

Climate Risk Profile Bomet County

Highlights

- Bomet County is endowed with vast areas of fertile land and high rainfall. Agriculture is the main economic activity with over 80% of the total population engaging in crop and livestock production. The sector also provides raw materials to agro-based industries in the county and therefore stimulates off-farm employment as well as the use of local resources. Despite the county's favourable climatic conditions, 31% of the population lives below the national poverty line.
- In spite of good rains and soils, food insecurity is a critical issue in Bomet County with approximately 36.2% of households being considered food-poor. Food scarcity peaks between the months of January and April each year, when harvested stocks are generally depleted.
- Food insecurity in the county can be partly attributed to the occurrence of climate related hazards. These include: drought, uncertainty in growing seasons (onset and duration), intense rains as well as changes in weather and climate over time. These hazards have been coupled with several agricultural challenges such as prohibitive prices of agricultural inputs, pests and diseases, post-harvest losses amongst others.
- The most common adaptation strategies to climate hazards for crops include planting of improved varieties, staggered planting, in-field soil and water conservation practices, tree planting, food storage, value-added processing and small scale water harvesting. For livestock, main adaptation strategies include improved livestock breeds, water harvesting, breed diversification, fodder production and feed conservation.
- Longer term resilience and adaptation strategies suggested for the County include expansion of cold storage facilities for crop and livestock products, expansion of water harvesting and efficient irrigation, investing in local processing facilities for key value chain commodities and capacity building of cooperatives on agricultural marketing.
- Off-farm services such as early warning systems; agricultural extension trainings on climate hazards and good agricultural practices; and market information are offered to farmers to increase their climate-adaptive capacity. Such services are offered by a variety of actors, from government (such as the KMD, veterinary, agriculture, fisheries and livestock departments) and NGOs. Women and youth are among the most vulnerable groups in the county, with the lowest adoption rates of adaptation strategies.
- The capacity to develop and deliver relevant and timely climate and weather information to farmers within the county is curtailed by limited coordination between stakeholders, poor communications infrastructure, overstretched human capital, and financial resource constraints. Greater effort could be placed on developing innovative climate information systems and also involving farmers themselves in the interpretation of forecasts and identification of response strategies.
- Several programs and policies aimed at addressing topics related to climate risk and vulnerability have been put in place and implemented by various actors including government departments, non-governmental organizations, private sector, community-based organizations and cooperatives. However, the programs and policies face challenges of coordination and collective efforts by the various stakeholders.

List of acronyms

ACK	Anglican Church of Kenya
AI	Artificial Insemination
AEZ	Agro-ecological Zone
AFC	Agricultural Finance Corporation
ASDS	Agricultural Sector Development Strategy
ASDSP	Agricultural Sector Development Support Program
ATC	Agricultural Training Centre
CBO	Community-Based Organization
CBPP	Contagious Bovine Pleuropneumonia
CEAP	County Environmental Action Plan
CFA	Community Forest Association
CGA	Cereal Growers Association
CIDP	County Integrated Development Plan
CSA	Climate-Smart Agriculture
DVS	Department of Veterinary Services
EADDP	East Africa Dairy Development Program
EAMDA	East Africa Market Development Associates
EMCA	Environmental Management and Coordination Act
ERA	Economic Review Agriculture
FAO	Food and Agriculture Organization of the United Nations
GoK	Government of Kenya
IDA	International Development Agency
IDP	Internally Displaced People
ITK	Indigenous Traditional Knowledge
KALRO	Kenya Agricultural and Livestock Research Organization
KAVES	Kenya Agricultural Value Chain Enterprises
KCSAP	Kenya Climate-Smart Agriculture Project
KDFF	Kenya Dairy Farmers Federation
KEPHIS	Kenya Plant Health Inspectorate Service
KES	Kenya Shilling
KFA	Kenya Farmers Association
KFS	Kenya Forestry Service
KIHBS	Kenya Integrated Household and Budget Survey
KMD	Kenya Meteorological Department
KMS	Kenya Meteorological Service
KRCS	Kenya Red Cross Society
KWEN	KonyomWenditai Empowerment Network
KWFT	Kenya Women Finance Trust
MNLD	Maize Necrosis Lethal Disease
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
NCD	New Castle Disease
NEMA	National Environmental Management Authority
NGO	Non-Governmental Organization
PAFID	Participatory Approaches for Integrated Development
PCN	Potato Cyst Nematode
PSP	Participatory Scenario Planning
RCPs	Representative Concentration Pathways
SACCO	Savings and Credit Cooperative Societies
SDCP	Smallholder Dairy Commercialization Programme
SHoMaP	Small Holder Horticulture Marketing Programme
TIMPs	Technologies, Innovations and Management Practices
UNICEF	United Nations Children's Fund
USAID	The United States Agency for International Development
VC	Value Chain
VCC	Value Chain Commodity
WASH	Water Sanitation and Hygiene
WV	World Vision

Bomet

Foreword

Climate change is becoming one of the most serious challenges to Kenya's achievement of its development goals as described under Vision 2030. Kenya is already highly susceptible to climate-related hazards, and in many areas extreme events and variability of weather are now the norm; rainfall is irregular and unpredictable; while droughts have become more frequent during the long rainy season and severe floods during the short rains. The arid and semi-arid areas are particularly hard hit by these climate hazards, thereby putting the lives and livelihoods of millions of households at risk.

In 2010, Kenya developed a National Climate Change Response Strategy (NCCRS) which recognized the importance of climate change impacts on the country's development. This was followed by the National Climate Change Action Plan (NCCAP) in 2012 which provided a means for implementation of the NCCRS, highlighting a number of agricultural adaptation priorities. The focus of these initiatives has been at the national level, and there is need to mainstream climate change into county level policies, programmes, and development plans; therefore ensuring locally relevant, integrated adaptation responses with active involvement of local stakeholders.

The Government of Kenya (GoK) through the Ministry of Agriculture, Livestock and Fisheries (MALF), with funding by the International Development Agency (IDA-World Bank Group) is therefore implementing the Kenya Climate-Smart Agriculture Project (KCSAP). This projects objective is to increase agricultural productivity and build resilience to climate change risks in targeted smallholder farming and pastoral communities in Kenya, and in the event of an eligible crisis or emergency, to provide immediate and effective response. This Climate Risk Profile has been conducted within the framework of KCSAP and aims to inform county governments and stakeholders on the climate change risks and opportunities for agriculture so they are able to integrate these perspectives into county development.

This document presents the Climate Risk Profile for Bomet County which has a climate change vulnerability index of 0.473, higher than the national index of 0.431¹. The county is vulnerable despite its disposition as one of the regions with high agricultural

potential. In the recent past, Bomet county has suffered from anomalies in weather especially droughts and delayed rain fall which have significantly reduced the productivity of major crops in the area such as tea and maize. For instance, the 2017 prolonged drought in the country affected Bomet County in many ways an example being the forest fire that consumed almost 50 acres of vegetation of Chepalungu forest and killed a number of goats². A similar case was experienced in 2015, where most farmers lost their crop due to a persistent drought³; impacts which partly explain the high food insecurity in the county where for instance 36% of the children are stunted⁴. The examples among many more are evidence that the effect of a highly variable climate have and will continue to affect even the characteristically wet counties like Bomet. Despite the current on-going interventions for increasing resilience of the agriculture sector to climate variation and change, devotion of more resources in ensuring institutions have the capacity to deliver the necessary services to increase adaptation of climate smart interventions, and addressing the current policy gaps will go a long way in ensuring secure livelihoods, food security and a healthy environment.

The profile is organised into six sections, each reflecting an essential analytical step in understanding current and potential adaptation options in key local agricultural value chain commodities. The document first offers an overview of the county's main agricultural commodities key for food security and livelihoods as well as major challenges to agricultural sector development in the county. This is followed by identification of the main climatic hazards based on the analysis of historical climate data and climate projections including scientific assessment of climate indicators for dry spells, flooding and heat stress among other key climate hazards for agriculture. The document continues with an analysis of vulnerabilities and risks posed by the hazards on 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 enabling policy, institutional and governance context for adoption of resilience-building strategies. Finally, pathways for strengthening institutional capacity to address climate risks are presented.

1 Source: GoK; UNDP (2013b).

2 <https://citizentv.co.ke/news/50-acres-of-vegetation-goats-burnt-in-bomet-forest-fire-155159/>

3 http://www.ipsos.co.ke/NEWBASE_EXPORTS/Brookside/150319_Kass%20Weekly_34_9436b.pdf

4 GoK (2014b).

Agricultural context

Economic relevance of farming

Bomet County is located in the highlands of the South Rift Valley region of south western Kenya in an area commonly referred to as Kenya's high potential cereal and dairy livelihood zone. The county is bordered by Kericho County to the north, Nyamira County to the west, Narok County to the south and Nakuru County to the northeast. The County covers an area of 2037.4 km² and is subdivided into 5 sub-counties namely Chepalungu Sub-County (535.8 km²); Sotik Sub-County (479.2 km²); Konoin Sub-County (445.1 km²); Bomet East Sub-County (311.3 km²); and Bomet Central Sub-County (266 km²). The County borders a long stretch of the Mau Forest Complex which is an indigenous forest, home to different species of animals and plants and one of the most important water towers in the country (GoK, 2014a).

Agriculture is the main economic activity in Bomet County with over 80% of the total population engaging in crop and livestock production or being employed on farms. Agriculture is the main source of livelihood and food security in the county and also provides raw materials to agro-based industries and therefore stimulates multiplier effects in off-farm incomes and employment. Adult females provide the largest share of household labour for both crop and livestock production. Hired labour for livestock production is largely dominated by youth. Paid livestock related work is an important income source for both youth and their families. Male and youth headed households are more engaged in off farm and non-farm activities. Farmers in the county use improved seed for cash crops and local seed varieties for traditional food crops such as sweet potatoes and sorghum (GoK, 2014a).

The average annual household income in Bomet County is estimated at KES 187,920⁵ and from this households earn an average of KES 94,223.50 (50.1%) from on-farm activities. Livestock production contributes the largest share of on-farm household income averaging KES 118,398 per year (39% of total on-farm household income)⁶. Crop income represents KES 74,190.90 (24.4% of total on-farm household income), KES 8,000 (2.6% of total on-farm household income) from fishing activities, woodlot income averaging KES 24,800 (8.2 % of total on farm household income) pasture income represents KES

26,038.50 (8.6% of total on farm household income and KES 52,110.70 (17.2% of total on farm household income) from other on farm activities (GoK, 2014a).

People and livelihoods

The total population of Bomet County was estimated at 723,813 in the 2009 Population and Housing Census with 359,531 being male and 364,282 being female. About half (49.7%) of the total population is under 15 years. In 2012, the total population was projected to reach 891,168 by 2017 at an estimated growth rate of 2.7%. About 769,282 people live in the rural areas. The county has a total of 142,361 households⁷ with an average household size of 5 members. About 50.3% of the county's population was in the economically active age group⁸. However, a total of 160,583 persons are unemployed. Unemployment in Bomet is prevalent mostly among the youth. The major cause of unemployment in the county is low investment in the manufacturing sector and lack of entrepreneurial skills among the youth (GoK, 2013a).

Apart from agriculture, other key economic activities include small-scale industries such as carpentry and mechanics, the jua kali sector, artisanal mining for precious stones and quarrying for stones and sand. The important ones which are currently under exploitation are: murram, ballast and building stones. Local sand is found in Koiwa location in Konoin Constituency and at Kyogong area of Chepalungu constituency. Building stones are also found at Chepkositonik area of Bomet East Sub-County. The main source of energy in the county is wood fuel with approximately 91% of households using wood fuel⁹ for cooking (compared to 64.6% at the national level). Electricity coverage in the county is over 60% with all townships such as Sotik, Bomet, Mogogosiek, Sigor and Longisa having been connected to the national grid. However, actual household connection is much lower at 4% owing to the relatively high cost of connection compared to household incomes. Other sources of energy in the county include kerosene, solar energy and biogas which has seen a recent increase in use. (GoK, 2013a)

Approximately 86% of households have acquired formal ownership for their land and this has enabled many of them to participate actively in gainful economic activities as they can easily access credit for development (GoK, 2013a). The people displaced from the Mau forest in Konoin Sub-County are among the households without formal land ownership. The

5 This includes income from on-farm, off-farm and non-farm activities. Household incomes are not diversified implying that they derive their household income from one source.

6 Livestock mainly from milk, beef and poultry production contribute between 30% to 45% of the total household income (GoK, 2013).

7 Total number of female headed household is 11,389.

8 Labor force age is between 15 to 64 years both male and female.

9 This high percentage can be attributed to the existence of forests both private and public and thus Community Forest Associations (CFAs) in the county benefit widely from the forestry products such as wood fuel.

Despite the good rainfall and presence of commercial agriculture activities, 31% of the county's population lives below the national poverty line. The most affected divisions are Sigor, Longisa, Siongiroi where rainfall is low; and Sotik and Kimulot where there is a prevalence of landlessness, consequently affecting nutrition. However, no cases of malnutrition have been recorded in the county. The percentage of children who have adequate weight for age in the county is 60.2%. The 2013 County Integrated Development Plan (CIDP) identified climate change and erratic rainfall as key threats to poverty eradication in the county. The Kenya Integrated Household and Budget Survey report (KIHBS) of 2005 indicates that the county's poor are largely concentrated in the major urban centers, the tea estates, IDP camps and in the lower zones of the county (CBS, 2008).

The county has 1,716.6 km² of arable land (over 80% of the county's total land area). The total county acreage under food and cash crops is 74,755 and 33,222.5 ha respectively. The higher altitude areas in the northeast of the county are particularly suitable for tea plantations and dairy farming, while the middle part of the county is suitable for maize, coffee, pyrethrum and tea. In the southern parts of the county, livestock and milk production are the main economic activities. The county's geographical and climatic conditions are perfect for the production of fruit and vegetables. However, most households still primarily focus on maize production, with limited on-farm diversification into horticulture.

hot months is between December and January (GoK, 2014a). Rainfall is distributed unevenly throughout the year with April and May being the wettest months and January and February being the driest. Bomet County is located in the high potential cereal and dairy livelihood zone. Bomet County has both gazette and non-gazette forests with the gazetted forests¹⁰ covering an area of approximately 481.1 km². The forests in the county can further be distinguished between indigenous and plantation forests¹¹. The county has two gazetted forests: Chepalungu Forest Reserve (\approx 4,811 ha) and Transmara forest block (\approx 38,000 ha) of the Mau Forest Complex. In addition, the county borders parts of the Southwest Mau forest block. The forests are also the source of major rivers and forest products mainly timber, honey and herbal medicine.

The use of yield enhancing inputs such as organic manure, basal fertilizer and top dressing fertilizer are limited to 11, 61.1 and 6% of the county's farmers respectively. The use of field pesticides, storage pesticides and herbicides is 14.5, 3.7 and 39.1% respectively with only 0.8% of the county's farmers using irrigation facilities. The major constraints related to the

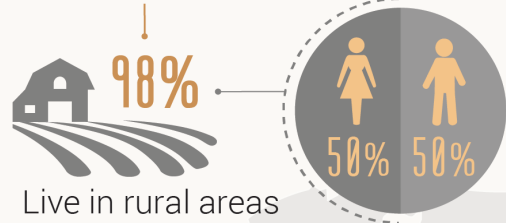
11 Chepalungu and Transmara Forest block of the Mau Forest Complex were both originally indigenous but with the human exploitation, there has been reforestation efforts.

Livelihoods and agriculture in Bomet

Demographics

2% Of Kenya's population

723,813 inhabitants



Access to basic needs

31% of the population lives in absolute poverty

Potable water	19%
Electricity for cooking	0.3%
Electricity for lighting	4%
Education (youth literacy rate)	ND

Food security

36% of the population suffers from food poverty

ND of household income spent on food

ND People undernourished

36% Children stunted

ND 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)

Farming

County's farming area

1,716ha 84%

32% of the population employed in agriculture production

35% of farmers have title deeds ND are women

Farming activities

Food crops



Cash crops



Livestock



Poultry

Cattle (heads)

Goat (heads)

44%

19%

Of county's agricultural land

644,435

369,412

102,907

Farming inputs

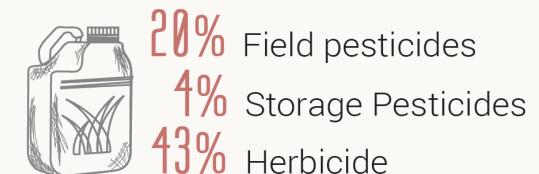
Water uses



Fertilizer types (% of households)



Pesticide types (% of households)



use of agricultural inputs include limited availability and affordability and perceived ineffectiveness of some inputs – possibly due to inappropriate use. The use of inputs in livestock production is high with 84% of households in the county using dewormers, 81% using acaricides, 77% using mineral supplements and 64% vaccinating their animals. Male-headed households report higher use of agricultural inputs than female-headed households (GoK, 2014a). This can be attributed to the domination of male-headed households in livestock production that includes cattle, goat and sheep and the prohibitive costs associated with agricultural inputs.

Use of farm machinery is low with only 41% of farmers using tractors and 28% using ploughs. Other machinery and equipment used in the county are harrows, pumps and planters. The use of livestock drawn equipment is also common. The majority of farmers use simple tools such as the hoe, jembe and spade. The County Government of Bomet provides machinery to farmers at a subsidized rate; this includes 10 tractors¹² normally used for harrowing, ploughing and mowing (key in harvesting hay¹³). Approximately 80% of farmers rely on improved raised on-farm granaries of various capacities. In addition, the National Cereals and Produce Board (NCPB) have three silos in the county located at Bomet, Ndanai and Sotik towns. The Bomet depot has a capacity of 180,000 bags while the others have a capacity of 100,000 bags each (GoK, 2014a).

Agricultural value chain commodities

A broad diversity of agricultural commodities is grown in the county. Of these commodities, various value chains have been prioritized as being strategic for the county as indicated in the County Integrated Development Plan (CIDP) and the Agriculture Sector Development Support Programme (ASDSP) as well as by government institutions such as the Kenya Agricultural and Livestock Research Organization (KALRO). For the development of this County Climate Risk Profile, four major value chain commodities (VCC) were selected for in-depth analysis based on: prioritization in County Frameworks and Programmes; economic value (KES/bag or KES/livestock or KES/unit livestock product)¹⁴; resilience to current weather variability and future climate change; and number of economically active people engaged in the commodity's value chain (including vulnerable groups, women, youth and the poor). The selected VCCs were banana, Irish potatoes, sweet potatoes and local chickens.

Banana

The banana value chain has been gaining importance for food security and livelihoods of farmers in Bomet County. It is estimated that 61% of the total population are engaged across this value chain and this is due to the fact that the crop is resilient to dry spells, pests and diseases. In terms of geographical coverage, banana production is well spread across all five sub-counties. It is also a commodity that is grown by all groups of farmers and it is particularly favoured by women and youth. This value chain is characterized by small-scale, mixed, subsistence farming systems in the areas of Sotik Sub-County, Bomet Central Sub-County including the areas of Silbwet, Tenwek, Cheptalal, Ndaraweta, Konion Sub-County including Kimulot, Chebangang and Kapkoros. Large-scale, commercial mono-cropping farming systems are only found on Nogirwet.

Seedlings and advisory services for banana production are provided by the county's agricultural extension staff as well as by KALRO and other partners. Due to the popularity of banana production, farmers now also source suckers from neighbours and there are a number of banana tissue culture nurseries across the county. Bomet East Sub-County in Kembu is the main center for acquisition of good quality planting material that is free of diseases. Most of the farmers apply fertilizers to increase their yield and for proper establishment of the banana crop. Fertilizers are sourced from farm input suppliers in the towns and at farm level. Farmers also use organic manure. Youth-headed households use more planting fertilizer and top dressing fertilizer compared to male- and female-headed households, on average 50 and 50 kg respectively. This can be attributed to the readily access¹⁵ and availability of information with regards to fertilizers by the youths. Male-headed and youth-headed households approximately use similar amounts of organic manure 106 kg and 103 kg respectively. This can be attributed to the ownership of livestock by the men. Farm labour for small-scale production of bananas is sourced at household level and hired in the event of large-scale farming. (GoK, 2013a). Once harvested the bananas are transported to main collection, marketing and storage centers in Bomet town, Sotik, Mogogosiek, Mulot, Chebole, Kapkwen where they are either sold in local markets or transported for sales outside the county (Nairobi, Mombasa and Nakuru).

¹² 2 tractors for each of the 5 sub-counties in the county.

¹³ Important in stall fed production systems.

¹⁴ As stated in the 2015 Economic Review of Agriculture (ERA).

¹⁵ Income from non-agricultural income generating income such as boda boda, mining, jua kali among others

Irish Potatoes

Between 41-60% of the county's population are engaged along the Irish potatoes value chain. Irish potatoes have been promoted as a strategic crop for value chain development in the county largely due to its fast growth, high productivity and high profit making potential. In Bomet County, this value chain is characterized by large-scale commercial farming systems in Bomet Central including areas of Kipsonoi, Kiplelji, Silibwet, Tenwek. In the areas of Sotik and Konoin Sub-Counties and Gelegele, it is characterized by small-scale, mixed cropping (tomato and livestock such as dairy) systems. Irish potatoes take four months to mature and with irrigation and timely access of seeds, farmers can harvest up to 3 times a year. Conservation agriculture and crop rotations are commonly practiced as a means of managing pests.

Between 2012 and 2013 the area under Irish potato production in Bomet County increased from 2,847 to 3,924 ha, an increase of over 37%. The total quantity produced increased from 43,600 tons to 74,504 tons during the same period representing an increase of 70% (GoK, 2015). These figures underline the growing importance of Irish potato in the county. The selection of clean, pest and disease free planting material is key in the production of potatoes and supported by institutions such as KALRO, KEPHIS, Kisima farm in Meru, and extension officers. Land preparation, production and harvesting are done by households and hired labour utilizing both simple farm tools and machinery such as tractors.

Potato is one of the commodities for which agricultural credit is available, either in the form of loans or else in the form of inputs for production. The Dutch Robin potato variety is the preferred variety in the county as it is suitable for products such as potato crisps. Bomet County is the leading provider of potatoes used by Deepa Industries¹⁶ which is one of the largest manufacturers of potato snacks¹⁷ in Kenya.

The Irish Potato Value Chain (VC) is affected by a number of pest and diseases such as bacterial wilt and Potato Cyst Nematode (PCN) and thus the use of pesticides is common. Potato aggregation centers (cold stores) are found at Tegat and Mogoma both in Bomet East. Key actors involved in linking potato farmers to buyers include, Kenya Midland Sacco, Deepa Industries, NORDA and the Agribusiness Marketing office at the county headquarters. Challenges to potato production include low availability of certified seeds, pests and

diseases such as bacterial wilt and PCN, and lack of structured markets.

Sweet Potatoes

Sweet potato is a heat loving, drought tolerant food crop that has widely been accepted in Bomet County. It is mainly grown in the lowlands of the county: Chepalungu, Bomet East, Sotik and parts of Bomet Central Sub-Counties. It is also used as a cover crop and thus key in conservation agriculture. Some farmers plant the sweet potatoes vines under the maize as a cover crop. Sweet Potatoes are characterized by subsistence, small-scale, and mixed farming systems across the county. Between 2012 and 2014a the area under sweet potato production in Bomet County increased from 429 ha to 2,333 ha. The total quantity produced increased from 4,650 tons to 30,971 tons during the same period (GoK, 2015). This indicates that the sweet potato VC has high potential. Most farmers are now shifting to this VCC because it is a drought tolerant crop with the potential to enhance food and nutrition security.

The county government through the Sweet potato project¹⁸ has supported farmers with high quality vines while organizations such as KALRO have been conducting training on sweet potato production. Demonstration farms and field days are used as a vital avenue in disseminating information and knowledge on this VC. Most farmers involved in this value chain use organic manure for their crops rather than mineral fertilizers. This is largely due to financial constraints. Sweet potatoes are sold unprocessed, however the Bomet County Cooperative Union set up a sweet potato bakery to bake cakes and bread. NGOs such as World Vision are involved in some aspects of the sweet potato value chain through the provision of processing and packaging equipment for making potato crisps in Chepalungu Sub-County, in Chebonyo, Cheleget, Saboson, Kamaget, Lelaitich and Mogor.

Chicken (local)

It is estimated that over 81% of the total population in Bomet County are engaged across the local chicken value chain either for meat, eggs, and supply of feeds, vaccine and income. The value chain is characterized by small-scale, subsistence, mixed farming systems. Local chicken breeds are relatively easy to manage. They are often left to roam freely and scavenge for food with very little supplementary feeding and minimal additional inputs. In some cases, farmers

¹⁶ Popularly known as Tropical Heat.

¹⁷ Potato crisps, chevda and potato sticks.

¹⁸ This project started in April 2016

use stall feeding and improved housing to maximize productivity especially when commercial production is the main aim. Because of the largely informal nature of chicken production in the county, information related to inputs used and production volumes is limited.

Chicken diseases, such as Newcastle disease (NCD) and fowl pox are a great challenge to production and

vaccination as well as cleanliness and decontamination are important aspects of production. Vaccination is offered by the Department of Veterinary Services (DVS) as well as by private providers. Local breeders and the agro-dealers are involved in the supply of chicks across the county. This value chain is key in both egg and meat production in the county.

Agricultural value chain commodities in Bomet



Provision of
seeds and other
inputs



On-farm
production



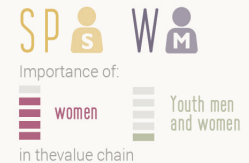
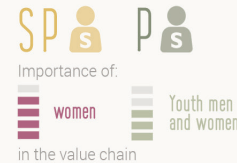
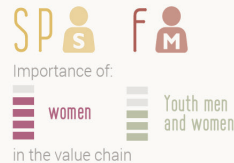
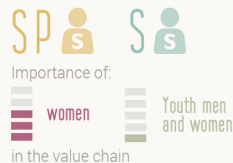
Harvesting
storage and
processing



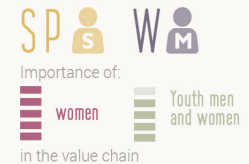
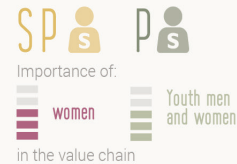
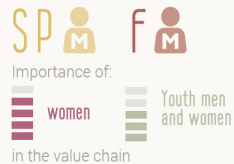
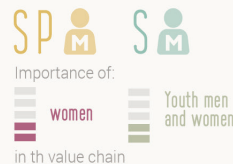
Product
marketing

Types of actors engaged in Value Chain

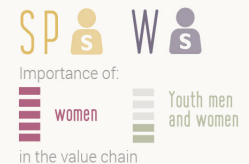
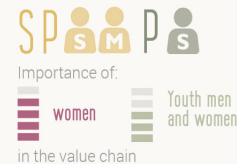
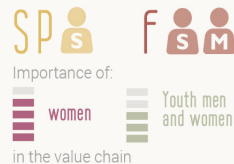
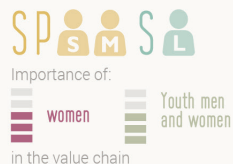
% of people engaged
in the value chain
21-40%
Sweet potato



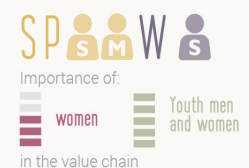
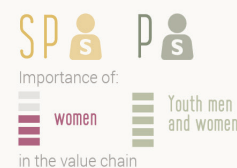
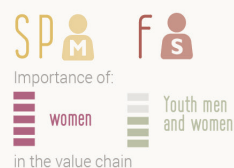
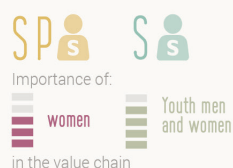
41-60%
Irish potato



61-80%
Banana



61-80%
Chicken
(local)



Conventions

Types of actors: SP Service providers S Suppliers F Farmers P Processors W Wholesalers/retailers

S small-scale M medium-scale L large-scale

ND: No data

Importance of women, youth men and women: 1 = very low; 2 = low; 3 = medium; 4 = high; 5 = very high; 0 = non-existent; N/D = no data.



Agricultural sector challenges

Despite the County's fertile soils, adequate rainfall, diverse range of commodities grown, and high productivity, there are still a number of challenges in the agricultural sector. These challenges relate largely to poor crop husbandry, use of uncertified seeds, lack of planting materials, pests and diseases, and low application of fertilizer and other farm inputs due to prohibitive prices. The county has a conducive agricultural environment and there is an overreliance on rain fed agriculture which has become unreliable in recent years. The use of climate resilient, productivity enhancing technologies such as irrigation and greenhouses is limited among smallholder farmers in the county. However, gains from the use of these enhancing technologies are hampered by poor crop and livestock husbandry techniques, use of uncertified seeds, and limited application of fertilizer and other farm inputs. Underdeveloped input market infrastructure makes quality inputs such as seeds, sometimes unavailable. For example, the lack of planting materials has sometimes affected productivity of pyrethrum¹⁹ and coffee, the two main cash crops in the lower areas of Bomet County.

There is a wide range of pests and diseases affecting crop and livestock production in the county. Cattle diseases include, foot and mouth disease, Rabies, Contagious Bovine Pleuropneumonia (CBPP), anthrax and black quarter; and in local chicken viral diseases such as NCD and fowl pox are experienced across the county. Many of these diseases are affected by weather and climatic conditions, with some being more prevalent during wet periods and others during periods of drought. In crop production there are also a wide range of pests and diseases that are affecting different value chains across the county; they include MNLD, fall army worm²⁰ in maize, PCN, bacterial wilt, potato blight in potatoes among others. The main water sources in the county (Nyongores, Kipsonoi, Itare, Kiptiget, Chemosit, Amalo, Mara and Sisei Rivers) have been polluted through poor use and disposal of farm chemicals. Erosion has also increased due to stream bank cultivation; this reduces water flow as well as water quality which affects crop and livestock production negatively.

The livestock sub-sector also faces low productivity due to poor cattle breeds, lack of quality feed and pastures and low adoption of appropriate technologies such as feed conservation, vaccination. Value addition of animal products is limited with most sales consisting

of unprocessed milk, raw goat meat and chicken meat. Limited functionality of input and output market chains expose smallholder farmers to exploitation by middlemen. In addition, the underdeveloped markets for farm produce within the county often result in high post-harvest losses and low prices for agricultural produce.

About 80% of farmers rely on on-farm grain storage, however, inadequate post-harvest technologies contribute to high post-harvest losses (infection by pests and fungi). While farmers' cooperatives do exist to support collective marketing and bargaining, their structures are often weak and subject to low participation and high failure or dormancy rates. Despite the wide range of financial institutions smallholder farmers in the county have limited access to credit and agricultural insurance mostly due to lack of collateral and the high risk associated with smallholder agriculture. When credit and insurance are available they are often at high interest rates and premiums which are not attractive for smallholder farmers. The extension service is often overstretched due to the high farmer - extension worker ratio. This is further exacerbated by the limited knowledge of extension agents on emerging issues such as climate change.

19 Kenya is the leading exporter of Pyrethrum in the world and Bomet is one of 19 counties in the country that produce it.

20 This is an emerging pest affecting maize across the county.

Climate change-related risks and vulnerabilities

Climate change and variability: historic and future trends

Bomet County has a generally cool climate with mean annual temperatures being below 20 °C throughout most of the county. The county has moderate mean annual rainfall of between 1000 and 1250 mm per year over most of the county. The lower highland part of the county has the highest rainfall, with rainfall decreasing in the upper midland zone which lies to the west of the rift valley, while the upper midland zone in the southern part of the county has the lowest annual rainfall. Although the County is not particularly dry or vulnerable to droughts, Bomet was among several non ASAL counties identified as being affected by the 2016/17 drought in Kenya. Incidences of extreme rainfall resulting in flash floods have also been recorded and farmers have testified to uncertainties in the start of the growing season.

Analysis of temperature trends in the county over 25 years (1981 to 2005), showed that temperatures have increased by approximately 0.5 °C for both the first and second seasons. Despite these increase in temperatures in both seasons there has not been an increase in the number of heat stress days²¹. On the other hand, analysis of average annual rainfall, measured over a 35-year period (1981-2015), showed no significant change in both seasons. Rainfall has however become more variable, with an increase in extremes (both highs and lows) from year to year, which has resulted in an increase in both flood and drought risk in the first season and an increase in drought risk in the second season.

Looking ahead to the period 2021-2065, climate projections based on two representative concentration pathways (RCPs²²) indicate that under both scenarios mean temperatures are expected to continue to increase. This results in an increase in drought risk, with the number of consecutive drought stress days²³ rising from an historical average of less than 60 days in each half of the year to as high as 80 consecutive dry days. Under both scenarios there is also expected to be an increase in flood risk with the maximum 5-day

precipitation average rising by approximately 20-25% from the historical average. Under the high emissions scenario there is also expected to be a reduction in rainfall in both seasons.

These changes in temperature and rainfall also have an effect on season onset and duration however the effects are different depending on the level of GHG emissions. Under the low emissions scenario, both the first and second seasons are expected to start lateral though the length of the second season is also expected to increase slightly. On the other hand, under the high emissions scenario season onset is similarly expected to recede however in this case the length of the second growing season is expected to reduce. Moisture stress²⁴ is also expected to increase under both scenarios although the magnitude is more pronounced under the high emissions scenario. Although the projections of future climate change under the two GHG emissions scenarios show some differences, both indicate the likelihood of noteworthy changes in the weather and climate of the county with probable impacts on crop and livestock production.

Climate Perceptions by the farmers

According to farmers, there has been an ongoing and intensifying change in climate and weather patterns in Bomet County in recent years. These changes have included: increased unpredictability in rainfall patterns in terms of amount and distribution as well as a rise in temperatures. Because of the uncertainties associated with the beginning and end of the growing season (a while back, the long rains would start mid-March but nowadays they start as late as in May) farmers are unable to prepare well for planting and harvesting. This has resulted in extensive crop losses and food insecurity.

Farmers believe that human activities such as environmental degradation and deforestation (caused by clearing of land for agriculture and grazing as well as the need for wood for construction and energy) and the increased demand of fuelwood for production of tea by the KTDA have led to erratic rainfall, increased river siltation, reduced water availability and that these in turn have affected agricultural production and productivity. Farmers noted that there are now long dry spells in the lowlands of Chepalungu and Bomet East and that these are attributed to the deforestation

21 Indicated by the number of days with a maximum temperature above 35°C.

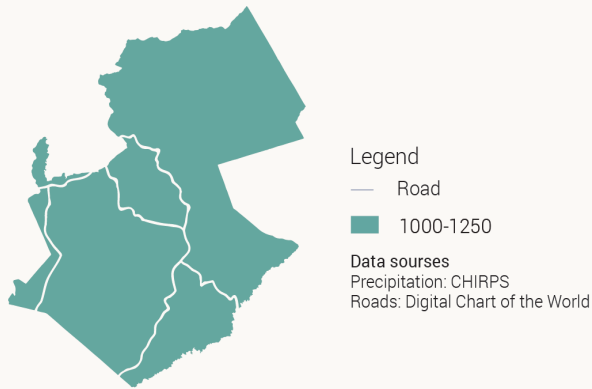
22 The two RCPs, RCP2.6 and RCP8.5, are named after a possible range of radiative forcing values in the year 2100 relative to pre-industrial values (+2.6 and +8.5 W/m², respectively). The pathways are used for climate modelling and research. They describe two possible climate futures, considered possible 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.

23 Days with precipitation less than 1mm per day.

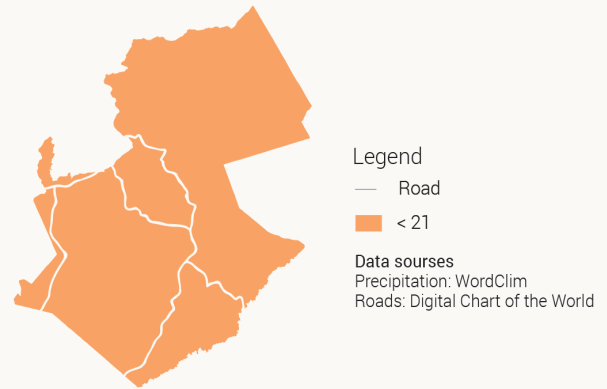
24 Number of days with ratio of actual to potential evapotranspiration ratio below 0.5.

Past and future impacts of climate hazards in Bomet

Historical annual mean precipitation
(mm/year)

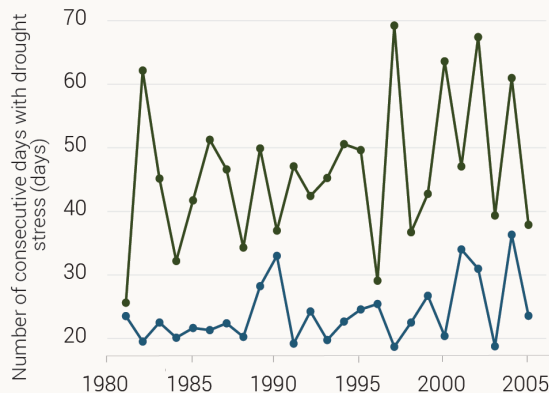


Historical annual mean temperature
(°C)



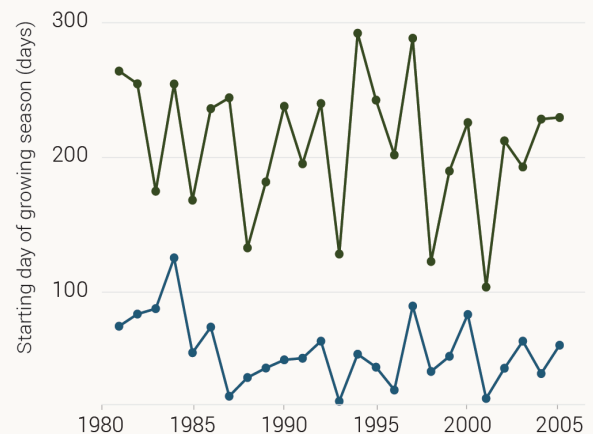
Moisture stress hazards

Historical extreme moisture stress events

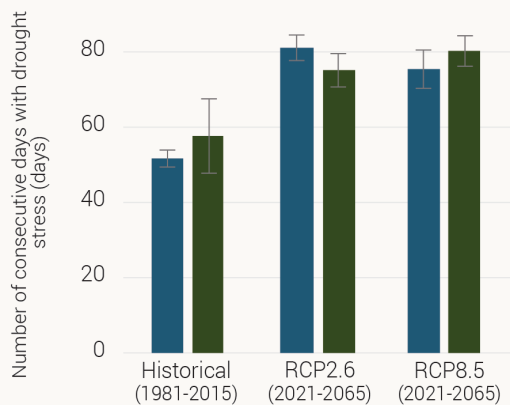


Uncertainty in the start of growing season hazards

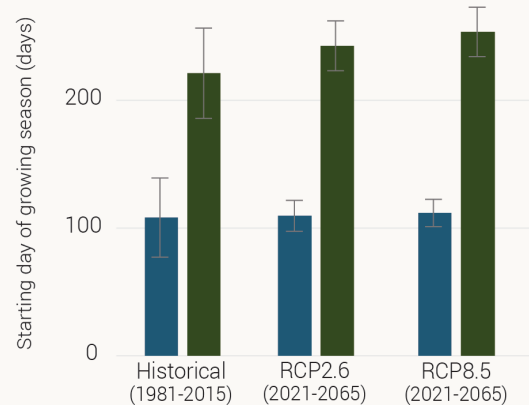
Historical uncertainty in the start of growing season stress events



Historical and expected extreme moisture stress events



Historical and expected uncertainty in the start of growing season stress events



■ January - June ■ July - December

in Chepalungu forest. In addition, farmers identified the wetland encroachment and streambank cultivation in the highlands of Konoin as some of the reasons for diminishing water availability from the water sources. This phenomenon has mostly affected the lowlands of the county: Chepalungu and Bomet East. Farmers believe that the water abstractions projects²⁵ at Rivers Nyangores, Kipsonoi and Itare are responsible for some climate related hazards in the county.

Farmers have also noted an increase in the occurrence and severity of wildfires between November 2016 and February 2017, a phenomenon they attribute to increased temperatures. Farmers stated that in the lower parts of the county (Chepalungu and Bomet East), distances to the main water sources (dams and pans) for domestic and livestock purposes have increased particularly during the dry seasons when farmers can trek as far as 5 km. Scarcity of water has also been attributed as a cause for increased cases of human diseases such as cholera. Farmers also reported increased incidence of mosquitoes and malaria due to temperature rises in the county that previously known as relatively mosquito free.

Climate vulnerabilities across agriculture value chain commodities

As indicated by farmers, there are numerous climate related hazards in Bomet County and these hazards have been compounded by various changes in weather and climate over past decades. The impacts of these changes are however not uniform across all agricultural value chain commodities. Climate vulnerability involves socio-economic factors that influence people's ability to cope.

Banana

Moisture stress affects the acquisition of farm inputs and land preparation. Farmers' delay the acquisition of inputs due to the high costs attributed to them and because they spend more time preparing the land due to the extra labour required breaking hardpans. These effects are not felt evenly; some farmers can access improved planting material while the majority depend on traditional suckers. The economically endowed farmers use modern farm machinery to break hardpans compared to poor farmers who lack such infrastructure due to financial constraints.

Moisture stress leads to delayed planting and reduced yields. Women and youth are more affected, as they

are more involved in this value chain. Farmers with adequate knowledge on good agricultural practices are less susceptible than those with limited knowledge. For instance, overcrowded stools suffer more moisture stress. Farmers with knowledge on the proper spacing and stool management suffer less. Those adopting minimum tillage, use of tissue culture planting materials are less vulnerable to the negative effects of moisture stress. The economically endowed farmers have the capacity to purchase clean planting material, inorganic fertilizers and prepare land properly²⁶ with the required machinery such as sub-soilers. Farmers that have limited access to early warning systems by the Kenya Meteorological Services are also more vulnerable than those that receive early warning information.

Moisture stress leads to reduction in bulking quantity and over-ripening, less production and high instances of post-harvest losses. With the reduction in production, transport becomes expensive, as farmers are no longer in a position to offset the overhead costs incurred. Poor infrastructural facilities especially in Konoin Sub-County²⁷ lead to more vulnerability compared to other areas. Most parts are hilly and the roads are not well maintained hence increasing transportation costs. The lack of on- and off-farm storing facilities also leads to post-harvest losses. For example, farmers in Bomet East are forced to sell their produce locally hence fetching low prices.

Moisture stress affects the prices of the banana due to poor quality and quantity of the produce. The demands of the market are not met due to low supply. This inconsistent supply will consequently lead to future market losses. Farmers with limited knowledge on market information and dynamics will be affected more.

Another climatic hazard that affects the banana value chain is the uncertainty of seasons (onset and duration) with consequences that are more or less similar to moisture stress. Additionally, Uncertainty of seasons (onset and duration) leads to fluctuation and poor prices due to missed market opportunities and unreliable markets. Farmers engaged in contract farming have to deal with the loss of trust due to dishonoured contracts. Some of the factors that make people more vulnerable than others include inter alia: financial constraints where women, youth and poor farmers have limited financial capability to use modern technology to engage in modern farming that do not rely on rainfall such as green houses. These categories

²⁵ These projects include Sigor water Project and Chepalungu that is almost complete and almost to start respectively

²⁶ Digging of the holes with right dimension.

²⁷ Due to the topography (sloppy)

of farmers do not have enough storage and cooling houses to keep their produce as they await better market prices.

Irish potatoes

Drought/moisture stress is a serious climatic hazard that affects the production of Irish potato as it leads to the creation of hardpan during land preparation and inadequate availability of seeds. Drought/moisture stress affects some parts of the commercial, large-scale farming systems (Kipileji, Kembu,) and parts of the small-scale, subsistence, mixed farming systems (Gelegele). Drought leads to soil compaction which makes tilling the land more difficult. This consequently leads to high cost of land preparation due to the use of machinery such as subsoilers. Low income from the farmers reduces the chances of acquiring credit facilities. The level of poverty hinders the availability of proper farm inputs

This stress also leads to the emergence of pests and diseases such as whiteflies affecting the leaf surface area. The farmers in the lowlands, the hot and dry agro-ecological zones (AEZ) in Bomet East and parts of Bomet Central suffer most due to the low humidity conditions in the area, thus increasing the prevalence of the whiteflies. Other pests include, spider mites and aphids. Economically empowered individuals have the capacity to source for irrigational infrastructure and thus become less vulnerable compared to the poor. Farmers with limited knowledge on post-harvest handling and management are more vulnerable. Areas with poor road networks such as Merigi/Chemana are more affected since access to markets becomes a challenge. Drought also leads to the interference by the middlemen (brokers) hence prolonging the value chain and less returns to the farmers. Promotion becomes expensive as the produce is less and thus increases overhead costs. The low quality and quantity of the yields lead to less bargaining power thus fetching low prices. Farmers that have limited knowledge on market information are more vulnerable to exploitation by the middlemen.

Another climatic hazard that affects this VC is intense rain which often leads to high infestation of pest and diseases such as bacterial wilt, potato blight. These pests are expensive to control, and the high incidence of diseases also leads to inadequate supply of clean seeds, thus increased input prices and higher transportation costs as the road network is hampered in the event of intense rain. In the on-farm production, land preparation cost increases. Increased incidences of pests and diseases (late/early blight) require extensive pest management thus leading to increased

production costs. The farms in sloping areas such as Ndarawetta, Merigi are more affected due to the high rate of leaching leading to poor yields. The economically endowed farmers engage in good agronomic practices as they have the capacity to absorb the climatic shocks through the implementation of proper infrastructure. Soil fertility also varies across the county. The lowlands of Bomet East and Sotik are characterized by clay soils that get logged thus affecting the productivity of this value chain. Intense rain impacts the large-scale commercial farming systems in Kapkoros, Ndaraweta, Silibwet, Tenwek and parts of the small-scale, mixed, subsistence farming systems in Cheptalal, Koiwa, Mogogosiek, Sotik areas.

Pests and disease control varies according to the level of credit facilities. Poor farmers often do not have access to credit facilities due to the lack of collateral that is a prerequisite by most financial institutions. Farmers with adequate knowledge and skills in the management of the crops are less vulnerable than the farmers with limited access or no access to knowledge and skills. The increased labor costs are likely to be felt more by the poor farmers as compared to the economically endowed farmers. Intense rain leads to high cost of transport. Areas with poor road networks such as Merigi and Chemana are more affected than areas that have well-developed road infrastructure. Poor storage facilities lead to high perishability.

Sweet potatoes

Moisture stress/drought affects the sweet potato value chain, in particular the small-scale mixed, subsistence farming systems in Chepalungu Sub-County, which includes areas of Chebunyo, Kaboson, and Sigor. Moisture stress reduces the availability of planting material at the bulking sites, thus the extension advice is thus less likely to be adopted. Poor farmers are not in a position to pay for planting material that retails at higher prices during periods of drought and thus are more vulnerable than the economically endowed farmers that can afford the high prices prevailing in the market. Poor farmers also typically keep less animals and thus have limited farmyard manure during periods of drought/moisture stress. Farmers adopting new varieties are less vulnerable than farmers opting for traditional varieties. The extension officer to farmer ratio is low and thus the dissemination of the extension service is curtailed thus making the farmers more vulnerable as they have limited knowledge transfer

Land preparation, especially in the lowland areas which predominantly covered with clay soils, becomes more difficult due to hardpans. This mostly affects

Adaptation to climate change and variability

On-farm adaptation practices

Current adaptation options in Bomet County are aimed at increasing farmers' capacity to cope with risks and adapt to climate change and variability. These interventions have been conceptually mapped to specific vulnerabilities in the 4 major VCCs as discussed below.

The department of water is encouraging water harvesting strategies particularly public institutions where they provide water tanks to schools, health facilities and have issued 250 water tanks to public institutions. The department collaborates with other institutions to ensure water security such as Water Service Trust Fund, UNICEF, World vision, Kenya Red Cross (KRC). To avoid contamination of water, there is improvement and protection of water sources such as the springs, through the spring box or the stand tap. There are surface water reservoirs such as dams and water pans for livestock production across the county. Dams are found in the drier zones of Chepalungu, parts of Sotik sub-county and Longisa in Bomet East sub-county. Households with corrugated iron roofs, public and private institutions engage in roof water harvesting and use the stock during the dry spell when they have water shortage. Adoption of the irrigation facilities across the county majorly in the lowlands is being promoted through the Bomet Integrated Development Programme in Chepalungu, the Bomet East-Chebaraa Irrigation scheme and Nogirwet irrigation scheme that is collaboration between the county Government of Bomet and the KRC.

Agroforestry is widely practiced in Bomet County due to reduced land sizes and the awareness of benefits that accrue from the practice. The demand for wood fuel by tea factories in the county has resulted in most farmers combining both trees and crops in their farming activities. The gains made from agro-forestry are immense as the decomposition of tree litter and pruning can substantially contribute to maintenance of soil fertility. Agro-forestry also controls runoff and soil erosion, thereby reducing losses of water, soil material, organic matter and nutrients. Growing of fruit trees is also being encouraged by various agricultural stakeholders so as to enhance the tree cover to the desired national standard of 10 % by the year 2030. Industrial fertilizer is expensive and out of reach for most farmers and as such use of nitrogen fixing tree

species such as *Leucaena leucocephala*, *Sesbania sesban* and *kajianas kajian* are an alternative to improvement of soil fertility.

Fodder trees have the potential for alleviating some of the feed shortages and nutritional deficiencies experienced in the dry season. Farmers also use molasses, Napier grass, and Boma Rhodes. Farmers have diversified the fodder crops; not only do they rely on the grasses but use legumes as well. The county government own 10 tractors where 5 are fitted with mowers and the other 5 fitted with balers²⁹ used for pasture conservation. The county government through the livestock department also issue pasture seeds to farmers and train them on diversification and feed formulation options. AI services are provided by DVS and private service providers. The former provides subsidized AI services attracting a high demand by farmers. Vaccination is also under the jurisdiction of the DVS and is subsidized with the exception of the rabies vaccination. In the fisheries department, the fish farmers destock the fish ponds³⁰ in the event of climate extremities such as dry spell while others engage in feed formulation, Sisich Fish Farmers cooperative society are actively involved in feed formulation.

Value addition in agriculture is any activity a farmer performs outside of traditional agricultural production to receive a higher return per unit of any product sold. This includes activities such as agri-tourism, storage, processing and marketing (Ntale *et al.*, 2014). A high number of households (73%) add value to cereals, vegetables (27%) and trees (24%) compared to the other crop categories. Grading/packing is the main value addition activity across all the crop categories (GoK, 2014a). Some of the value added products include sweet potato bread, cakes, crisps and Irish potato crisps. Different types of value addition are undertaken within each livestock product category. Much of the value addition is done by male adults. This can be attributed to the ownership of the livestock and thus key decision makers in the livestock. A high number of households add value to milk through fermentation, to the popular *mursik*, yoghurt, cooling, boiling, grading, pasteurization and packaging. Value addition for eggs include grading, packaging, boiling and for chicken de-feathering, boiling, salting and packaging. Diversified of farm enterprises include bee keeping, and switching from rain fed food crops to irrigated horticultural production to cushion against climatic shocks and increase household income.

The main sources of climate related information in the county are meteorological department and Indigenous

29 Data from the department of agribusiness.

30 The fish farmers use pond liners.

Traditional Knowledge (ITK) while the channels of dissemination are radio³¹, agricultural officers and television. Other dissemination channels include but are not limited to: public extension, community based organizations (CBOs) and partners. More female-headed households had higher access of climate information from ITK and radio, while the majority of youth-headed and male-headed households obtained climate related information from television.

Annex 1 identifies patterns of adoption disaggregated by head of household, as well as the common input requirements and challenges to implementation.

Off-farm adaptation practices

Off-farm services, such as early warning systems, extension and training, credit facilities, storage facilities, and market information are offered to farmers to increase their climate adaptive capacity. Such services are offered by a variety of actors, from government (such as the meteorological, veterinary, agriculture, fisheries and livestock departments) to organizations like KRCS, World Vision (WV). Participatory scenario planning meetings are organized every season, bringing together key stakeholders under the guidance of professional experts who assist in collectively finding ways to interpret the information (both local and scientific knowledge) into a form that is locally relevant and useful. For instance, the Kenya Meteorological Department (KMD) provides weather forecasts for the expected rainfall; the Department of Agriculture (DA) and ASDSP have information about specific crops' water requirements or the ideal type of the seed for the season; the Department of Livestock (DL) gives marketing advice; the Department of Veterinary Services (DVS) offers advice on interventions for managing expected diseases and pests. Uniting all this expert information, a dissemination plan is compiled and transformed into a version that can be broadcast on the radio in the local language and field barazas. In addition, these departments might follow up their recommendations by providing the following services, amongst others: agricultural extension, weather and climate information, early warning systems, market.

Agricultural extension officers sensitize and train farmers on sustainable land management practices such as intercropping, conservation agriculture, terracing, water harvesting, composting, and agro-ecological crop selection (e.g. sorghum for drought tolerance). Extension agents play a key role in the adoption of improved farming practices and adaptive mechanisms. Early warning systems enable farmers to

know when and where to plant, and when to move livestock, based on information on expected drought and floods occurrence which can affect crop and livestock production. The KMD is responsible for the county's weather early warning systems. Daily, weekly, monthly, seasonal forecasts are generated by KMD in integrating scientific and traditional knowledge. This information is then shared and distributed through emails, SMS, public barazas, pamphlets/brochures, broadcasted on local radio in local language and TV. The majority of the population has access to radios, making it an effective means of transmitting information.

Climate smart advisories are offered by the department of Agriculture, Livestock and Fisheries with the support of key stakeholders such as ASDSP, KDFF, Hand in Hand East Africa, SDCP, KWEN. Agro chemicals and seed companies such as KFA. They have information about specific crops' water requirements or the ideal type of the seed for the season, marketing advice, and advice on interventions for managing expected diseases and pests. These advisories are important in promoting preparedness among the farmers and the expected outcomes from the early warning information from the KMS.

The department of agribusiness is key in providing agricultural extension services that are supported by agricultural research and appropriate technology to farmers, regulation and quality control of the sector's inputs and products as well as improving their access and the support of the management and the control of pests and diseases in crops. The department of livestock provides the extension services to farmers on good production systems that are linked to the climate weather advisories. The DVS also support the management and control of pest and diseases in livestock and the management and conservation of the natural resource base for livestock production. The department of fisheries also provides extension services through field days, fish eat campaign³². Private Service providers also provide extension services such as the seed companies and agro dealers. Another key off-farm adaptation option that is not exploited in the county is that of insurance services offered by the various financial institutions. There is the need for sensitization on the importance of this adaptation tool. This can ultimately benefit the farmers against climatic hazards and their consequences. It was clear that majority of the farmers are not aware of this adaptation option.

³¹ Majorly in the vernacular radio stations such as KASS, majority of the population have access to radio in their households.

³² Teach the fish farmers how to prepare the fish so as to promote fish intake in the county.

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

Banana

Provision of seeds and other inputs

On-Farm production

Harvesting storage and processing

Product marketing



Moisture stress/
droughts

Delayed acquisition of planting materials; Delayed acquisition of inorganic fertilizer till onset of rains; Prolonged land preparation, digging of holes due to hard ground

Poor bunch formation, lower number and small sized fingers resulting

Reduced weight, bulking quantity and value of product. High post-harvest loss. Higher transport cost in relation to product value

Accelerated fruit ripening and decay during transportation. Low prices due to low quality and quantity of produce. Inconsistent supply resulting in difficulty in securing markets. Low revenues and profits for farmers

Magnitude of impact

Major

Major

Minor

Severe

Farmers' current strategies to cope with the risks

Application of farm manure to help conserve soil moisture during dry spells

Manual irrigation using water buckets and watering cans

Spraying of water on harvested produce to reduce perishability and prolong freshness

Exploring multiple markets (mostly individually)

Other potential options to increase farmers' adaptive capacity

Application of plant organic matter as mulch to help conserve soil moisture and protect seeds and seedlings. Mechanised land preparation. Early land preparation

Use of modern low-cost irrigation systems such as drip, flood and sprinkler irrigation. Use of in-field water conservation practices to conserve soil moisture (pits, mulching, minimum tillage)

Use of improved storage facilities with appropriate moisture/ RH regulation. Storage in common facilities through cooperatives

Use of improved storage, transportation and preservation techniques to prolong quality of produce. Bulking and collective marketing through cooperatives



Uncertainty of seasons
(onset and duration)

Wilt and loss of suckers. Delayed acquisition of inputs. Increased storage costs for inputs

Some areas may experience hardpans, affecting land preparation; delayed planting due to inadequate soil moisture; delayed weeding

N/A

Inconsistent supply resulting in difficulty in securing markets. Change in season can affect production quality and quantity and hence income. Missed market opportunities

Magnitude of impact

Moderate

Major

Moderate

Severe

Farmers' current strategies to cope with the risks

Use of manual irrigation

Postpone land preparation; delayed planting

Harvest crop early in the morning to reduce shattering (pods splitting open); immediate disposal of the produce

N/A

Other potential options to increase farmers' adaptive capacity

Application of plant organic matter as mulch to help conserve soil moisture and protect seeds and seedlings. Mechanised land preparation for timely planting. Early land preparation. Enhanced use of agro-meteorological information

Use and adoption of appropriate early maturing varieties

Use of improved packaging and storage facilities with appropriate moisture/ RH regulation. Storage in common facilities through cooperatives

Enhanced use of marketing information system. Collective marketing

Irish Potato



Provision of inputs



On-Farm production



Harvesting storage and processing



Product marketing



Drought/ Moisture stress

Creation of hardpan during land preparation. Inadequate availability of seeds particularly from accredited seed suppliers (sometimes costly or not locally available). Low quality seeds

Cost of land preparation is high due to need for use of machinery. Vulnerability of crop to pests and disease

Wilting and moisture loss during storage resulting in low weight and quality. Reduced quality and shelf life of the product

Low prices due to low quality of produce. Susceptibility to middlemen who pay low prices. High transport costs compared to product value

Magnitude of impact

Moderate

Major

Moderate

Moderate

Farmers' current strategies to cope with the risks

Carry-over of seeds

Incorporation of organic manure into the soil to help conserve moisture

Use of appropriate packaging materials to control moisture loss while minimising susceptibility to rotting

Sales to middle men

Other potential options to increase farmers' adaptive capacity

Capacity building and licensing of community seed suppliers to ensure supply of high quality seeds

Use of agro-meteorological information to improve farm decision making. Use of drought or flood resistant varieties. Use of conservation agriculture practices (mulching) to conserve soil moisture

Strengthen cooperatives to acquire cleaning and sorting machinery. Construction of improved storage facilities with appropriate moisture regulation mechanisms. Invest in value addition and processing facilities

Strengthen marketing associations and cooperatives to add value; improve market information platforms; contract farming to protect from total financial losses. Introduction of agricultural fairs



Intense rains

Pests and diseases affecting seeds. Water damage to stored inputs. Transport of input supply can be hampered

Difficulty in land preparation due to water logged fields. High incidence of pests and diseases (e.g. leaf blight)

Difficulty in harvesting from water logged fields. Rotting of produce. High perishability during storage due to excess humidity

High transportation costs due to low accessibility (e.g. flooded roads). High rainfall could lead to more production hence market glut; low prices due to high supply and few market options

Magnitude of impact

Moderate

Moderate

Moderate

Moderate

Farmers' current strategies to cope with the risks

Carry-over of planting materials

Early land preparation and planting. Spraying with fungicides

Timing harvesting to coincide with reduction of rains. Covering of product with grasses and polythene papers. Harvested tubers are left to dry before selling/storage

Selling through middlemen. Transportation by bodaboda or smaller vehicles when large roads are impassable

Other potential options to increase farmers' adaptive capacity







Capacity building on appropriate storage and management of seeds. Use of organic pesticides and disease control methods for seeds. Training on use of high quality, certified seeds

Use of conservation agriculture practices to manage infield water. Use of IPM to manage pests and diseases. Use of flood resistant/tolerant varieties

Mechanized harvesting, cleaning and sorting. Construction of improved flood proof storage facilities

Improvement of rural road networks. Improvement of market information using cell phones and social media

Sweet potato

	 Provision of seeds and other inputs	 On-farm production	 Harvesting, storage and processing	 Product marketing
 Moisture stress/ droughts	Reduced availability and quality of planting materials	Hard ground makes tillage difficult. Low size, quality and strength of tubers	High collection and transportation costs in relation to low value of produce	Low prices due to low quality of produce. Susceptibility to middlemen who pay low prices. High transport costs compared to product value
Magnitude of impact	Severe	Moderate	Moderate	Moderate
Farmers' current strategies to cope with the risks	Obtain planting materials from previous crops/vines	Communal land preparation. Spreading of animal manure during the dry period to be absorbed when rains fall. Intercropping sweet potato with maize. Bucket irrigation	Low quality produce is consumed at the household level. Delayed harvesting	Sales to middle men. Sales from individuals to individual
Other potential options to increase farmers' adaptive capacity	Establish bulking/seed plots of improved varieties	Provision of subsidized tractor services by the county government. Strive to do early land preparation when the soils are still wet. Compost production to enhance soil fertility, reduce hardpans and improve water holding capacity. Establish small scale irrigation. Infield ridges for water conservation. Use of drought resistant varieties	Construction of cold storage facilities. Farmers to be trained on appropriate pre- and post-harvest handling and storage. Mechanized cleaning and sorting	Collective marketing through cooperatives
 Uncertainty of seasons (onset and duration)	Uncertainty in timely availability of planting materials	Wastage of inputs such as seed and fertiliser due to untimely application. Difficulty in planning farm activities	Low yields. Poor quality, low weight produce. Greater storage costs and more labour required for harvest	Difficulty in collective marketing due to differences in maturing date and low quality produce. Low prices due to low yield and quality
Magnitude of impact	Moderate	Moderate	Moderate	Minor
Farmers' current strategies to cope with the risks	Obtain planting materials from previous crops/vines	Land preparation and planting are done concurrently	Low quality produce is consumed at the household level. Delayed harvesting	Quick sales of produce once it has been harvested in an uncoordinated manner between farmers
Other potential options to increase farmers' adaptive capacity	Establish bulking/seed plots of improved varieties. Extension agents to visit farmers early before the rains start. Improved agro-meteorological information	Prepare land in advance of the season and long before planting	Proper sorting and grading of harvested crops	Collective marketing and synchronised harvesting to increase volumes and pursue larger more profitable markets

Chicken

(local)



Provision of seeds and other inputs



On-farm production



Harvesting storage and processing



Product marketing



Moisture stress/
droughts

Local feed shortages and price increases. Chick parasites and disease due to drought

Bird deaths. Low production (weight and eggs) due to malnutrition and heat stress. Increase in disease incidence

Reduced shelf life of eggs. Reduced quality and size of eggs and chickens

Supply not able to meet demand

Magnitude of impact

Moderate

Moderate

Major

Moderate

Farmers' current strategies to cope with the risks

Use of local crop residue and waste as feed

General livestock health promotion. Use of homemade enclosures to protect chickens from outside weather

Destocking

Selling poultry and poultry products locally; individual to individual sales using locally made cages

Other potential options to increase farmers' adaptive capacity

Training on improved homemade poultry feeds and supplementation

Improved hatcheries and chicken enclosures

Establishment of modern chicken and egg collection, storage and processing facilities

Collective marketing and contract chicken and egg farming; use of improved chicken cages. Establishment of market information systems



Intense rains

High chick disease prevalence. High mortality rate of chicks. Feed spoilage due to high moisture

High incidences of endo-parasites and chicken disease. Contamination of chicken enclosures

Higher perishability of chicken and chicken products. Storms can cause power cuts which affect cold storage facilities

Supply not able to meet demand. Impassable roads make marketing difficult

Magnitude of impact

Major

Severe

Moderate

Moderate

Farmers' current strategies to cope with the risks

Sun drying of feeds to avoid losses

Irregular deworming and vaccination. Use of multiple and synchronised hatching

Prompt sales of chickens and eggs (destocking)

Individual sales at local market or to vendors

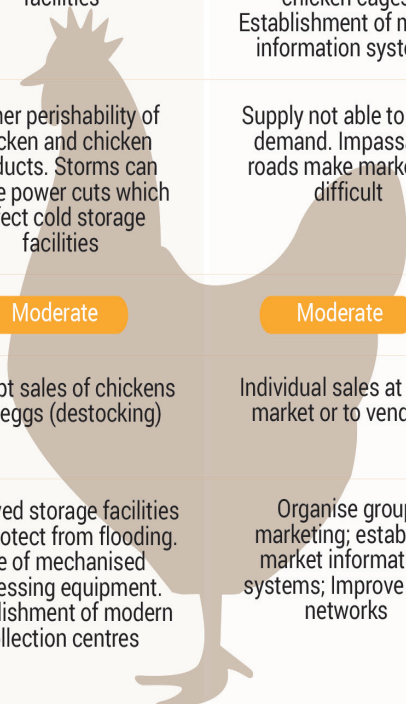
Other potential options to increase farmers' adaptive capacity

Use of modern feed storage facilities to protect from moisture

Regular deworming and vaccination combined with modern chicken cage rearing systems. Regular sanitation of chicken enclosures. Use of modern hatching and brooding systems that protect from water intrusion

Improved storage facilities that protect from flooding. Use of mechanised processing equipment. Establishment of modern collection centres

Organise group marketing; establish market information systems; improve road networks



Policies and Programmes

Several policies and programs aimed at broadly addressing topics related to climate vulnerabilities have been put in place through the collaboration of local and international, public and private actors along with the community at large. Some of the policies that are being implemented in Bomet County include the national statutes and strategies, International conventions and local policies, there are efforts to domesticate some of these policies; these efforts have not been completed yet. Some of these policies and programs include *inter alia*:

The Climate Change Act, 2016 has been enacted by the legislature; the act provides a framework for funding operation and mitigation of climate change issues both at the national and at county level. The Forest Act of 2005 contains several innovative solutions to rehabilitate degraded sites and support the planting of trees nationwide. There is a strong emphasis on partnerships, the engagement of local communities, and promotion of private investment. KFS Bomet cooperates with the farmers groups and communities to implement activities related to forestry³³ and ecosystem conservation³⁴, protection of Chepalungu forest. The Forest Act acknowledges forest community associations as important partners in forest management. Nonresident cultivation formerly known as the Shamba system is ongoing in the county through 13 CFAs³⁵ in Chepalungu forest³⁶. This helps to improve livelihoods while at the same time protecting the forest. The main challenge to implementation and adoption is the lack of community participation.

The Environmental Management and Coordination Act (EMCA) of 1999 was amended in 2015, including climate change considerations on the agenda. It guides ministries to consider climate change mitigation measures in their actions and budgets, requesting the establishment of environmental departments or designated officers in each County. Department of Environment and NEMA in Bomet County are the key implementers of this statute. County Environmental Action Plan (2013-2018) is implemented by NEMA in accordance with the provisions of the Environmental Management and Coordination Act (EMCA) of 1999 Section 40. The CEAP is an important tool in integrating environmental concerns in implementation of county project, programmes, millennium development goals (MDGs) and sustainable development in general.

ASDS (2010-2020) seeks to progressively reduce unemployment and poverty, and to spur agricultural growth. The vision of the ASDS is a food-secure and prosperous nation. Since the agricultural sector is still the backbone

of Kenya's economy and the main source of livelihood for most of the rural population, it is key to food security and poverty reduction. The overall development and growth of the sector is anchored in two strategic thrusts: increasing productivity, commercialization and competitiveness of agricultural commodities and enterprises and developing and managing key factors of production. The ASDSP Bomet aligns its operations and interventions to this strategy.

The Crops Act, 2013 seeks to accelerate the growth and development of agriculture, enhance productivity and incomes of farmers and the rural population, improve investment climate and efficiency of agribusiness and develop agricultural crops as export crops. Department of Agribusiness, Livestock, Fisheries, value addition, cooperatives and marketing carries out its interventions aiming to meet the expectations of this act. Lastly, Vision 2030 has identified agriculture as one of the key sectors to deliver the 10% annual economic growth rate envisaged under the economic pillar. To achieve this growth, transforming smallholder agriculture from subsistence to an innovative, commercially oriented and modern agricultural sector is critical.

The Agricultural Sector Development Support Program (ASDSP) is a program funded by the Governments of Kenya and Sweden whose objectives is to transform Kenya's agriculture into an innovative, commercial oriented, modern industry as part of a larger strategy to alleviate poverty and improve food security. In Bomet County, the ASDSP is involved in the facilitation and coordination of the participatory scenario planning with the key stakeholders such as the Kenya Meteorological Department, The Indigenous Knowledge systems, NEMA, Dept. of Agribusiness cooperatives and marketing, media-vernacular radio and TV such as KASS FM, KASS TV, Change FM. The ASDSP has been funding the Participatory Scenario Planning (PSP) with the help of KMD while the Department of Agribusiness cooperatives and marketing disseminates the advisories through barazas.

The ASDSP also works with key value chains actors, including farmers and county departments, towards developing and strengthening value-added practices in the Dairy, Local Chicken, Irish potatoes and maize. The value chain development had a thematic, technical working group. County steering committee and later validated in workshop. The program also focuses on environmental resilience and social inclusion, institutional and capacity development. Challenges that ASDSP faces include lack of infrastructure such as value addition infrastructure,

33 Issue grazing and monthly fuel license through the CFA, KFS charges sh.100 per cow p.m. and sh.100 per month respectively.

34 KFS Bomet issue permit for transportation in the event of tree cutting->4 tones one is charged 1000, <4 tons is equivalent to shs.1500, >10 tons is equivalent to sh.2000.

35 ASDSP reports that the county has 13 established CFAs and accrues benefits from forest products such as, timber, honey, fire wood, building materials, herbal medicine, pottery clay, grass and pine gum.

36 One acre they charge KES 1000, 0.5 acre they charge KES 500.

The Livelihoods and Resilience Project is spearheaded by the World Vision in partnership with the county government of Bomet. The focal area of operation is in Chepalungu Sub-County, the hot and dry agro-ecological zones in Chebonyo, Cheleget, Saboson, Kamaget, Lelaitich and Mogor locations. The main objective of this project is to promote resilient communities and its goals include, enhancing eco-empowerment through youth groups, women and men saving groups, training in entrepreneurial skills, vocational training, improving food production mainly nutrition among mothers and children where WV works with farmer groups and mitigate against climate change extremities through disaster reduction³⁷. World Vision promotes Climate-Smart Agriculture (CSA) practices such as drip irrigation, small

Kenya Agricultural Value Chain Enterprises (KAVES) works with smallholder farmers, businesses, national and county government partners to address constraints in the entire value chain to develop fully-functioning, competitive value chains. In Bomet, this program started in early 2014 and its duration is 5 years. KAVES in Bomet aims to increase the productivity and incomes of smallholder farmers, and other actors along the value chain, who are working in the dairy, maize and beans⁴⁰ and horticulture sectors by promoting good agricultural practices such as promoting mechanization, threshing, use of herbicides, use of hermetic bags to prevent post-harvest losses, promoting hydroponics or feed formulation, promote AI, by working with different stakeholders such as CGA based in Sotik that is engaging in maize value chain, EAMDA that is working in the 3 Value Chain. The activity develops smallholder enterprises that combine maize, high-value horticultural crops and dairy farming to generate wealth, thereby enhancing food security, improving nutrition and increasing economic opportunities for women, youth and other vulnerable populations. In Bomet, they work with vulnerable women groups such as Samaria Kisabita and other key stakeholders such as PAFID in conservation agriculture in Bomet East in Kapkimolwa and Chepalungu.

Small Holder Horticulture Marketing Programme (SHoMaP) Mogogosiek market/Konoin is a programme started by the County Government of the Bomet with the aim to increase incomes from horticultural production for the domestic market, to increase employment opportunities in the production, processing and marketing of horticultural produce; to reduce the cost to consumers and design and construction of fresh produce market infrastructure (market stalls, stores, toilets, and fencing). Other key programs in the county include East Africa Dairy Development programme (EADDP) under Heifer International and various projects initiated by the county government and implemented by the various departments in line ministries.

40 Classified as staples.

Policies and programmes are key considerations for agriculture decision making, since they affect actions and outcomes related to resource use. Tackling the impacts of climate change and ensuring that agriculture is aligned with climate-compatible practices is of the utmost urgency. Concerted efforts at the farm, community and national levels are necessary to deploy a variety of solutions, interventions and instruments to address the impacts of climate change on agriculture. Climate challenge to agriculture requires adaptation solutions that could extend beyond the scope of current agricultural techniques and farmers systems. Mainstreaming adaptation to agriculture is a dynamic process that goes beyond introducing new agricultural techniques that must also cover institutional reform, policy and regulatory mechanisms as well as harness market-based instruments.

Governance, institutional resources, and capacity

Institutions are key considerations for agriculture decision-making since they shape actions and outcomes related to resource use. In agriculture, the role of institutions can be related to the design of policies and investment frameworks, knowledge development and sharing, technological development or the delivery of financial and non-financial incentives for agricultural investments (FAO, 2010). Bomet County has several institutions actively involved in climate-related issues, ranging from county government institutions (Department of Agribusiness, Livestock, Fisheries, Value addition, Marketing, Cooperatives, Department of Water, Environment and Natural Resources) to national government institutions such as NEMA, KMS, KFS to non-government to the private sector (agro dealers, financial institutions) and community based organizations and cooperatives. Bomet County is also home to many Savings and Credit Cooperative Societies (SACCO) whose main focus is agriculture and microcredit. There is a department within the agribusiness that is managing the cooperatives in the county⁴¹. There are micro finance institutions such as Kenya Women Finance Trust (KWFT) that aims to empower women economical. Some of the key institutions are discussed below.

County governments are the main providers of agriculture and livestock extension services while the national government formulates policy, develops extension services delivery standards, and builds capacities of service providers. Other extension service providers include agro-veterinary pharmaceutical companies, animal feed manufacturers, milk processors, Non-Government Organisations, and

Community-Based Organizations. NEMA's key function is to coordinate the institutions that are dealing with the management of the riparian land through the county environment committee and coordination of various environmental projects. NEMA is key in rehabilitation of Chepalungu forest, where 50 acres has been fenced to protect it. Enrichment of 25,000 seedlings (insitu) where they plant indigenous species. They collaborate with CFA and the community in general and key stakeholders such as KFS. However, NEMA faces a lot of challenges such as inadequate finance, human capital; the awareness level among the communities is low as the communities are not receptive to new technologies.

The Kenya Forest Service (KFS) is a semi-autonomous government parastatal, implementing activities related to climate change, forestry, forest conservation, and ecosystem conservation. It works with NEMA, CFAs, county government and other key stakeholders to finance and monitor projects in ecosystem conservation. KFS engages in tree planting, such as the afforestation project in Chepalungu forest, conservation of the catchment areas⁴² by providing extension services and technical advice. KFS works closely with the CFAs in the county through non-resident cultivation formerly known as the Shamba system in Chepalungu forest that helps in livelihoods improvement⁴³ and at the same time forest conservation. KFS' tree planting initiatives face some community resistance, as the efforts are not self-driven and communities do not always see the direct benefits. Lack of adequate funds, climate related risks such as reduced rainfall curtailing their tree planting interventions and consequently challenging efforts to increase the forest cover in the county.

The Kenya Meteorological Department (KMD) generates daily, weekly, monthly and seasonal forecasts through data analysis and workshops held with key stakeholders, including indigenous weather forecasters and relevant departments. Through Participatory Scenario Planning (PSP) the experts develop a dissemination plan that may include components such as information sharing through the ASDSP environmental resilient officers, Emails, SMS, brochures, public barazas, radio station and TVs in vernacular stations such as KASS and Change FM. Many of the entities or institutions that collect environmental/ climate data work independently and in isolation, often failing to share data or to collaborate in a way that would support and enable the creation of better, more relevant information. The lack of adequate equipment such as rain gauges in the county, understaffing and insufficient funding challenges KMD's capacity to implement activities.

41 There is a multipurpose cooperative society in the 30 wards in the county that comprises farmer groups, small medium enterprises that are well organized. They are under the Bomet County Cooperative Union that is the umbrella of all the cooperatives in the county.

42 Mau Natural Forest Complex that lies administratively in Narok County.

43 This is through proving land for tilling, grazing animals and for fuel wood for cooking. They achieve this through issuing permits.

Kenya Red Cross Society (KRCS) is a humanitarian organization established under Cap 256 of the Laws of Kenya as the National Red Cross Society in Kenya. The Society is auxiliary to public authorities in the humanitarian field with an objective to prevent and alleviate human suffering throughout the territory of Kenya. In Bomet, it operates in the lowlands of the county, in Chepalungu. Through the BIDP it carries out its mandate through the five components of WASH, Water supply and irrigation, Nutrition and Agribusiness through food security and livelihoods expounded above. The challenge KRCS experience is inadequate funding to reach more beneficiaries. World Vision is a global Christian relief, development and advocacy organization dedicated to working with children, families and communities to overcome poverty and injustice. World Vision serves all people, regardless of religion, race, ethnicity, or gender. Its area of jurisdiction in Bomet County is in the lowlands of Chepalungu in the 6 locations in the livelihoods and resilience program mentioned above. As earlier indicated, the poor road network curtails their climate related interventions.

Agro-veterinary companies such as Kenya Seed Company, KFA, KEPHIS, engage in the distribution and sale of agro-chemicals and other farm inputs and often train farmers on the safe usage of pesticides, fertilizers and other input supplies. They include: Financial institutions such as AFC and banks (Equity Bank, Cooperative Bank, Kenya Commercial Bank, National Banks) provide loans to farmers to purchase the inputs needed for the production and storage of produce. The extent to which such formal financial institutions are accessible and used by farmers is yet to be clear. With cooperatives, farmers can pool production from their individual farms in order to meet market demand, reduce risk, access better financing, acquire and share farm machinery and other assets, value addition, negotiate better prices, and jointly market their produce. Cooperatives in the county vary in size and influence. The Department of Cooperatives in the county is actively involved in this devolved function. Every ward in the county has one or two multipurpose cooperative societies⁴⁴. The umbrella of the 30 multipurpose cooperative societies is the Bomet County Cooperative union that has a sweet potato plant. About 80% of the cooperatives are organized and structured to carry out their mandate. The challenge faced include, the governance of these cooperatives due to political interference and the climate related risks affecting the prices of the agricultural produce and thus affecting the operations of the cooperatives.

Factors affecting agricultural industry are low rate of technology adoption, underdeveloped supporting services and inadequacy of information among other factors. For value addition institutions, the challenge was mainly as a

result of environment and climate change that affected quantity and quality of produce thus inhibiting value addition services. Strong research and extension institutions are key in enhancing competitiveness in the agricultural industry and increasing agriculture and livestock productivity. The main constraints in research and extension service delivery within the agriculture and livestock sub-sector include low investment in agricultural research by public and private sectors, inadequate attention to post-production research, particularly value-addition and marketing, and inadequate facilities for dissemination of the research findings. The county government in liaison with all the relevant stakeholders needs to strengthen early warning systems to enhance drought preparedness and mitigation.

Synthesis and Outlook

Increased frequency and severity of climatic shocks such as drought, floods, heat stress and uncertainty in the start and duration of the growing seasons all have negative impacts on agriculture and food security. There is an urgent need to implement adaptation measures that can help farmers reduce their vulnerability and cope with the adverse consequences of climate change. This involves both short-term and long-term adaptation strategies.

In Bomet County, where dairy production is a major livelihood activity, farmers have not exploited Biogas technology fully due to both limited awareness as well as insufficient income from farming activities. Biogas utilization at household level will result in both economic and non-economic improvements. The anticipated economic benefits will include saving cost on fuel, reduction in the amount of wood extraction, increased revenue and employment creation. No carbon trading initiatives have been introduced so far. However, there are opportunities for carbon-related projects in Bomet County given the large vegetation cover in the Mau, Chepalungu forest and private forests. There is a need to integrate environmental conservation, for instance, in the case of vaccination, proper disposal of tins and plastics. With the low farmer to extension officer ratio in the county, the viable opportunity option is to improve link between extension officer& farmers for better technology development, transfer & adoption. This can be achieved through increased personnel and capacity building and training.

There is a need for an enabling policy framework in the county. Bills such as the Bomet animal welfare bill, Bomet County animal disease bill, Tea bill, Crops

44 Currently, there are 30 multipurpose cooperative societies in the county.

agriculture bill (2016), Irish potato policy draft, input subsidy policy draft, crop protection policy draft are still in the county assembly. There is need for prioritization and enactment of these bills and policies so they can be fully functional and meet the needs of agriculture and ultimately climate change. Increased cases of human wildlife conflict in the communities bordering the forest indicate the need for a tailored policy on how to intervene on these matters. There is also need to strengthen the capacity of KMD) so as to strengthen weather monitoring, early warning, and drought warning systems and extend it to crop yield forecasts by providing the necessary skills, funds and capacity building at the community level.

The government policy on subsistence crop improvements is not adequate hence the limited work being done in this area compared to commercial agriculture. Both human and financial capacities are inadequate to support new institutions at county level in the service delivery necessary for adaptation to climate change. There is need for policy reform to encourage individuals, groups and private companies to take advantage of good seasons by creating good and reliable business environment that may improve access to agricultural inputs and technologies. There is need to address factors hindering the wider adoption

of available technologies which could be beneficial to poor households to improve their returns on agricultural investment. There is, however, a commitment to improve research and development, strengthen the human and financial capacities of research institutions and strengthen collaboration between research, policy and public-private partnerships.

Attention should be placed on identifying and introducing a climate-compatible strategy or new policy or improve existing policy or program that is tailored to the agricultural sector under evaluation, but which is in line with a broader national policy and cross-sectoral climate change strategy. Improving the enabling environment through policy action and governance reform for climate adaptation also requires synergies that are horizontal (across ministries and government agencies) and vertical (between public and private sectors, especially between government and vulnerable stakeholders, including small-scale farmers, women and young groups). Required interventions may also require putting in place market-based mechanisms or policy driven economic incentives to encourage the uptake of adaptation best practices. Implementation may also require policy dialogue resulting in institutional reforms and new governance structures that are necessary to achieve climate adaptation and sustainability.

Works cited

FAO. 2010. Climate-Smart Agriculture: Policies, Practices and Financing Food Security, Adaptation and Mitigation. The Hague conference of agriculture, food security and climate change. Rome: Food and Agriculture Organization of the United Nations. Available at:

GoK. 2013a. Bomet County First County Integrated Development Plan 2013-2017. Republic of Kenya, Nairobi: Government of Kenya.

GoK. 2014a. Agricultural Sector Development Support Programme (ASDSP). Ministry of Agriculture Livestock and Fisheries. Kenya, Nairobi: Government of Kenya.

GoK. 2015. Economic Review of Agriculture (ERA). Kenya, Nairobi: Ministry of Agriculture, Livestock and Fisheries. Available at: http://www.kilimo.go.ke/wp-content/uploads/2015/10/Economic-Review-of-Agriculture_2015-6.pdf

CBS. 2008. The Kenya Integrated Household and Budget Survey report (KIHBS, 2005). Nairobi: Central Bureau of Statistics, Ministry of Planning and National Development

Ntale JF, Litondo KO & Mapopa Mphande O. 2014. Indicators of Value Added Agri-Businesses on Small Farms in Kenya: An Empirical Study of Kiambu and Murang'a Counties. DOI: 10.15640/jsbed.v2n3-4a6

GOK. 2014b. Kenya Demographic and Health Survey. The Kenya National Bureau of Statistics, Nairobi.

GoK; UNDP, 2013b. Kenya National Development report; Climate Change and Human Development, Harnessing emerging opportunities. Government of Kenya, United Nations Development Programme. Nairobi.

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