure to facilitate market access; farm gate sales (due to low household incomes); destocking
Other potential options to increase farmers' adaptive capacity	Construction of flood resistant/control structures; improved access to extension service agents and agrovets in rural/inaccessible areas; construction of more livestock water sources	Re-afforestation and replanting of pastures; flood control and water capture measures (dykes, canals, pans); rangelands management (pasture planting)	Adoption of modern methods of meat preservation (caning, refrigiration); farmer trainings on post-harvest handling of goat products (meat, milk, skin); reclamation and rehabilitation of flooded areas; setting up of a slaughter house and a meat processing plant; revive the hides and skin tannery	Farmer groups/ cooperatives to bargain better market prices; imporved weather forecast to predict suitable times for goat sales; County fund to cushion farmers from market losses
Droughts	High labour costs; low availabilty and productivity of pasture/feeds; increased demand for animal drugs	Animal malnutrition (poor feeding); increased mortality incidence; low reproductive rates; high prevalance of pests and diseases	Reduced milk and meat production	Reduced goat sales by farmers; higher market demand and higher prices
Magnitude of impact	Major-Moderate	Major-Moderate	Major	Major
Farmers' current strategies to cope with the risks	Use of household labour; migration (in search of water and pastures); use of indigenous goat breeds	Goat herding; controlled feeding; culling of weak animals; use of traditional medicine (concotions/ natural herbs) for disease/pest management; use of traditional drought early-warning systems	Use of traditional meat (smoking) and milk (fermented) preservation methods; farm gate disposal during intense drought	Informal sale and purchase of goats to reduce middlemen; farm gate sales; enterprise diversification (traders engage in other value chains)
Other potential options to increase farmers' adaptive capacity	Sourcing of hired labour; construction of storage (water, fodder) structures; introduction of drought- and disease- resistant breeds	Pasture conservation (protected community pasture reserves); improved access to vaccines; enforced culling during disease outbreaks; land conservation (tree, shrub planting); enterprise diversification; access to modern early-warning sytems advisories; bulletins	Access to modern milk and meat preservation methods (refrigiration/cooling); access to animal insurance programs to cushion farmer goat losses	Organized structures (associations/groups) to facilitate profitable goat sales by producers; linkage to new external markets

Cattle (milk)

	Provision of inputs	On-Farm production	Harvesting storage and processing	Product marketing
High Temperatures	Poor pasture/feeds quality and quantity; inadequate water supply; high demand for extension services (diseases, feeds); high demand for drugs (from agrovets)	Malnutrition; poor animal vigor; increased disease incidence; high production costs; increased animal mortality	Reduced milk production; high milk spoilage; poor milk quality; low household income	Increased market price (milk scarcity)
Magnitude of impact	Moderate	Major-Moderate	Major-Moderate	Major-Moderate
Farmers' current strategies to cope with the risks	Alternative feed resources (grinded maize stovers); artificial insemination (for improved breeding); use of locally- sourced improved bulls	Use of vaccination for disease control; controlled feeding regimes (paddocks); increased awareness of animal husbandry practices (hygienic milking, feeding); suplementation and improved feeding	Construction of milking sheds and parlors; milk cooling and boiling; milk storage in traditional vessels; milk fermentation; mild distribution (milk bars, hawkers)	Use of local markets for selling dairy products
Other potential options to increase farmers' adaptive capacity	Introduction of feed supplements (pastures/ mineral supplements); capacity building for supplements preparation, pasture conservation and use of alternative diseases/pest control techniques; feed/fodder conservation technologies (hay, silage)	Use of modern certified vaccines for disease and pest control; mechanization of dairy process (feed chopping; cleaning)	Promotion of cooling structures in rural areas using solar energy; establishment of county-based processors (pasteurization and packaging); value addition to cultured milk products (milk powder, yorghut, cheese)	Linkage with consumer organizations for profitable milk sales; enterprise diversification (poultry, crop farming)
Droughts	Inadequate inputs (pasture, water); pressure on extension services	High costs mantainance/operations; lack of feeds/pastures; increased animal mortality	High incidence of milk spoilage; high transporatation costs; Low milk volumes; reduction in transporters ; under-utilization of facilities	Low milk supply to markets; poor milk quality supplied; increased market price (milk scarcity)
Magnitude of impact	Major-Moderate	Major-Moderate	Major-Moderate	Major-Moderate
Farmers' current strategies to cope with the risks	Alternative feed resources (tree branches, grinded maize stovers); artificial insemination (for improved breeding); Using locally-sourced improved bulls	Regulating animal movement during disease outbreak; culling/sale of sick animals	Hygienic milk production (cleaning udder with cold water); use of plastic containers for milk storage	Use of local markets for selling dairy products; Milk transporation using donkeys/bicycles
Other potential options to increase farmers' adaptive capacity	Supplemental feeding (hay/ silage facilities)	Use of modern certified vaccines (for disease and pest control); access to modern feed/fodder conservation technologies (hay, silage); mechanization of dairy process (feed chopping; cleaning)	Capacity building on clean milk production procedures; introduction of mastitis test kits; establishment milk coolers within/near market centres; use of aluminium containers; milk processing after cooling	Linkage with consumer organizations for profitable milk sales; enterprise diversification (poultry, crop farming)

Bulb onion

	Provision of seeds and other inputs	On-Farm production	Harvesting storage and processing	Product marketing
Floods	Inaccesibility to farms and input dealers (damaged roads); low input sales (seeds, fertilisers, chemicals)	Distortion of planting durations; poor productivity; increased incidence of pest and disease	high transport costs (inaccesibility to roads); high post-harvest losses; high storage costs	High costs of products (low supply); income losses (poor quality and perishability); reduced market activity (loss of job and value addition opportunities)
Magnitude of impact	Severe-Major	Severe-Major	Severe-Major	Major-Moderate
Farmers' current strategies to cope with the risks	Farmer (community) initiatives to maintain feeder road (ease access to farms/inputs supplies); credit access for inputs purchase; use of cerified seed; use of fertilisers (organic and inorganic); use of early maturing varieties	Stagerred planting; construction of soil and water structures (wells,tanks); tree planting (sloping land); agroforestry and crop rotation regimes; enterprise diversification (pastures/root crops)	Timely harvesting; sorting and grading; use of above-ground storage facilities; use of efficient farm transportation means (donkeys instead of lorries); engagement in farmer cooperatives to facilitate bulb storage; value addition through packaging in nets; curing to increase the shelf life	Quick sale (farm-gate and local markets)
Other potential options to increase farmers' adaptive capacity	Roads improvements (with proper drainage systems); diversification of input dealers; improved credit access	Promotion of conservation agriculture; Capacity bulding/awareness raising on soil and land management, agroforestry systems; viable tree species	Capacity building/awareness raising on improved storage facilities; access to alternative materials/methods for bulb storage; imrpoved access to early- warning systems	Development and promotion of crop insurance products to cover production losses; expansion of existing stores (within community/markets); County support in seeking external markets and marketing opportunities
Droughts	Changes in prices of inputs; deterioration of bulb onion nurseries	Decreased production and quality of bulb onions; increased incidence of pests and crop failure	Low volumes of bulked produce	Low pricing of bulk onions; low bargaining capacity of farmers; low demand for produce by external markets; loss of markets
Magnitude of impact	Severe-Minor	Severe-Minor	Major-Moderate	Major
Farmers' current strategies to cope with the risks	Enterprise diversification among input suppliers; utilization of certified seed, foliar fertilisers, and/or indigenous onion varieties; use of drought tolerant varieties	Utilization of drip (sprinkler) irrigation; chemical control (weeds, pest and diseases); conservation agriculture; crop rotation; cover crops	Timely curing of bulb onion to prevent spoilage; grading; storing and packing in nets; bulb storage in dry and aerated stores	Farmer pricing of bulb onion; linkage to local and external markets; bulb transport using locally available means (bikes; trucks)
Other potential options to increase farmers' adaptive capacity	complimentinf basal fertilisers Promotion and research of drought-torelant varieties, of foliar fertiliserss (complimenting basal fertilisers); use of water efficient technologies	Farmers trainings (hygiene of production site; intergrated pest management; spraying regimes); conservation agriculture, integrated with with soil and water management technologies	Upscale utilization of bulb curing technique; packaging and storage in cold stores; improved access to modern storage facilities; promotion of value addition	Formal marketing structures; collective market transportation; contract farming arrangements

Policies and Programmes

Policies and programmes that address climate change adaptation at county level are quite limited. However, several policies have been introduced at the national level with implications at the regional and even local level, including in West Pokot County.

The National Livestock Policy (2008) prioritizes actions such as breeding, feeding, value addition and marketing, disease control, and research and extension in the livestock sector. The policy encourages adoption of best practices, for example through breeding programmes that share information about animal genetic resources, including those better adapted to climate conditions. This could be especially important for the dairy sector in West Pokot, where climate adaptive practices will be key in the value chain.

West Pokot is a major migratory route for livestock crossing between neighbouring Baringo county and Uganda, putting the county at high risk of disease transmission. The county government considers this a priority issue and provides adequate financial resources for regular provision of free livestock vaccination, helping to keep disease incidences low. On the other hand, there has been a serious decline in provision of extension services, with the introduction of the demand-driven, privatized model. Those producers most likely to request for services are well organised in producer groups, well connected to people with resources, have access to information, and have the financial means to reach out to extension officers. In order to provide services equitably, it is necessary to review the structure of delivery and increase the number of extension officers. At this time, action to address these two challenges is hampered by the current extension service policy and budgetary allocation decisions, respectively.

The Arid and Semi-Arid Lands (ASALs) Policy - (2007) aims to revitalise ASALs by supporting livelihood opportunities in the drylands. The policy acknowledges pastoralism as a legitimate and productive livelihood. It aims for coherent development of the ASALs through provision of basic services (health, education, and infrastructure) and decentralization of strategic planning on livelihood diversification, community participation, and drought EWS. ASALs are the most vulnerable areas to impacts of climate change and variability. Accordingly, the policy works to provide ASAL-specific linkages between adaptation and the development agenda.

The ASAL Policy is mainly implemented through programmes of the National Drought Management Authority (NDMA). An EWS and weather advisory services are in operation to guide producers and the general community through appropriate activities on a weekly, monthly or season basis. While adoption of such recommendations is high in the high and midlands, in the lowland areas of the county, where sand harvesting and charcoal burning are prevalent, low daily income undercuts adoption.

The National Irrigation Policy - draft (2014) aims to expand land under irrigation; increase agricultural water harvesting and storage capacities; promote water harvesting and the exploitation of groundwater for irrigation; build capacity for creation and application of irrigation research, innovation, and technology; and promote and adopt an integrated approach to sustainable commercial irrigation farming. Under this policy, there have been concerted efforts to promote drip irrigation and various forms of water harvesting such as through the establishment of negarims, roof water harvesting, storage tanks, and water pans (which have had considerable success in West Pokot).

County climate experts report good progress on planning and implementation of irrigation technologies. However, political considerations, including the need for elected officials to demonstrate visible accomplishments to their constituents, often bear on sustainable development and manifest themselves in the county budget approval process. For example, great emphasis is placed on the provision of water (e.g. through construction of water pans and development of springs), while little attention is paid to the protection of water sources (e.g. planting bamboo trees). As a result of this reactive instead of proactive response, facilities are strained with limited access and maintenance costs remain high.

The KAPP is a series of programmes and interventions operated by the Kenyan government under the second of three phases of the Adaptable Programme Loan administered by the WB. The programme works on projects that address policy and institutional support, agricultural research systems, extension and stakeholder empowerment, and agribusiness and market development. The second phase purportedly works towards the formulation of a National Agriculture Sector Extension Policy (NASEP) and the National Livestock and Dairy Policy. The affiliated KACCAL programme has initiated a number of livelihood activities to assist communities in increasing climate resilience by providing inputs and extension services to the communities in West Pokot.

Kenya Agricultural Productivity Programme is a well-funded programme; it has had considerable success bringing together key actors from different sectors towards common goals. This is a major factor in helping to cultivate long-term relationships between producers, service providers, and other actors in their respective value-chain enterprises. In the future, it would be beneficial to develop guidelines for engagement of such actors in promoting greater diffusion

of knowledge in the county. By including more actors at each node of the value chain, especially where vulnerable groups have typically been marginalized or excluded, KAPP would be employing a sustainable process for developing skills and creating linkages.

West Pokot refers to national policies to guide sector-specific affairs such as environmental conservation. Although the policies are comprehensive, enforcement is low, in part due to poor coordination between the county government and the Ministry of Interior & Coordination of the national government. The 2010 constitution eroded the administrative powers of Chiefs, who were previously the key enforcers of environmental conservation laws at the grassroots level. There is need to develop working arrangements with relevant ministries in order to make use of this crucial human resource that is knowledgeable about the community and representative of the population down to the smallest administrative unit of the county.

Governance, institutional resources, and capacity

Several organizations and offices that aim to address climate change adaptation at the national level have a presence in West Pokot. In many cases, the government is still in the process of decentralizing these national operations to the county level. Through programmes such as KAPP, the level of participation by various stakeholder groups, especially community-based organisations (CBOs), in climate-related programmes in the county has increased. One factor that limits the success of the key institutions that address climate adaptation in West Pokot is a lack of integration and collaboration with international, non-governmental organisations and the private sector. To remedy this situation, a Coordination Bill is currently under development to help harmonise the work of all stakeholders operating in the agriculture sector.

At the country level, NDMA creates, consolidates, and disseminates information on drought management and climate change adaptation through the Revised Early Warning & Analysis System (REWAS). The system provides credible early-warning information on drought risks and coordinates action across sectors and agencies at all stages of the drought cycle, at both national and county level. The NDMA publishes monthly bulletins to communicate information aimed at supporting planning across the supply chain. Additionally, it carries out a food security assessment on the basis of weather patterns (Long and Short rains). The aim is to determine the population's vulnerability based on agricultural performance during the seasons.

The National Environmental Management Authority (NEMA) coordinates all activities related to the environment at the county level. In West Pokot County, NEMA programmes depend heavily on extension staff associated with the Ministry of Agriculture as well as administration structures supported by the county leaders or Chiefs who also play an important role in informing the public about NEMAs work and sharing relevant information. NEMA uses these same channels to carry out its monitoring and enforcement activities, and as such, it is well integrated into the West Pokot agricultural community. Unfortunately, NEMA is understaffed, as is the Ministry of Agriculture. Furthermore, NEMA's mode of operation is quite reactionary in that their work often responds to crisis or concerns raised by the public after the fact instead of working proactively to prepare for and mitigate risks. Evidently, there is a correlation between the reactive approach taken by NEMA and the difficulties that they face trying to carry out their large mandate with very limited resources

The Kenya Red Cross Society (KRCS) works closely with the Ministry of Agriculture to train extension officers. The ministry typically coordinates the extension staff while the KRCS finances operational aspects such as transportation and food. In a similar way, ASDSP is a national programme partially funded by the Swedish Government that supports various initiatives through funding and capacity building. Nationwide, the ASDSP mandate considers many different themes that touch on climate adaptation, including insurance, irrigation, and pasture programmes. In West Pokot, ASDSP follows a model similar to the KRCS by funding stakeholder forums. This approach allows them to get around resource constraints. However, its sustainability in the long run is questionable as the programme has never truly been integrated into the county government structure.

Other actors present in West Pokot include national and international organizations that primarily support productivity gains. The United Nations World Food Programme (WFP) takes part in various programmes in the region. FAO on the other hand has intervened through capacity building, promoting agriculture diversification and marketing of produce, Action Aid has taken part in promotion of livestock production, for instance through introduction of superior goat breeds in Sigor whereas World Vision has been Involved in farmer capacity building and introduction of dairy livestock to groups in Chepararia. In terms of processing and marketing, both state and non-state actors make up the key institutional presence in West Pokot. For example, NCPB has a nationwide mandate to support the production, post-harvest, and marketing activities for the cereal grains sector. It is often a major actor in terms of post-harvest storage facilities. In West Pokot, the Board offers storage services with limited support

for post-harvest transformation and value-addition. The CABESI (Camels, Bees, and Silk) project was initiated by the International Centre of Insect Physiology and Ecology (ICIPE), which provides research and capacity building services. CABESI is the main processor and packer of honey in West Pokot, although it only handles about 10% of the county-wide production due to collection and processing capacity constraints.

One important private sector actor in West Pokot is Brookside Dairy Ltd., Kenya's largest dairy processing firm that controls 45% of the national dairy market and distributes across East Africa. The Dairy is a major player in the county in terms of offering market for West Pokot milk. The company maintains a good working relationship with its affiliated farmers and is actively involved not only in processing and market activities but also in organizational skills and on-farm extension. Often linked to the company, several farmer cooperatives operate buildings or offices that serve as milk collection centres run by semi-skilled staff. The county government works in cooperation with the cooperatives to provide cooling tanks and refrigerators while Brookside provides specialized skills and training, including one "quality assurance" staff per collection centre. There is potential to integrate climate adaptation training into the extension services and training provided by the county and Brookside.

Generally, the institutional capacity to offer the required resources and incentives needed to increase resilience to climate change is low in the county despite the many actors. Contributing factors to the low capacity include less priority for climate change in the policy discourse and poor dissemination of available climate information. Therefore, County government should increase investment in adaptation to climate change through allocating more funds to climate change and encourage more partnerships with organizations that can promote value chains such as aloe vera and practices like conservation agriculture which can highly increase adaptive capacity. A large budget of the climate change funds should be directed to capacity building both the farmers and pastoralists, and officials in relevant departments and organizations in matters pertaining to climate change.

Synthesis and Outlook

Droughts and floods are the main climate risks in West Pokot, and are expected to intensify between 2020 and 2060.

The road network in West Pokot, prone to severe damage during the rainy season, is a major vulnerability to development of value chains, particularly of milk and onions. Effects range from increased transport costs of inputs and produce to non-delivery of the same. At present, the most often used adaptation methods during times of floods are value-addition of perishable products (milk) and curing to prevent spoilage (onions).

Drought has a major impact on the quality and availability of pasture for livestock. To manage, producers are improving their pastures, to harvest and store for later use. Additionally, they are converting to livestock breeds that are better able to adapt to harsh conditions.

With regard to the bulb onion value chain, which has been a major economic success, concerns about the environmental degradation in the growing areas – cultivation is along slopes in the midlands – are starting to be addressed. Extension programmes focus on soil and water conservation practices, as part of wider farmer trainings on climate smart agriculture. Additionally, construction of terraces and storm water harvesting structures is undertaken as a community programme in owners' farms across the three AEZs: highlands, midlands and lowlands.

The county government has capably managed county-wide livestock vaccination drives, demonstrating its priorities and management capabilities. Additionally, West Pokot provides a welcoming and enabling operating environment for non-profit and for-profit organisations, with which it has fostered productive working relationships. The county government should continue to engage with non-state actors to strengthen the extension services programme.

Although the current situation points to duplication and lack of consultation between county and national governments, there is indication of coordination between the KAPP and the county's Department of Agriculture, Livestock and Irrigation. There is opportunity to improve links with national government agencies such as the Water Resource Management Authority (WARMA).

On the whole, sustainable exploitation of land and water resources is a major issue in the county. Pressures arise from the rapidly growing population, conversion from pastoralism to commercial (often irrigation) agriculture and a devolved system of government that demands short-term rather than long-term programmes.

Conservation of stormwater; fastmaturing for use during dry seasons is already ongoing. However, the projects are small-scale and piecemeal, as is the case when water pans are constructed short of environmental standards. For effective implementation, county officers may choose to use a combination of public awareness creation and legislation about constructing water conservation structures. This will help to obtain public support and secure the full budget allocations for projects.

Support is also needed in bringing down the cost of seeds, especially of onions and maize. With the shrinking growing seasons it is necessary to scale-up promotion of fast-maturing and drought-tolerant seeds. Producers will benefit from logistical and financial facilitation of institutions such as KAPP, the county's Department of Agriculture, Livestock and Irrigation, as well as farmers cooperatives.

For further information and access to the annexes, visit https://cgspace.cgiar.org/handle/10568/80452

Annex 1: Average Milk Animal Endowment and Milk Production, West Pokot County
Annex 2: Climate analysis
Annex 3: Common Adaptation Practices in West Pokot County (information obtained from workshop and interviews with value chain actors and Climate Experts)

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