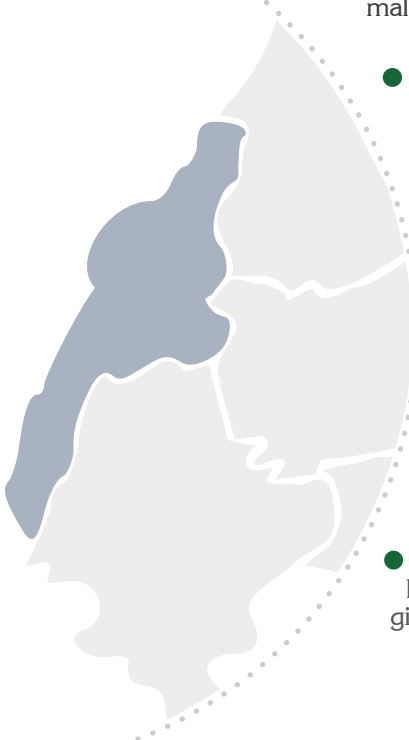


Climate Risk Profile Busia County

Highlights

- 
- Agriculture is the mainstay for the economy of Busia County. The sector employs about 78% of the labor force and contributes approximately 50% to household incomes. About 64% of the population in the County lives below the poverty line and approximately 54% are food insecure with high cases of child malnutrition.
 - Busia continues to suffer low agricultural productivity due to declining soil fertility and extreme climate events mostly drought and floods. Historical data shows that drought frequency has remarkably increased from every 10 years to every 2-5 years. The flood-prone areas like Budalangi are expected to have more floods. These extreme events are anticipated to impact negatively on crop production with maize being most affected and to some extent sorghum.
 - The most problematic hazards in the County were identified as moisture stress mostly in the drier areas, increased temperature and intense rain/soil erosion. The adaptation mechanisms that have been used to combat the negative impacts include water harvesting, cultivation of drought tolerant traditional crops, agroforestry and soil and water conservation for the crop farmers and local feed formulation, practicing free range, keeping vaccines in thermos flasks among others for the poultry value chain. However, these strategies have not been very effective. For example, 84% of respondents in Bunyala reported that strategies used in the region are not adequate.
 - Women are the most affected by the hazards since they have limited access to resources and have to spend more time looking for food and maintaining their families after disasters like floods given their responsibilities for household subsistence.

List of acronyms

ADS	Anglican Development Service
AEZ	Agro-Ecological Zone
APDK	Association for the Physically Disabled in Kenya
APHRC	African Population and Health Research Center
ASAL	Arid and Semi-Arid Areas
ASDSP	Agricultural Sector Development Support Programme
CBO	Community based Organisations
CIAT	International Center of Tropical Agriculture
CIG	Common Interest Groups
CMS	County Meteorological Services
EAAPP	East Africa Agricultural Productivity Project
EABL	East African Breweries Limited
GEF	Global Environmental Facility
GoK	Government of Kenya
HDI	Human Development Index
ICIPE	International Centre of Insect Physiology and Ecology
KACCAL	Kenya Adaptation to Climate Change in Arid and Semi-Arid Lands
KALRO	Kenya Agricultural and Livestock Research Organization
KAPP	Kenya Agricultural Productivity Programme
KMD	Kenya Meteorological Department
KNBS	Kenya National Bureau of Statistics
LM	Lower Midland
NCCRS	National Climate Change Response Strategy
NEMA	National Environmental Management Authority
NGO	Non-Government Organisation
PALWECO	Programme for Agriculture and Livelihoods in Western Communities
PSP	Participatory Scenario Planning
SCCF	Special Climate Change Fund
USAID	United States Agency for International Development
VCC	Value Chain Commodity
WB	World Bank



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 extremely susceptible to climate-related events, and projections indicate that the impacts are likely to affect the country even more in the future. In many areas, extreme events and variability of weather are now the norm: rain is irregular and unreliable; some regions experience frequent droughts during the long rainy season, others severe floods during the short rains. The arid and semi-arid areas are particularly hard hit by these climate hazards, thereby putting the lives of millions of households and their social and economic activities at risk.

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

To strengthen local capacities to reduce the near-, medium- and long-term vulnerability to current and future climate variability, the Kenyan Government, through the Ministry of Agriculture, Livestock and Fisheries (MALF) is implementing the Kenya Adaptation to Climate Change in Arid and Semi-Arid Lands (KACCAL) project. The project is funded with a grant from the Global Environmental Facility (GEF)/ Special Climate Change Fund (SCCF) through the World Bank (WB). The present study is part of the KACCAL project; it aims to inform the County government and stakeholders on the climate change risks and opportunities for agriculture so that they are able to integrate these perspectives into their development plans and processes.

This document presents the Climate Risk Profile for Busia County, where past climatic events have had tremendous impacts on the agricultural sector and the livelihoods of the people. Farmers in the County have observed that drought and flood events that were rare in the 1940s to the 1990s have become more frequent in the recent past. This is evident from flood occasions

that have been witnessed in for example Bunyala and Budalangi¹. The repercussions of these disasters have had same impacts on the people, starting from the recorded events of 2003 in Budalangi where 24,000 people (approximately 4,000 households) were displaced from their homes, property destroyed, livelihood activities disrupted and water contaminated (Paron et al., 2013, pp321), 2011 in Bunyala where animals drowned and an outbreak of waterborne diseases such as cholera (Opondo, 2013) to 2016 again in Bunyala where 639 households were displaced and big losses incurred due property destruction and livestock drowning. This resulted to a food shortage for the displaced necessitating the County government to supply food relief worth 1.6 million Kenyan shillings (KES). All these events together with droughts for example that of 2016 in Teso North where scarcity of water necessitated supply of relief water (Star, 2016) result to crop failures in the County leading to high food prices, unaffordable to most residents in the County due to high poverty levels. These recurrent vulnerabilities make planning for the climate disasters to increase resilience paramount.

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

1 Bunyala has experienced floods since 1937 in 1947, 1951, 1957/1958, 1961/1962, 1963, 1975, 1977/1978, 2002, 2003, 2006 and 2007 (USAID, 2014).

Agricultural context

Economic relevance of farming

Busia County covers about 1695 square Km² (KNBS, 2013). It is located in the western region of Kenya and borders Siaya to the South West, Bungoma County to the North, Kakamega County to the East, Lake Victoria to the South East and Republic of Uganda to the West. The County falls under the Lake Victoria Basin that supports over 25 million livelihoods (Swallow et al., 2009). The major physical features in the County include the Funyula and Samia hills as well as the Yala Swamp in the southern part and rivers Nzoia, Malaba, Sio and Malakisi (see Annex 1 for a description of the administrative division of the County).

The mean temperatures in the County is about 21-27⁰ Centigrade² (Jeatzold et al., 2010) whereas the annual rainfall is about 750-2000mm (GoK, 2014a), though it varies across the County with areas near Lake Victoria receiving the least rainfall of about 760-1015mm and Butula and Nambale sub-counties receiving the highest rainfall. The rainfall is bimodal; the long rains normally come between March and May (First season) and the short rains between August and October (Second season).

The County is categorized into four Agro-ecological zones (AEZs) (Jaetzold et al., 2010) (See map in Annex1):

- LM1, also known as the Lower Midland Sugar Cane Zone, is at an altitude of 1200-1440 meters above sea level and receives an annual rainfall of about 1800-2000mm (Nambale, Matayos and Butula sub-counties)
- LM2, also known as the Marginal Sugar Cane Zone, is at altitude of 1,200-1,350 meters above sea level and receives an annual rainfall of about 1,550-1,800mm (Budalangi, Funyula and Teso North sub-counties)
- LM3 also known as Lower Midland Cotton Zone, is at an altitude of 1,140-1,500 meters above sea level and receives an annual rainfall of about 1,015-1,420mm (Budalangi and Funyula sub-counties)
- LM4 also known as Marginal Cotton Zone, is at an altitude of 1,135-1,200 meters above sea

level and receives an annual rainfall of about 900-1,100mm (Budalangi sub-county)

The agricultural sector is the main source of income in the County. It employs about 78%³ of the workforce and contributes about 50% to the household incomes (GoK, 2013a). The major agricultural activities practiced in the County include crop production (mainly cassava, sorghum, maize, groundnuts, sugar cane and some horticultural crops such as local vegetables and mangoes), livestock keeping mainly free range poultry, sheep and goats as well as cattle and fish production with approximately 1500 fish ponds (Ibid). The major fish caught in the County are Tilapia, Cat fish and Nile perch. In 2012, the value of the major crops produced was estimated at KES 5,249 million with tomatoes and maize having the highest contribution of about 44% and 32% respectively (GoK, 2014a). In the same year the largest shares of all the livestock products valued at KES 5,135 million came from beef (84%) and poultry meat (9%).

About 81% (1,365 Km²) of the total land area is arable land. Farming in the County is for subsistence given that 84% of the crops output is used for household consumption (USAID, 2014). Land holdings range from 0.4 Hectares [Ha] for small scale to 6 Ha for large scale and only 31% of the farmers have title deeds (GoK, 2013a). The small number of farmers with title deeds may due to the fact that only one member mostly the male adult owns a title deed for an extended family even after land subdivision. In addition residents in close proximity to urban areas with government offices are likely to have title deeds (GoK, 2014a).

People and livelihoods

The population in Busia County was approximately 809,985 people in 2012, with slightly more women (52%) than men (48%) (GoK, 2013a). The population growth rate for the County is at 3.1%, and based on this projection, Busia County will be having 953,337 people in 2017(Ibid). The County has a higher population growth rate compared to the national rate of 2.9% due to the high fertility rate that is at 6% compared to the national rate of about 4.2% (GoK, 2013a; APHRC, 2014). The low acceptance and use of birth control measures that is currently at 41% is also a contributing factor to the high population growth rate. The population is largely rural considering that only 10% of the population resides in the urban areas (GoK, 2013a). The urbanization rate in Busia is also among the lowest (16.4%) in the country.

2 The lowest temperatures according to GoK (2013a) ranges between 14 and 22⁰ C (Celsius) whereas highest temperatures are between 29-30⁰ C.

3 This figure was calculated by dividing the total number of people employed in Agriculture by the total number of employed people (labor force) as given GoK (2013a).

Approximately 64% of the population lives below the poverty line, making Busia one of the counties with the highest poverty incidences in the country. Majority of these people are found in the rural compared to the urban areas (64% and 42% respectively). The Human Development Index (HDI) that measures the quality of life is relatively low in the County (0.42) compared to the national HDI of 0.52 (GoK, 2013b). The low HDI is as a result of low literacy level (people who can read and write) which stands at 75%, high income inequality (GoK, 2013c), that may be partly as a result of the high unemployment levels in the County which is at 70% (GoK, 2013a), poor access to electricity considering that only 6% and 0.2% use it for lighting and cooking respectively. Majority of the population (83% of the male- and 87% of the female-headed households) use firewood as the main source of energy for cooking (GoK, 2013c). Access to health facilities is also poor as 71% of the population has to walk for 5 or more Km to a health facility.

Food poverty in the County is at 54% (GoK, 2013a). Malnutrition of children below 5 years is very high where approximately 27%, 14% and 10% of the children are stunted, underweight and wasted respectively a factor that is attributed to high consumption of cereals and low consumption of animal and vegetable proteins (Nungo, 2012). According to the Agricultural Sector Development Support Program (ASDSP) Survey of 2013, 87% of the households that were interviewed did not have enough food in that year. The high food insecurity level in the County may be attributed to low agricultural production which persists as a result of declining soil fertility and unfavorable climatic conditions.

Agricultural activities

Out of the total arable land which forms 84% (136,500 ha), 13,624 ha are under cash crops which include sugarcane, tobacco and cotton whereas 58,871 ha are under food crops which are mainly maize, cassava, sorghum, sweet potatoes, African Leafy Vegetables, soya bean sesame among others. Gazetted forest area is barely 1% of the total land considering the fact that most of the trees are not on gazette land. In 2014, approximately 85% (50,400 ha) of the total arable land was under maize whereas sorghum and cassava occupied 22% (13,109 ha) and 33% (19,580 ha) of the arable land respectively (GoK, 2015)⁴.

Agriculture is mainly rain fed given that only 363 ha (barely 1% of arable land) are under irrigation (GoK, 2013c). Utilization of inputs such as fertilisers is relatively low (41%); inorganic fertilisers utilization being 22% and organic fertiliser use being 25%. In 2013 as was found by the ASDSP survey, use of basal fertiliser was highest among the male-headed households (approximately 26%) compared to the female- and youth headed households (8% and 4% respectively)⁵. The difference in fertiliser use among the different age and gender groups might be attributed to degree of resource access to the different groups, youth and women having the least access⁶. The generally low input utilization in the County is mainly due to high prices and long distances to buying centers (GoK, 2014a).

Agricultural value chain commodities

A broad diversity of agricultural products is grown in Busia County. Various value chains have been prioritized for development interventions by different government organizations and programmes such as the Agricultural Sector Development Support Programme (ASDSP), the Kenya Agricultural and Livestock Research Organization (KALRO), the University of Nairobi survey, and the Kenya Agricultural Productivity Programme (KAPP). For the development of this County Climate Risk Profile, four major value chain commodities (VCCs) were selected for in-depth analysis, based on their contribution to food security, productivity characteristics and importance to the economy. These VCCs, validated by local stakeholders, have been selected from a list compiled from the above-mentioned documents, using the following prioritization indicators: harvested area (hectares), production (90 kg bags where relevant), variation in production (in the past five years), value of production (KES\$/bag), dietary energy consumption (Kcal/ capita/ day), protein content (g of protein/ 100 g of product), iron content (mg of iron / 100 g of product), zinc content (mg of zinc / 100 g of product), and Vitamin A content (IU Vitamin A/ 100 g of product). The selected value chains were maize, sorghum, cassava and local poultry. However, leafy vegetables are a high income earner for many households in the county.

Maize

Maize is the main staple food for the population in Busia County. Busia's maize production in 2014 was

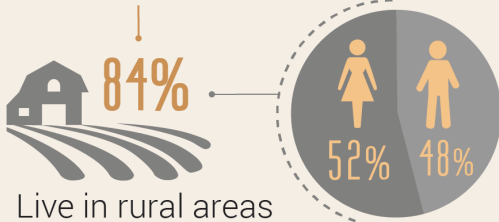
4 The land shares under the different crops may not add up to 100% since the crops are normally grown as intercrops (Woomer & Mulei, 2015).
5 Youth refers to male and female persons between the ages of 18-35 years whereas male and female refer to persons above the age of 36 years.
6 The figures are the means of basal fertiliser utilization in the first and second season as presented in the ASDSP.

Livelihoods and agriculture in Busia

Demographics

2.1% Of Kenya's population

809,988 inhabitants



Access to basic needs

62% of the population lives in **absolute poverty**

Potable water 96%

Electricity for cooking 0.2%

Electricity for lighting 6%

Education (youth literacy rate) 75%

Food security

54% of the population suffers from **food poverty**

ND of household income spent on food

ND People undernourished

34% Children stunted

3% Children wasted

ND: No data

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

Farming

County's farming area

135,500ha 81%

72% of the population employed in agriculture production

31% of farmers have title deeds ND% are women

Farming activities

Food crops



43%

Cash crops



10%

Livestock



Cattle (heads) 163,795

Poultry (heads, local) 869,695

Goat (heads) 85,773

Of county's agricultural land

Farming inputs

Water uses



Fertilizer types (% of households)

31% Organic manure

38% Planting fertiliser

29% Top dress fertiliser

Pesticide types (% of households)

3% Field pesticides

0% Storage Pesticides

2% Herbicide

Busia

806,352 (90-kg) bags, valued at KES 2 billion. The total production area under maize grew at an annual rate of 9% between 2012 and 2014 to 50,400 Ha (GoK, 2015). The crop is cultivated in small-scale farms averaging 2 acres, in Teso South, Teso North, Nambale, Samia, Bunyala and Butula. The crop is suitable for production in Busia, Butula, Samia and Teso South Sub counties, though more basal fertiliser (300Kg/Ha) is required in Busia Sub-County (GoK, 2014b). The crop is grown in both the long and short rains.

The maize value chain employs over 80% of the population, which is important not only for human but also livestock nutrition. Among the top four prioritized value chains in the County, maize has the highest dietary value and, as a staple food, is an important contributor to food security in the County. The value chain is dominated by small scale actors namely farmers with farm sizes averaging 2 acres, input suppliers, though a few medium scale suppliers are found in major towns, processors with the exception of Western Dulexe a large scale processor that started operation in 2016, and wholesalers. The wholesalers are small scale owing to lack of storage facilities that result to 15-30% of maize loss during storage.

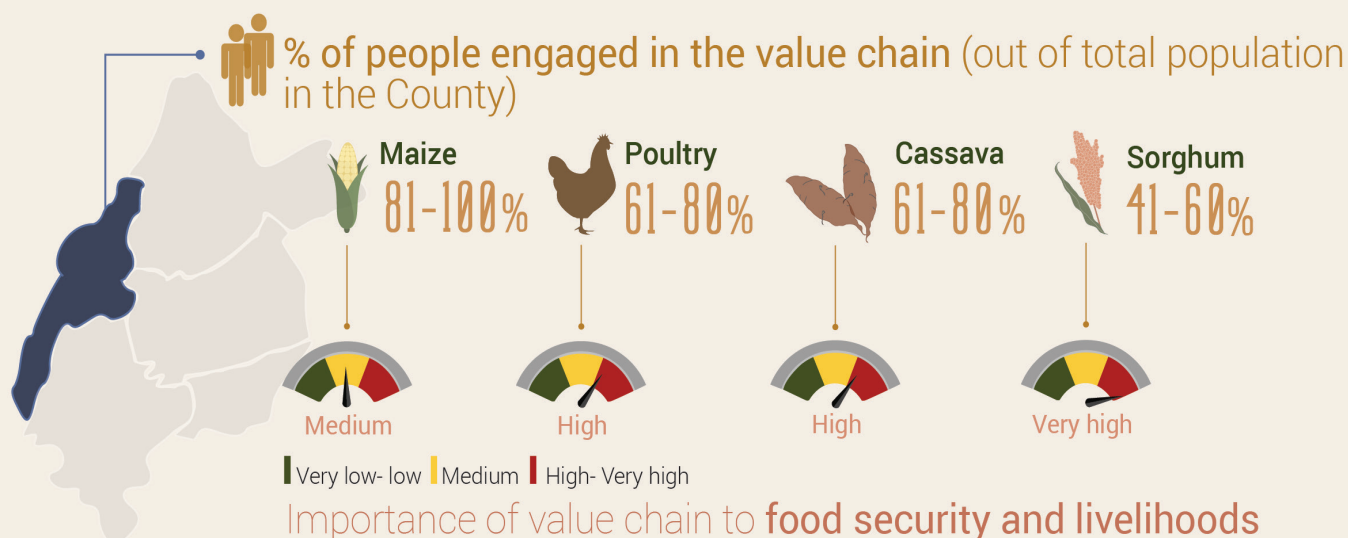
Farmers obtain seeds from on-farm grading and selection as well as from agro dealers in nearby markets; middle-scale seed dealers are found in the larger towns. Hired and household labour are used for planting, weeding and harvesting. The County provides a fee-based tractor service for land preparation.

However, logistical management challenges limit its scope (Standard Newspaper, 2014). The harvested crop is usually stored at the household level, in hermetic bags and granaries.

According to the ASDSP survey of 2013, productivity was highest among the male- headed households compared to both female- and youth headed households in both seasons (see Annex 3). The high productivity among the male- headed households is associated with high utilization of inputs such as fertilisers. Lack of fertilisers has been identified as one of the major challenges that farmers face in the County (Ali-Olubandwa et al., 2011). Other challenges for maize include unfavorable climate events such as drought, diseases for instance the lethal maize necrosis, weeds like striga and storage pests. The common storage pests include larger grain borer, Saw-toothed grain beetle and maize beetles, with the larger grain borer ranking as the most severe (Midega et al., 2016). In 2013, the maize yield gap as a result of drought and diseases was 61% (Agroinsurance, 2013).

Processing (grinding to flour) is done by small-scale millers located in village centres and towns in Teso North, Bunyala and Butula. Farmers in Teso North, Teso South and Nambale are organised into cooperatives that bulk up the product, making it easier to market the crop. Middle men and extension officers are the main agents for linking producers with markets. Maize is sold in market centres within Busia and in neighbouring Siaya and Bungoma counties.

Agricultural value chain commodities in Busia



Cassava

Busia is the largest producer of cassava in Kenya. In 2014, total production was 3,250,859 (90-kg) bags, valued at KES 6.5 billion, over an area of 19,580 ha (GoK, 2015). Cassava is an important value chain in the County given that it is a source of income from sale of tubers as well as planting material and an important food crop contributing to household food security. The crop is considered a woman's crop though both male and female farmers participate in production of cassava. In areas such as Chakol North and Amukura Central wards in Teso South Sub County where the East Africa Agricultural Productivity Project (EAAPP) was involved, the cassava value chain was reported to be dominated by adult women and female youth.

Approximately 61-80% of the population is involved in the cassava value chain. Producers, input suppliers, processors and wholesalers operate at small scale. Farm sizes range from 0.5 acres to about 5 acres. Production is mainly produced in AEZs LM2 and LM3 and the common variety is Magane which is a local cultivar (Njoroge et al., 2016). Main production areas are Teso South, Teso North, Bunyala and Samia. Cassava is culturally considered a woman's crop; production and processing activities are predominantly undertaken by women.

The area under cassava production in Busia was higher in 2013. Despite the large areas, 2014 had better production relative to 2013 and 2012 (GoK, 2015). This may be as a result of adoption of improved varieties as well as success in disease control. According to the ASDSP survey of 2013, productivity was highest among the male-headed households (524Kg/Acre) compared to the female- and youth headed households (320 kg/Acre and 169 kg/Acre respectively) (see Annex 2). The tendency of men to have control over household resources that enables them to purchase and use more agricultural inputs explains the high productivity among the male headed households.

While cassava makes up the major part of the diet for Busia residents, they consume only the tuber (as opposed to leaves as well, as in neighbouring communities). For this reason, cassava ranks as a mid-level contributor to food security in the County.

Cuttings for propagation of the crop come from neighbouring farmers (for which they earn income) but also from Community based Organisations (CBOs)

and the Kenya Agricultural and Livestock Research Organisation (KALRO). Production activities on the farm are labour-intensive and highly time-sensitive (to obtain fine soil tilth and combat weeds), necessitating use of household and hired labour.

Processing of the crop (washing, peeling, drying, fermenting and chipping) is done at the household level while grinding is at small-scale millers. Construction of the Agribusiness Development Centre, a factory to process cassava, is underway in Teso South sub-County. Producers and traders employ proper storage in order to maintain the quality of the product and also to await favourable prices.

Marketing is not organized as it is done individually. Men are more likely to sell processed cassava and are more likely to sell the produce in farther markets since they can use motorbikes and bicycles to transport the cassava. On the other hand, women mainly sell to nearer markets where they can walk or at farm gate. Notwithstanding, market participation (the quantities sold) is high among the female and youth headed households selling 75% and 59% of their produce respectively (GoK, 2014a). This may be as a result of the youth and female headed households having limited alternative income sources compared to the male headed households hence depending on income from cassava. Linking producer groups to the market is facilitated by farmer cooperatives, Farm Concern and the Programme for Agriculture and Livelihoods in Western Communities (PALWECO). Cassava products are sold in major markets such as Budalangi, Funyula, Amukara and Malaba, either by individual operators or increasingly through farmer cooperative. The latter provides members with a platform to negotiate for better prices and obtain larger markets.

Sorghum

Busia is one of the top five producers of sorghum in Kenya. It is produced in small-holder farms measuring 1 – 2 acres throughout the County. Production was 193,756 (90-kg) bags in 2014, a 105% increase compared to 2012. The area under production also increased by 71%, to 13,109 ha, between 2012 and 2014 (GoK, 2015). This dramatic increase was driven by demand generated by the East African Breweries Limited (EABL), in a program launched in 2012 to procure all of its sorghum requirements within the country. Sorghum is an important value chain in Busia in terms of food security since it is produced mainly for consumption purposes. It can be consumed alone

(flour used either for porridge or ugali) or mixed with either maize or cassava or both. The crop is also an important source of income with more stable prices compared to maize and cassava as was reported. Productivity is relatively higher since the crop can ratoon and is tolerant to drought and floods relative maize. Sorghum is particularly well suited in Busia: its seeds are readily available, it is drought-tolerant, performs well when inter-cropped with maize and cassava, and it has a stable price, which is advantageous to both producers and consumers.

The sorghum value chain employs about 41-60% of the population in the County. The local varieties are the most preferred since they are better adapted to harsh climatic conditions such as drought and floods and are readily available. Both input suppliers and processors are small scale with processing being limited to milling in posho mills and meal is stored at homes in buckets or sacks for consumption. In cases where there is a market surplus, the local market forms the major selling outlet. . Most farmers obtain seeds locally, from previous harvests. Seeds may also be purchased from small-scale input suppliers in Busia, Nambale, Kakamega and Samia Subcounty. KALRO is an important source of improved (disease-resistant and drought-tolerant) varieties of sorghum seeds.

The area under sorghum in Busia increased in 2013 as well as 2014, though 2014 registered low production (GoK, 2015). In 2013, productivity was highest among the youth headed households (291 kg/acre) relative to the male and female headed households with productivities of 203 kg/acre and 200 kg/acre respectively (GoK, 2014a). This may be as a result of quick adoption of new crops by the youth given the promotion activities for the value chain.

Farmers apply fertiliser and manure to enhance crop management and improve soil structure, both of which help to improve yields. The Busia Agricultural Training Centre (ATC) is the most important distributor of fertilisers and manure, since the County government channels all subsidised fertiliser through the facility. Farmers also use manure from their own or neighbouring farms, and alternatively source fertiliser from agro dealers located in towns throughout the County.

Timeliness in land preparation, planting and weeding is essential for maximising rains and breaking the life cycles of weeds, pests and diseases. Labour for these activities is provided by the farmers' households

and hired workers. Farmers also make use of County tractors for which they pay a fee.

Small-scale posho mills located in town centres throughout the County convert harvested grain to flour, usually for home consumption. For millers, such processing increases the prices they can obtain for the product. Proper storage helps farmer households to preserve the whole or processed crop for future use while traders employ the technique to allow them to await higher selling prices in off-peak seasons.

When the crop is ready, it is transported by farmers on foot, bicycles or via motorbikes to markets (such as Busia, Butula, Bumula, Funyala and Lugulu). Prices are determined through negotiations between farmers and consumers or with brokers. Linking between farmers and buyers and eventual selling is conducted by farmers themselves, brokers or contractors, as in the EABL programme.

Poultry (local)

At least every household in Busia County owns a chicken, mainly in small scale operations of between 15 and 20 birds; the low space requirement for production is a major driver of this value chain in the County. Local poultry are an important source of income and source of proteins for households. In 2014, local poultry generated KES 316 million from sale of 791,184 chickens (GoK, 2015). The land area used for production remained unchanged at 182,400 Ha between 2012 and 2014. Although local poultry provides the highest vitamin content among the four value chains prioritized in the County, it makes up only a small part of nutrition in the home; local poultry is kept mostly for income and is consumed at the household level only rarely, during special occasions.

The local poultry value chain employs about 61-80% of the people. Production is mostly among the small scale farmers who own 5-20 birds. Common value addition activities for the value chain involve differentiation of parts and de-feathering for chicken, and boiling and fertilizing for eggs. Processors and wholesalers also operate at small scale.

Input suppliers are generally mid-sized and operate in trading centres throughout the County. Commercial farmers, distributed throughout the County, are more likely to have proper housing units and use feeds.

Farmer groups and hired handymen provide assistance in construction of housing units. Breeding stock is obtained from other farmers, breeders and extension staff, while feeds are supplied by fellow farmers and agro dealers. Cooperatives and processors operate hatcheries to supply chicks to the local area.c

Egg production was highest among male headed households from improved local chicken (23 eggs/4 laying cycles) and highest in female headed households for indigenous chicken (14 eggs/hen/3 laying cycles) (GoK, 2014a). The high productivity among the male headed households for improved local chicken may be attributed to better access to inputs such as feeds and vaccinations. Low production among the youth headed households may be due to the fact that these households keep chicken for meat purposes given that they registered the highest number of local improved chicken slaughtered in 2013 (GoK, 2014a). Nevertheless, male headed households had the highest number of indigenous chicken slaughtered in the same year (Ibid).

Local poultry is susceptible to diseases, although less so than hybrid or exotic breeds. As such, the main activities in rearing the stock are feeding, cleaning and vaccination. Farmers rely on household labour and expertise for all these activities but may reach out to extension service providers and veterinaries for the latter.

The market is characterised mainly by small-scale operators. Farmer groups and cooperatives handle promotion as well as pricing of the product when large quantities are involved. Otherwise, farmers and consumers agree on sale prices during market days. Farmers and motorbike operators deliver live chicken to collection points while farmer groups and traders deliver to market centres in Hakati, Busia, Bunyala and Burumba. Slaughtering for commercial purposes is mostly done by hoteliers in the County.

Agricultural sector challenges

Some of the drier parts of the County, such as Butula, Bunyala and Samia are also the most susceptible to soil erosion. Soils are generally thin (the bedrock is close to the surface) and have low levels of fertility. At the same time, clearing of land for agriculture in these near-ASAL zones and spiking demand for firewood have depleted vegetative cover. To remedy the situation, the County may consider scaling up of current training programmes on the use of manure and other organic matter, as well as agroforestry.

Households, women in particular, are spending a greater proportion of income and time in search of firewood. This is having a negative impact on resources expended to on-farm activities as well as household nutrition - budget choices between food and firewood. Charcoal burning for income is also prevalent in Teso North and South. Development and diffusion of fuel technologies and cooking techniques may help to ease the burden on women.

Busia County has actively promoted production of drought resistant crops such as sorghum and finger millet but has encountered challenges in achieving widespread uptake in the vulnerable areas – Butula, Bunyala and Samia. Producers point to the limited market opportunities for their produce, owing to long-held dietary habits (high preference of maize and cassava) in the local market. Demand-side intervention to promote consumption of crops suited to local production conditions would help to address the situation.

Extraction of underground water is widespread, raising concerns about cost (of sinking boreholes) and sustainable use of such sources. There is vast opportunity for application of water harvesting technologies such as water pans in Samia and Bunyala, and damming of flood waters on the Budalangi plains.

Climate change and agriculture risks and vulnerabilities

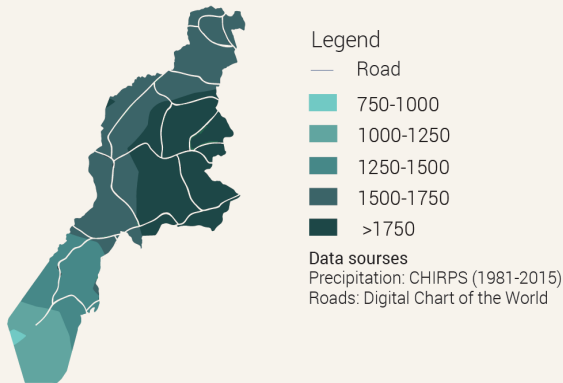
Climate change and variability: historic and future trends

Busia County is fairly hot (21-23°C) and moist (760 to over 1,750 mm precipitation annually) throughout. There is a strong precipitation gradient with the northern areas receiving the most precipitation > 1750 mm, and the southern areas closer to Lake Victoria receiving 760-1,250 mm of precipitation. The temperature is fairly consistently warm through the year. Precipitation also consistent throughout the year, although the first half of the year (January-June) receives a slightly greater amount of precipitation than in the second half of the year (July-December). Intense precipitation and heat stress are both hazards that contribute to agricultural risk in the county throughout the year, whereas dry spells are more an issue in the second wet season.

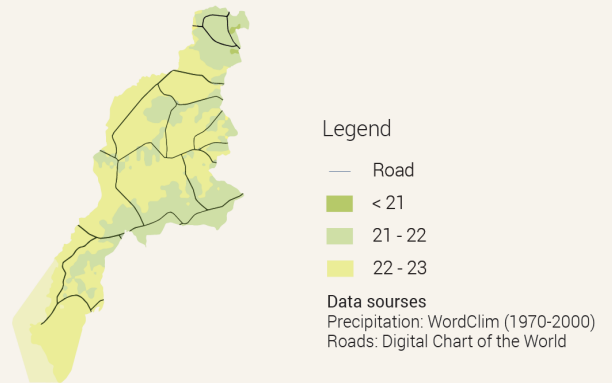
Historic analysis of weather in Busia county shows that both dry spells and extreme precipitation are hazards

Past and future impacts of climate hazards in Busia

Historical annual mean precipitation (mm/year)

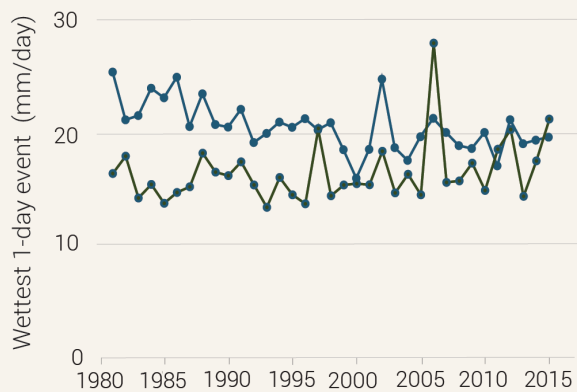


Historical annual mean temperature (°C)



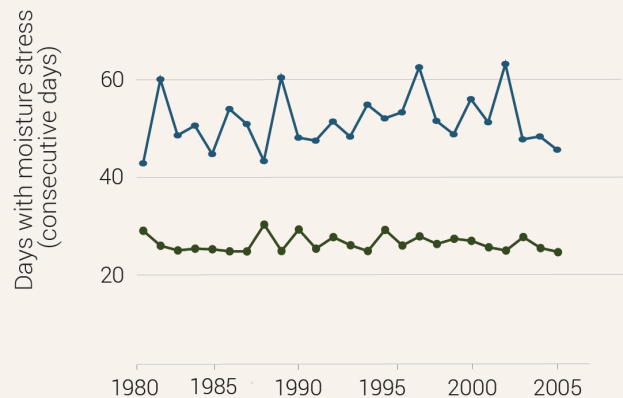
Flood hazards

Historical extreme flood events

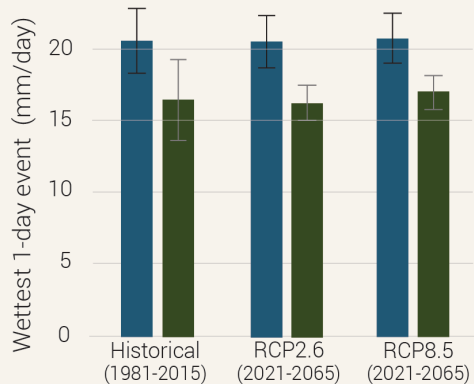


Drought hazards

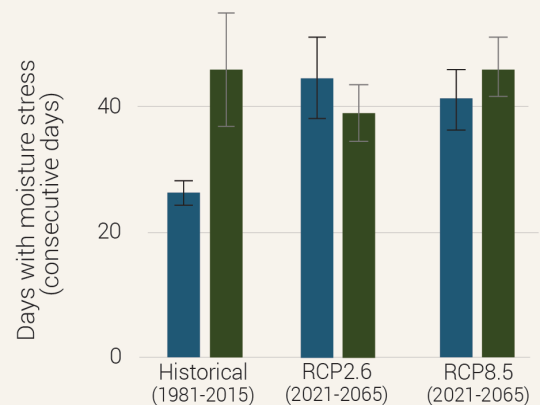
Historical drought stress events



Historical and expected extreme flood events



Historical and expected drought stress events



■ January - June ■ July - December

in the County. Dry spells are on average longer during the second wet season varying between 35 and 65 consecutive days of moisture stress, whereas moisture stress is consistently less than 30 days during the first wet season. Extreme precipitation and flood risks⁷ are moderate to low in both seasons, with most years receiving between 10 and 25 mm of precipitation on the wettest day⁸.

Climate has already been observed to change slightly in the county. Since 1981, the first wet season—the predominant rains of the year—have experienced a moderate (1.0°C) increase in mean temperature and reduction in crop cycle. There was a tendency toward a slight increase in precipitation during this season. The second wet season experienced a slight increase in temperature (~0.5°C), and a significant increase in precipitation of approximately 25%. This has resulted in an increased precipitation hazard contributing to flooding and erosion.

Looking to the future in the years of 2021-2065 (by the early 2040's), temperature is projected to increase by 0.2°C, with the first wet season projected to experience even greater changes. And by this time, precipitation is projected to increase by 0.5 % in the first wet season, and 4 % in the second wet season. Prolonged moisture stress is projected to occur in the first season of the year, whereas intense precipitation looks to change little in either season. Consecutive days of moisture stress is projected to almost double in the first wet season from approximately 25 days to around 40-45. In contrast, moisture stress in the second wet season is projected to decrease from over 60 consecutive days of moisture stress to 45-50 days. These projections of future climate change under the two climate scenarios—RCP 2.6 and RCP 8.5⁹—show some small differences, but generally show the same future projections, suggesting climate change impacts will be fairly similar during this time frame no matter the greenhouse gas emissions that occur.

Climate from the farmers' perspective

Farmers report higher temperatures and low rainfall throughout the County but especially in the low-lying Samia, Bunyala and Bunyula. Also, the dry spell has expanded from November - December to November - February. This has in turn affected the start of the planting season from January/February to March. The

traditional rainy season (March-April-May) has also shortened; in 2016, rains began in April and ceased in late May.

There is already a projection of crop failure, especially of maize, whose prices are expected to increase significantly in the second half of the year. Since maize is a major staple food in the region, many households in the afore-mentioned sub-counties will be hit hard from needing to purchase a large part of their food requirements at increased prices.

For the local poultry value chain, extended dry spells result in slower growth of grass around the homestead. Households that keep free-range chicken and that have limited resources to procure commercial feeds regularly contend with insufficient food for chicken, and therefore longer maturity rates and lower prices at the market.

Farmers have also observed an increase in frequency and intensity of rainstorms, whereby a lot of rain all within a short period, often causing flash floods. At the same time, occurrence of hailstones (which damage crops) and lightning strikes (which adversely affects human activity in various value chains) has gone up.

Climate vulnerabilities across agriculture value chain commodities (VCCs)

The most important climate hazards for the prioritised value chains in Busia County are: increased rainfall, increased soil erosion risk, floods, increased heat stress, increased temperature and increased moisture stress.

Cassava

The climate conditions expected to have major impact on the cassava value chain are: increased rainfall and increased risk of soil erosion.

Increased rainfall is expected to cause minor cases of flooding, water logging and erosion. There would be moderate effects on timeliness of carrying out cutting and planting, as well as on effectiveness of tractors, hand-drawn-oxen and physical labour. Farmers with limited financial resources for employing hired labour or tractors and those situated in areas without proper/well-drained roads would be especially affected.

7 Refers to the wettest 1-day event (mm/day) indicator in the infographic.
8 Note that this is 20 mm on average over the entire county, so specific parts of the county will have experienced greater than this (possibly much greater), whereas other parts will have experienced less.
9 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.

Flooding resulting from increased rainfall would cause major delays in on-farm activities such as land preparation, resulting in major cost increases. The scale of losses due to rotting and delayed planting would be severe, while the cost of weed control would be moderate. Groups at risk include male and female farmers with limited resources to hire labour. Activities would be delayed since the required manpower would exceed supply; women would be overworked during such periods.

Rotting of tubers at the post-harvest stage would result in severe losses. With poor roads affected by increased rains, there would be moderate delays in storage, bulking and transportation activities. Farmers and traders served by poor roads or who lack proper storage facilities and expertise would be the most affected.

Promotion activities would be moderately affected while effects on linkages between farmers and markets would be minor. Prices would go up only slightly. Vulnerable groups at this stage would be farmers who market their produce independently, without support from a farmers' cooperative.

On the other hand, increase in soil erosion risk would have a major impact on soil fertility, necessitating a moderate increase in labour to construction of conservation structures. This would mostly affect farmers with limited resources for hiring the extra needed labour.

Increase in soil erosion risk has a severe effect on on-farm activities; the top soil and planting materials would be washed away, while weeding would be delayed. Women and youth would bear the burden of the additional labour needed for construction of soil conservation structures.

Roads and bridges would be damaged, delaying marketing activities. Conversely, processing and storage would be affected only slightly. Value chain actors that would be affected are traders and farmers operating in areas with poor transport infrastructure, as well as farmers without resources and expertise for setting up proper storage structures.

Increase in soil erosion risk has a moderate effect on promotion events but only minor effects on linkage of farmers to markets and pricing. Farmers, traders and consumers are most affected due to the primary role of road transport in promotion of cassava.

Maize

The main climate hazards in the maize value chain in Busia are increase in temperature and floods. Increased temperature would have a major effect on land (reduces soil moisture and adversely affects micro-organisms) and labour (reduces efficiency). There would also be a moderate effect on planted seeds - viability is adversely affected - and on poorly stored seeds - prone to damage. Farmers located in Bunyala and Samia, which are the drier parts of the County, as well as women and children, who are relied upon for labour, are most at risk.

There would be a major impact on germination, as a result of the hardening of the ground. This would also affect weeding activities moderately, as farmers would need to be careful to avoid damaging the root system of the crop. To a minor extent, increased temperatures would cause dehydration, leading to low output. Male and female farmers would be affected, though the magnitude will be highest among widowed women and children.

Increased temperatures would cause severe losses from increased weevil infestation and fungal infection (aflatoxin) of maize that is not well dried. However, there would be minor effects on labour productivity in the transport and processing functions. Farmers who are most vulnerable at this stage include those with limited resources for purchase of preservatives. Women farmers are also at risk since they have low levels of mechanisation (transport of produce to market) on their farms. Small processors may feel greater pressure to their business by having reduced labour output.

There would be minor impact on marketing activities. However, women without the financial means to pay for sheltered meeting locations would forego the opportunity to participate in pricing and policy discussions.

Floods would have a severe impact on land, labour and planting materials. Land would be water-logged, eliminating any need for productive labour for planting and weeding during that period. Additionally, any planted seeds would fail to germinate. Risky areas are low-lying areas in Budalangi and Sio, and along rivers as well as wetlands in Nambala, Teso North and Teso South. Vulnerable farmers are those with limited means for employing mechanised farming techniques.

Floods would have severe effects on stored maize, with high incidence of rotting. There would be a major increase the cost of transportation and a minor impact on ability of human labour to reach processing work stations. Groups at risk are: farmers and dealers/processors with limited financial resources for hiring labour, and actors located in flood-prone areas such as Bunyala, Samia, Nambale, Teso North and Teso South.

There would be moderate impact on marketing activities such as promotion, transportation and linkage of farmers to markets. Actors at risk are those highly-reliant on transportation for their businesses, especially those located in Bunyala and Samia sub-counties. With halting of economic activities, women, orphans and youth are highly vulnerable during this period.

Poultry (local, meat)

The main climate conditions for local poultry in Busia are increase in heat stress and increase in rainfall. Increase in heat stress would have a major impact on development of chicken as there would be an increase in pests. At the same time there would be a major impact on productivity of human labour. Heat stress would also have a moderate effect on productivity/weight gain of chicken. Vulnerable farmers are those with low level of skills about managing their stock in such times, as well as those with limited financial resources to put up proper housing for their birds and purchase balanced feeds to support bird development during this period. In addition, farmers located far from stockists are at risk. Elderly women and nursing mothers are likely to bear the brunt of such conditions. Sensitive areas include: Samia, Bunyala.

Increased heat stress would have a major effect on the cost of feed and vaccines, and a moderate effect on availability of water for husbandry purposes. Farmers at risk are those who do not produce at least part of their own feeds, have small plots of land, are located far from stockists (transport costs are high), are without a stable source of water, as well as the elderly and youth (limited physical or financial resources to obtain feeds and vaccines). Additionally, rural areas not served by proper roads and electricity are more vulnerable.

There would be a major impact on collection activities since more space would be required to hold the birds during times of heat stress. Transportation costs per bird and storage services (refrigeration) would increase moderately. Farmers and traders without electricity and cool storage facilities, as well as transporters without proper cages are at risk of getting high losses.

Increased heat stress would cause a major increase in prices of chicken and major decline in demand for breeding stock. There would be a moderate decline in feed production. Most at risk of being affected are consumers with limited food budgets, small-scale traders and farmers lacking information about current market conditions.

Increased rainfall would cause a major increase in incidence of diseases and consequently a major increase in expenditure on treatment. There would be a moderate decline in demand for inputs as road conditions become unfavourable and fares increase. Farmers and input suppliers served by poor roads are at risk of losses, as are farmers with limited resources for construction of proper housing and purchase of proper feeds and vaccines.

There would be a major impact on quality of feed; increased rainfall would increase the risk of development of aflatoxin, which is harmful to bird health. At the same time, there would be a moderate increase in incidence of diseases and demand for on-farm activities such as cleaning. Farmers most vulnerable are those with low-level skills for carrying out proper bird husbandry, those with limited resources for putting up proper housing structures and those located off poor roads.

Increased rainfall would have a severe impact on transportation and slaughtering. Poor roads limit access, increase costs and increase risk of loss of value to the farmer or trader (weight loss or death). At the marketing stage, there would be a major increase in the price of chicken due to low quantities produced. For promotion and selling activities, which require meeting with buyers, the impact is moderate. Farmers unable to travel due to limited financial resources or illness are most at risk of these adverse effects. Also, farmers unwilling to promote and deliver their produce during rainy season would likely lose on the market.

Sorghum

The top two climate hazards for the sorghum value chain in Busia County are: increase in moisture stress and increase in erosion risk.

Increase in moisture stress would have a major adverse effect on availability of soil nutrients to plants and soil structure - organic soil cover may become depleted and soil may develop cracks. In this case farmers would delay application of fertiliser until conditions are wetter. There would be a moderate effect on expenditure on seeds - incidence of poor germination would necessitate replanting. Vulnerable actors are small-scale agrovets, as well as farmers

with no access to water sources for irrigation, limited access to credit facilities and limited access to training facilities/extension services, and those with low literacy levels. Women are also particularly at risk because of low land ownership.

This climate condition would have a severe toll on on-farm activities such as planting and weeding, which would be delayed and carried out at higher cost. Dry planting, a recommended practice, may become more common. There would be a major increase in cost of ploughing land. With labour requirements increasing for all farmers, those with limited resources for hiring additional labour would be most affected. Women would provide the additional labour needed.

Increase in heat stress would have a minor effect on the post-harvest stage. Drying and storage techniques would need adjusting to prevent the grain from drying beyond the recommended moisture content. Otherwise, this state would be conducive for grading and cleaning activities, providing respite for workers, mainly women. Transport costs would increase slightly owing to a drop in efficiency of potters and increased incidence of punctures and repairs. Since men are often the potters and own the means of transport, they are the most affected.

Marketing activities would be moderately affected. The moisture content of sorghum would be lower than usual, affecting its market value. Activities of sellers, buyers and facilitators would also reduce due to dehydration effects. This would cause price increases of sorghum even in local markets. Most affected are traders and market sellers, who are usually women.

Increase in soil erosion risk would have a major effect on input supply; there would be loss of nutrients and support material for crops, leaving seeds exposed to pests. The water-holding capacity of the land would also be affected. Vulnerable actors are: farmers with inadequate know-how of utilising land despite erosion or lacking financial resources to improve the land. In addition, agrovets would experience a decline in demand for seeds.

There would be a major effect on on-farm production such as ploughing and planting. With rockier soil exposed, farmers would face higher labour costs and low seed germination rates. Weeding activities would be moderately affected; labour costs would increase to keep weeds (better-adapted to poor soils) from out-performing the sorghum crop. The groups most affected are: small-scale farmers, especially those without financial means to till the hard soils. Small-scale agrovets would also be at risk in a depressed market for seeds.

At the post-harvest stage, there would be moderate effects on transportation; damage to roads would interfere with movement and require higher fuel consumption. On the other hand, there would be minor effects on storage; erosion of the bases of structures would increase risk of collapse. Transporters, many of whom are men, and farmers unable to absorb increased costs of transport and maintenance of storage structures would be most affected.

Increase in soil erosion risk would have moderate effects on marketing activities. Transportation by road would be adversely affected, as would market structures. Market vendors, usually women, and other traders would be most affected.

Households' capacity to respond to climate hazards is generally low. Among households surveyed, 21.3%, 20.4%, 19.3%, and 18.2% have high adaptive capacity to floods, droughts, poor rainfall distribution and landslides respectively (GoK, 2014). Female-headed households are especially vulnerable to droughts and poor rainfall distribution - only 3.7% and 8.6% respectively have high adaptive capacity. None of youth- and female-headed households have high adaptive capacity to landslides.

Adaptation to climate change and variability

On-farm adaptation practices

In general, vulnerable groups are small-scale operators across the value chains. Among farmers, those at risk have limited financial resources to make improvements on the farm, lack expertise in managing their farms under changed situations, and operate in areas not served by all-weather roads, electricity connections and stable water supply. Women and youth are relied upon to provide additional labour during unfavourable climate conditions, while men will absorb the added cost of transport when roads are damaged. Samia, Bunyala and southern parts of Butula are historically low-rainfall areas with thin soils; the situation is expected to be increasingly challenging for agriculture in the run-up to 2060.

To prevent delays and added costs associated with increased rainfall, cassava farmers procure inputs and carry out on-farm activities early in the season. Use of fast-maturing varieties and early harvesting are common to reduce the risk of rotting of tubers. 22.2% of households are reported to practise water harvesting (GoK, 2014). Potentially, the County could scale up drainage of waterlogged fields and collect the

water in water pans. Also, farmer training on cultivation and care of cassava in conditions of increased rainfall could be offered.

During periods of increased rainfall, when prevalence of diseases is high, poultry farmers use local herbs to clean water, and wood shavings for bedding. They also undertake vaccination of the birds themselves, to save on costs of hiring a veterinary. New options include using disinfectants to clean equipment and implementing County-sponsored vaccination drives (conducted by veterinaries) when outbreaks are forecasted.

Given the increased risk of soil erosion, cassava farmers have adopted such budget-sensitive on-farm practices as use of contour ploughing methods, mulching and planting of cover crops. Overall, 37.2% of households reported using soil and water conservation adaptation strategies. The proportion of youth-headed households employing these methods was highest, at 51.6% (GoK 2014). In addition, they are managing the heightened competition for hiring County-owned tractors by procuring the services during the dry season. Among the proposed options are: construction of gabions, reducing the tractor hire fee and increasing the number of tractors available for hire.

During periods of increased temperatures, maize farmers work on their farms in the early morning and late evening, and have shortened working hours. They also use organic manure, which is not only a source of nutrition but also useful in retaining soil moisture. This minimises labour requirements for additional on-farm activities, as well as reduces damage to crops from working otherwise hard soil. As a potential option, households could be encouraged and trained on improving working terms and conditions and labour productivity. Also, considering that just 6.7% of households practised irrigation (GoK, 2014), irrigation infrastructure could be set up at the County level; damming of River Malaba, Malakisi and Sio could provide for watering needs in Teso, Butula, Bunyala, Samia and Nambale.

To reduce post-harvest losses during periods of increased temperatures, maize farmers have adopted proper drying methods (to recommended moisture content) and use of hermetic bags. Out of households surveyed, 21.8% and 10% were found to practise value-addition and have access to food storage facilities respectively (GoK, 2014). Proposed strategies are: improving ventilation in storage structures and promoting use of hand-held shellers at the household level.

During conditions of increased heat stress, farmers use cheaper insulation materials (such as grass thatch) to construct poultry housing. In addition, feed conservation or diversification was found to be used as an adaptation strategy by 13.8% of households (GoK, 2014). New options include: promotion and training on formulation of high-value feeds from sunflower seeds, soya, beans and millet, as well as termites and stovers.

Off-farm adaptation practices

The County has improved major tarmac and murrum roads in many parts of the County, improving farmers' access to suppliers, service providers and markets. Prompt repairs of roads and foot bridges is helping to shield farmers, traders and transporters from potential losses due to delays and increased in transportation costs. Farmers and cooperatives also use four-wheel drive vehicles during increased rainfall and motorbikes when there are increases in temperature to prevent delays in marketing activities. Prospective solutions include: installation of processing facilities at the household (individually-owned) and cooperative level, as well as silos at the sub-County or County level in order to encourage proper post-harvest activities.

Farmers in Busia are well-organised - cooperatives exist for every major value chain. In addition to increasing farmers' access to training - extension officers prioritise organised groups, these groups help members to obtain credit (such as the County-administered Agriculture Development Fund), and cost-effective marketing services. Farmer groups promote their products through local radio stations such as Bulala FM and Murembe FM, and link with markets via mobile phone, emails and social media (Twitter and WhatsApp). New options for securing markets include strengthening marketing capabilities of the groups (through training and educational tours) and establishing contract farming.

During periods of increased heat stress, transporters and traders ferry poultry using reed baskets having good ventilation. At the marketing stage, small-scale processors prepare deep-fried and roasted chicken to reduce spoilage. To help maintain trading activities, the County operates a number of structured markets that provide shade and storage space for market vendors. Potentially, transporters could use multi-storeyed cages to ferry a larger number of birds, or use cool storage/ice cubes for transportation of slaughtered chicken.

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

Maize



Provision of seeds and other inputs



On-Farm production



Harvesting storage and processing



Product marketing



Floods

Increased seed spoilage (premature germination/rotting); decreased labour availability and requirement

Deteriorated soil condition (water logging); reduced seed germination/poor stand establishment; decreased agronomic activities (weeding/spraying)

Low quality and quantity of harvested grain; increased post harvest losses (rots/germination/aflatoxins); damaged storage structures; high transport costs; high energy costs (seed drying); limited access to labour

Limited access to markets; low sale prices by farmers; low market/marketing linkages/opportunities; increased transport costs to markets; high market costs by brokers/traders

Magnitude of impact

Severe

Severe-Major

Severe-Minor

Moderate

Farmers' current strategies to cope with the risks

Use of traditional maize varieties; use of low quality organic manure; non-use of mineral fertilisers

Land left bare; reseedling; staggered planting; early planting; agroforestry; farm drainage structures (furrows); planting in raised furrows/beds; use of mechanized labour (land preparation); intercropping

Hired/household labour; early harvesting; construction of drainage structures (within storage areas); construction of raised granaries (unshelled maize); delayed harvesting; use of hermetic bags; shift to higher grounds

Local produce selling (farm gate/along maize corridor); delayed marketing activities (until flood recede); produce marketing through public media (radio) and to local institutions

Other potential options to increase farmers' adaptive capacity

Access for fast maturing varieties; promote adoption of Early Warning Systems

Drainage structures (canals/pans/dams); enterprise diversification (to fishing/horticulture); promote intercropping; agroforestry; County support for hire machinery (land preparation/planting)

County support to access moisture free storage structures; use of metallic silos; promote use of hermetic bags; access to protective clothing; county support for hire of machinery (harvesting/shelling/packaging)

Construct raised stores; County support for roads repair (market access); promote rehabilitation programmes for cereal markets; value addition of grain produce (corn oil/wines/poultry feed); crop insurance schemes



Increased Temperatures

Decreased viability of planting seed; decreased demand for seed/fertiliser inputs (low household income); lack of water

Decreased viability of planting seed; decreased demand for seed/fertiliser inputs (low household income); lack of water

Low quantity and quality of harvested grain; increased pests damage at harvest/storage; reduced labour efficiency at harvesting/shelling/winnowing/packaging

Limited chances for farmer linkages; decreased producer prices (low quality); increased transport costs (to markets); grain scarcity in market; increased sale prices (brokers/traders)

Magnitude of impact

Major-Moderate

Major-Minor

Severe-Minor

Minor

Farmers' current strategies to cope with the risks

Use of certified seed/inputs from certified stockists/agrovets; seed recycling (previous harvests); early input acquisition; use of animal power (draught animals) for land preparation

Seed priming for early germination; conservation agriculture; organic farming; mulching; agroforestry; cover crop; intercropping; conduct agronomic activities early morning/late evening; timely weeding

Harvesting in the morning; engage manual/family labour at harvesting, packaging and storage; use of local transport means (bikes); pesticide application (fungal/pest control); use of hermetic bags (cereal storage); seed storage in moisture free spaces

Formation of farmer groups (facilitate marketing); contractual farming (with processors); County support to link farmers to external markets (millers); marketing through middlemen/brokers word of mouth; farmer sale to external markets

Other potential options to increase farmers' adaptive capacity

Train farmers in Composting; use of short-shelf life seeds (less seed treatments); regular inspection visits by extension officer (input dealers/farms); use of certified seed from reliable and recognized input suppliers; drip irrigation

Promote agroforestry; improved conditions for labour engagements (shortened working hours); promote conservation agriculture; organic farming

Promote use of improved storage (hermetic bags); construct ventilated stores; use of moisture free bags (gunny compared to synthetic bags); promote large scale milling by producers; farmer access to hand held maize shellers

Organized and targeted marketing (e-platforms and media); produce sale in well packaged containers; County support in to construct market shades; regulated maize pricing to curb farmer exploitation

Poultry

	 Provision of inputs	 On-Farm production	 Harvesting, storage and processing	 Product marketing
 Increased rainfall	Increased input demand/cost (drugs, moisture-free poultry structures); limited input access (damaged infrastructure); increased transport costs	Decreased brooding/breeding activities; increased flock mortality; increased poultry feed spoilage; increased labour requirements; increased pests and diseases incidence; increased demand for extension services	Delayed egg collection; delayed transport of poultry products to collection centres/slaughter facilities; low quantities of eggs; increased incidence for egg spoilage (moisture/dirt)	Limited access to markets; low sale prices by farmers; low market/marketing linkages/opportunities; increased transport costs to markets; high market costs by brokers/traders
Magnitude of impact	Major-Moderate	Major-Moderate	Severe-Moderate	Major-Moderate
Farmers' current strategies to cope with the risks	Local poultry houses (iron roofed/brick walls); use of breeding stock/ breeding chicks; use of hay brooder boxes/clay pots (for flock brooding)	Use locally available feeds supplements (crop after harvest remains, kitchen waste); use of local resources to clean poultry water (wood shavings, husks); vaccinating flock	Use of wire cages and baskets to transport chicken; use of local transport means (bikes); household slaughter	Chicken sale in open air markets/hotels; use of local marketing channels (promote bird sales); individual poultry pricing; groups pricing (farmers within cooperatives); hoarding (market speculation)
Other potential options to increase farmers' adaptive capacity	Train farmers on housing construction from local resources (timber/stone); introduce brooder boxes/pots; promote insulated poultry structures; training (bird breeding); local input stockists; repair of rural access roads	Repair of rural access roads; access to certified feed stockists; promote poultry hygienic supplements; disinfect feeding/water equipment; access to early warning advisories (timely vaccination); construct raised houses	Formation of farmer cooperatives (affordability to better transport means e.g. lorries); establish local slaughterhouses (facilitate bird delivery); better access to cage facilities for marketing	Repair of damaged roads; marketing through e-platforms and print media; farmer groups (collective farmer bargaining); County support to explore better market outlets (supermarkets/tourist hotels/schools)
 Increased heat stress	Low vigour of breeding poultry; increased prices for inputs (drugs/feeds); reduced ability for input access; reduced natural feed sources (insects/green biomass); increased water requirements; low vaccines efficacy (storage challenges)	Reduced brooding/breeding activity; increased pests and diseases incidence (mites) in poultry houses; malnutrition and weight loss; increased vaccination; high space requirements; increased flock mortality	Low egg/meat viability (increased egg spoilage); low egg quantity and quality; increased storage costs (refrigeration); decreased flock numbers; high transport costs (scarcity); loss of job opportunities; high energy requirements	increased chicken prices (scarcity); low demand for breeding stock; reduced market activity/linkages
Magnitude of impact	Major-Moderate	Major-Moderate	Major-Moderate	Major-Moderate
Farmers' current strategies to cope with the risks	Keeping poultry in wooden/sheet roof structures; vaccines storage in thermos flasks; grass thatched chicken houses	Cleaning and disinfection of poultry houses/equipment; free range; local feed formulation (supplements commercial feeds/kitchen waste); reduce flock movements; water harvesting (tanks); use of compound and thermostable vaccines	Use of egg trays; proper tray practices (egg positioning); storage and transport vessels made from local resources (reeds) for ventilation; improved storage (refrigeration/ice cubes); weighing using hands (determine chicken weight)	Marketing using local marketing channels (word of mouth) and farmer cooperatives; value addition at markets (roasting/deep frying); selling of live bird; value addition to poultry meat (cooking/frying); increase sale value
Other potential options to increase farmers' adaptive capacity	Insulation of iron sheeted structures (regulate temperature)	Planting poultry feeds (sunflower/soybean/millet s); promote insect feed supplements (termites/maggots) and their production technologies; synchronized hatching (facilitate batch farm operations)	Specialized transportation facilities (ventilated cages); building spacious/ventilated storage structures (air circulation); improved bulk storage to reduce transport costs; use of weighing scale; standardized meat processing (per weight/kg)	Promote marketing (electronic/print media); contracted marketing; differentiated chicken parts sales (instead of whole)

Cassava

	 Provision of seeds and other inputs	 On-farm production	 Harvesting, storage and processing	 Product marketing
 Increased rainfall	Delay in access to cuttings; labour scarcity; high labour costs	Delayed land preparation/planting; crop damage (hailstones/rotting); decreased labour efficiency; increased incidence of flooding/water logging/erosion; increased weed incidence	Low quality and quantity of harvested tubers; increased post harvest losses; damaged storage structures	Delayed marketing; tuber scarcity; increased market prices; missed marketing opportunities; damaged infrastructure
Magnitude of impact	Moderate-Minor	Major-Moderate	Major-Moderate	Major-Moderate
Farmers' current strategies to cope with the risks	Release of water from dams; construction of on-farm water harvesting structures (pans/furrows)	Timely land preparation, ploughing and planting; removal and disposal of diseased field materials; timely weeding; use of herbicides; mulching; intercropping; crop rotations (cereals); seed selection before planting	Use of improved transport to storage facilities (trucks/bikes); use of solar dryers; timely tuber harvesting/storage/processing (before rain onset); access to credit facilities (purchase dryers); use of hermetic bags; staggered harvesting	Marketing (using local media); trade negotiations (using mobile phones); value addition of marketed products (flours); cassava flour enrichment (groundnut flour)
Other potential options to increase farmers' adaptive capacity	Capacity building on water harvesting structures; use of irrigation; credit access to underground storage tanks; access to improved cassava varieties (early maturing/disease resistant); promote community tuber bulking	Crop insurance; enterprise diversification (groundnuts); capacity building GAP (pest/disease control); introduce policies to regulate mechanization land preparation; access to Early Warning Systems; intercropping; mulching	Maintenance of roads; access to improved storage facilities (community owned); formation of cooperatives (facilitate transport affordability); County support to provide silos; promote use of hermetic bags (tuber storage)	Formation of farmer groups (facilitate marketing); contractual farming; County support to link farmers to external markets; farmer and extension exposure (through tours); County assisted marketing of tuber produce; promote value addition
 Increased erosion risk	Challenges in land succession (identification/adjudication); topsoil loss; weakening/loss of planting material; high labour demands	Loss/destruction of planted material; lowtuber establishment; delayed agronomic practices; soil erosion	Delayed harvesting; increased chances for damage of storage structures; decreased processing; increased incidence of post harvest losses	Limited market access; low prices; low market/marketing linkages
Magnitude of impact	Major-Moderate	Severe	Major-Minor	Moderate-Minor
Farmers' current strategies to cope with the risks	Construct soil and water conservation structures (terraces)	Construction of water conservation structures; plough/planting along contours; mulching; cover crops; agroforestry; mulching; intercropping; timely planting; ridge planting; use of chemicals	Facilitated road movement (repair roads, drains, footbridges); timely processing, harvesting and storage	Timely marketing (using local media, e-platforms); establish local marketing linkages (through brokers)
Other potential options to increase farmers' adaptive capacity	Promote gabions construction; tree planting activities; agroforestry; increased research on improved varieties	Promote mechanized farming (tractors in land preparation); County support to improve access to inputs and agricultural machinery (from extension services); capacity building on good husbandry practices and IPM	Promote road repairs and maintenance; County support to access to tuber processing equipment (solar dryers); County support to establish storage facilities (warehouse)	County support to seek external marketing; establish county controlled pricing policies; promote print/electronic marketing (phones, newspaper); external education tours (farmer exposure)

Sorghum



Provision of seeds and other inputs



On-Farm production



Harvesting storage and processing



Product marketing



Increased moisture stress

Labour scarcity; high labour costs; limited access to certified seed/inputs (low demand)

Soil degradation (reduced soil cover, organic matter and microbial activity); poor germination; seed loss (pests/diseases damage); reduced fertiliser efficiency; delayed agronomic activities (planting, weeding); increased labour costs

Low quality and quantity of harvested grain; increased postharvest losses (pest/rodent damage); high transport costs; labour scarcity (harvest/threshing/packaging); reduced labour efficiency

Reduced seed density (mass per unit volume) increases producer losses; reduced market spoilage; reduced market/marketing activities; increased demand for shelter/shade in markets

Magnitude of impact

Major-Moderate

Severe-Major

Minor

Moderate

Farmers' current strategies to cope with the risks

Participation in awareness creation campaigns (certified inputs/fertilisers); local seed acquisition (farmers exchange); acquire seed from research institutions (KALRO); use of low quality manure; access to poor quality agrochemicals

Use of mechanical and animal draught (ploughs); hand weed control; early land preparation; intercropping; tree planting; crop rotations; staggered cropping; use of manual/household labour

Household/hired help (winnowing/sorting/threshing); storage (gunny bags, home silos and granaries); farm gate sales (avoid postharvest sales)

Produce hoarding (market speculation); market value addition (flour); local marketing (brokers/word of mouth/local forums); sales to local markets/institutions; build temporary shades (in markets)

Other potential options to increase farmers' adaptive capacity

Promote soil and water conservation on farms/fields; improve land management (agroforestry); use of early mature and drought-resistant varieties; access to Early Warning Systems; County support for input access (seeds/inputs)

Regulate use of rotary tillers; promote efficient weed control practices; access to weather advisories (EWS); access to efficient mechanized equipment (tractors); promote widespread FYM use

Access to mechanized threshers (minimize harvest losses); introduce and train producers on specialized equipment (grain sorting, winnowing and grading); use of moisture free oxygen bags; construct county-wide storage facilities (NCPB)

Regulated cereal pricing; contracting cereal production; County support for external markets; access to crop insurance schemes (prevent production/market insurance); construct modern markets (improved infrastructure)



Increased soil erosion

Loss of planted seeds; reduced fertiliser efficiency/efficacy

Soil/land degradation (loss of soil cover, soil nutrients, water holding capacity); seed loss (damage by pest/insects); low stand counts; increased weed prevalence; crop nutrient competition with weeds; loss of crop vigour

Limited transportation; high transport costs; increased damage to storage structures; increased postharvest losses (rotting/pre-germination); increased seed losses at winnowing; increased cost of structural maintenance

Poor quality and low quantity of marketed produce; limited access to market (damaged roads); damage to market structures; reduced market linkages/marketing opportunities

Magnitude of impact

Major

Major-Moderate

Moderate-Minor

Moderate-Minor

Farmers' current strategies to cope with the risks

Staggered planting; terracing; agroforestry; depth planting (prevent seed loss); covering manure/fertiliser (after application); timely planting; enterprise diversification (tree seedling/bee keeping); intercropping with legumes; conservation agriculture

Gender (women) biased labour use (winnowing, sorting and grading); use of local transport means (bikes); use of local materials for storage structures (wood, nylon, bricks); use of gunny bags; drying produce using local sheds/dryers

Local grain sales (farm gate/along maize corridors); grain marketing through public media (radio) and local market channels (word of mouth); sell to external markets (through external middlemen/brokers)

Other potential options to increase farmers' adaptive capacity

Promote agroforestry and afforestation; efficient extension services (visits/information); explore strategies for curbing seed loss (after planting); training on manure composting; apiculture in hilly areas; promote weather advisories

Establish community based grain processors; County support at community organized grain collection and transport systems; introduce postharvest grain inspection program; capacity building (postharvest storage, value addition and packaging)

Inspection of grain weighing equipment (scales); introduce mechanical sorting/packaging equipment (improve produce market quality); County support to form organized farmer groups at village levels (collective marketing)

Policies and Programmes

Several government and non-governmental organizations involved in climate change adaptation at the national level have a presence in Busia. In many cases, the government is still in the process of decentralizing national operations to the County level. Despite having representation on the ground, effectiveness of the key institutions in Busia is limited by lack of integration and collaboration between non-governmental and governmental organisations. Often organisations work in the same areas and duplicate programs. To harmonise the work of all stakeholders operating in the agriculture sector, the Department of Agriculture and Animal Resources is developing a Sector Coordination Concept

Agricultural Sector Development Support Programme (ASDSP) is a national government program that facilitates development of agricultural value chains. In Busia, the program is supporting development of fish, groundnut and improved poultry. ASDSP convenes and coordinates stakeholder forums, provides training and facilitates linkages between value chain actors. Forums operate on a cost-share basis, majorly funded by ASDSP initially but progressively borne by other stakeholders. However, top-up amounts from stakeholders have not grown in a corresponding manner, forcing cuts in number of activities members served. Activities that have been most affected are: development of value chain concepts, organising Participatory Scenario Planning (PSP) forums and dissemination of climatic information from the same. There have been concerns about the County's capacity to coordinate stakeholder forums convened by programmes with the possible change in ministry leadership change in 2017. Partners may consider developing continuity plans (financial and policy) for on-going programs.

The Programme for Agriculture and Livelihoods in Western Communities (PALWECO) is a national government programme aimed at improving productivity and incomes from agriculture. PALWECO is implemented through the Ministry of Devolution and Planning and as such is represented in all seven sub-counties in Busia. Using pre-existing local administration structures, the program benefits from long institutional memory and proximity to intended beneficiaries. The program has been especially strong in the cassava value chain, where it has provided marketing training to farmers and supported linkages to markets.

Governance, institutional resources, and capacity

Busia Local Poultry Cooperative Society is a member-owned organisation operating in all seven sub-counties in Busia. It is funded by members' contributions as well as

thorough in-kind support from KAPP (farmer training and placement of chick incubators in all sub-counties). The organisation uses member contributions on administrative activities and does not currently have resources for developmental programs such as to expand farmer training on production of high-quality feeds and to provide free or subsidised veterinary services during vaccination drives. The Agricultural Development Fund, which provides credit to individuals, could increase its support to value chains by opening eligibility to groups and companies that support farmers. Further, cooperatives in general may benefit from strategic meetings with funding organisations (facilitated by programs like KAPP) as well as training on proposal writing and program development.

The National Environmental Management Authority (NEMA) is called upon to provide guidance on regulation during interactions with stakeholders such as the Department of Water, Environment and Natural Resources. NEMA has just two permanent technical staff but works with consultants to provide Environmental Impact Assessments (EIAs) at inception of programs and projects. However, its capacity to monitor and respond to complaints raised by the public extremely limited. Additionally, NEMA does not provide online access for such reports; the process of requesting for documents is bureaucratic and delays operations of other departments that rely on their work. As the primary national stakeholder in environmental issues, NEMA may consider drawing public support for larger budget allocation from national government. During development of programs funded by multi-lateral or other governments, NEMA may also choose to negotiate for allocation to Information Technology and support to staff.

Anglican Development Services (ADS) is a national non-governmental organisation working mainly in environmental conservation. ADS provides support for formation of Common Interest Groups (CIGs), training on business management (such as on tree nursery management) and linking farmers with County departments and other non-profits. The organisation works closely with the Department of Water, Environment and Natural Resources, the Department of Health and Sanitation as well as with the Department of Agriculture and Animal Resources during development of its strategic plan as well as through engagement of County extension or health officers during implementation of its programs. Along with a diversified funding structure, this model allows it to have wide reach and continuity in its programs despite having seven staff members in Busia (about one per sub-County). As the organisation matures, funding will likely shift from smaller but more experimental sources to more traditional establishments, such as government agencies and international NGOs. This may have implication of nature of future programmes and engagement with local government.

County Meteorological Services (CMS) has provided weekly weather updates to stakeholders and end users via SMS, email and local FM radio channels. The Water Resource Management Authority (WRMA) a national government organisation looked upon to provide policy direction and lead in sustainable water resources use. WRMA has a primary role in enforcement of rules through Water Resource Users Associations (WRUAs). Although there are serious water use challenges (for example, overuse of boreholes for farm purposes), the organisation is not an active participant in stakeholder forums. Limited technical resources in the Busia office

Synthesis and Outlook

Among the climate hazards deemed important in Busia County, one affects at least two of the major value chains: increased soil erosion risk (cassava and sorghum). While effects of increased rainfall in cassava are similar to those of floods in the maize value chain – similar vulnerabilities emerge. Other projected conditions are: floods, increased heat stress, increased temperature and increased moisture stress.

While irrigation as an adaptation strategy was often mentioned during the study, implementation remains low and mostly at the household level. Admittedly, rains in the County in the last year have been low and poorly distributed, which has been limiting opportunities for water harvesting

for farm use. However, rains in neighbouring water towers such as Cherangani hills and Mount Elgon have been higher than usual and kept water levels high in Malakisi, Malaba, Sio and Nzoia rivers. County-wide irrigation infrastructure, crossing Teso to Samia areas, would have high technical and financial requirements, for which collaboration would be needed between County and national governments.

Although traditional foods such as brown ugali (made from maize, cassava, sorghum and finger millet) are extremely popular in town centres in Busia, household demand is suppressed by the perceived complexity and long preparation time required. To unlock the local market, the County may consider developing low-cost processing and distribution arrangements, and scaling up current nutrition training for young households. Primary and secondary schools also offer opportunity to promote local foods, for example by serving traditional foods in meals and demonstrating preparation during regular lessons or special events.

In an unforeseen development, upgrading of the road network has dramatically improved movement, there has been an increase in livestock theft. Motorised traffic has increased in previously closed-off areas while drive-time to markets has decreased. To protect meat value chains, including local-poultry, the County government may consider using existing stakeholder forums to address such emerging and potential challenges.

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

Annex 1: Busia County map showing agro-ecological zones (AEZs) and administration units

Annex 2: Selection of Value Chain Commodities in Busia

Annex 3: Crop productivity by gender

Works cited

APHRC. 2014. Family planning matters. Briefing paper. African Population and Health Research Center, Nairobi.

Agroinsurance. 2013. Africa-Farmers advised to grow traditional but adaptive crops to climate change. <http://agroinsurance.com/en/25586/>

Ali-Obubandwa, A. M., Kathuri, N. J., Odero-Wanga, D., & Shivoga, W. A. 2011. Challenges facing small scale maize farmers in western province of Kenya in the agricultural reform era. *American Journal of Experimental Agriculture*, 1(4), 466.

Governement of Kenya, 2013a. Busia County Integrated Development Plan.

Government of Kenya; United Nations Development Programme. 2013b. Kenya National Development Report; Climate Change and Human Development.

Government of Kenya. 2013c. The Project on the Development of the national Water Master plan 20130. Final report Volume 5-Sectoral Report (2/3).

Government of Kenya; Ministry of Agriculture Livestock and Fisheries. 2014. Agricultural Sector Development Support Programme.

Government of Kenya. 2015. Economic Review of Agriculture. Government of Kenya (GoK), Nairobi.

Government of Kenya. 2014b. Soil suitability evaluation for maize production in Kenya. Ministry of Agriculture, Livestock and Fisheries State Department of Agriculture.

Jaetzold, R., Schmidt H., Hornetz B., Shisanya C., 2011. Farm Management Handbook of Kenya, Vol. II – Natural Conditions and Farm Management Information – 2nd edition.

Kebeneey, S. J., Msanya, B. M., Semoka, J. M., Ngetich, W. K., & Kipkoech, A. K. 2015. Socioeconomic Factors and Soil Fertility Management Practices Affecting Sorghum Production in Western Kenya: A Case Study of Busia County. *American Journal of Experimental Agriculture*, 5(1), 1.

Kenya National Bureau of Statistics. 2013b. Exploring Kenya's Inequality; pulling apart or pulling together. Busia County. Kenya National Bureau of Statistics (KNBS), Nairobi.

Kenya News Agency. 2015. Busia gives 100 Million to Agricultural sector. <http://kenyanewsagency.go.ke/en/busia-gives-100-million-to-agriculture-sector/>

Knoke, I. 2013. Adaptation to climate change Insurance (ACCI) in Kenya. *Internationale Zusammenarbeit (GIZ)*.

Luedeling, E. 2011. Climate change impacts on crop production in Busia and Homa Bay Counties, Kenya. Nairobi, Kenya: World Agroforestry Centre.

Mbakahya, G. M., & Ndiema, A. C. 2015. Farming households' vulnerability and resilience to climate change in Nambale sub-County of Kenya. Retrieved from: <http://www.ijset.net/journal/815.pdf>

Midega, C. A., Murage, A. W., Pittchar, J. O., & Khan, Z. R. 2016. Managing storage pests of maize: Farmers' knowledge, perceptions and practices in western Kenya. *Crop Protection*, 90, 142-149.

Mugure, A., & Oino, P. 2013. Benefits of Agroforestry Farming Practices among Rural Households in Kenya: Experiences among Residents of Busia County. *International Journal of Science and Research*, 2(4), 442-449.

Ngugi, J., Muigai, S., & Muhoro, F. (2014). Transforming agriculture through contracted extension service delivery systems: the case of Kenya's Agricultural Productivity and Agribusiness Project. *African Crop Science Journal*, 22, 905-915.

Njoroge, M. K., Kilalo, D. C., Miano, D. W., & Mutisya, D. L. 2016. Whiteflies species distribution and abundance on cassava crop in different agro-ecological zones of Kenya.

Paron, P., Olago, D. O., & Omuto, C. T. 2013. Kenya: A Natural Outlook: Geo-Environmental Resources and Hazards (Vol. 16).

Nungo, R. A., Okoth, M. W., & Mbugua, S. K. 2012. Nutrition status of children under-five years in cassava consuming communities in Nambale, Busia of Western Kenya. *Food and Nutrition Sciences*, 3(6), 796.

Osumba, J., & Riox J. 2015. Scoping study on climate smart agriculture in Kenya; Smallholder integrated crop-livestock farming system. Food and Agriculture Organization of the United Nations, Rome.

Opondo, D.O. 2013. Loss and damage from flooding in Budalangi District, Western Kenya. Loss and Damage in Vulnerable Countries Initiative, case study report. Bonn: United Nations University Institute for Environment and Human Security.

Star. 2016. Relief water for drought-hit areas in Busia. http://www.the-star.co.ke/news/2016/03/03/relief-water-for-drought-hit-areas-in-busia_c1305276

Swallow, B. M., Sang, J. K., Nyabenge, M., Bundotich, D. K., Duraipappah, A. K., & Yatich, T. B. 2009. Tradeoffs, synergies and traps among ecosystem services in the Lake Victoria basin of East Africa. *Environmental science & policy*, 12(4), 504-519.

USAID. 2014. Household and community experiences and perceptions on climate change impacts due to floods, and expectations on policy in Bunyala Sub-County, Western Kenya. United States Agency for International Development.

Woomer, P.L., & Mulei, W. 2015. Better farming in West Kenya; Finding solutions to common farm problems. Western Region Agricultural Technology Evaluation (WaRATE).

Acknowledgements

This study is the product of the Ministry of Agriculture, Livestock and Fisheries of Kenya (MoALF), with assistance from the International Center for Tropical Agriculture (CIAT) and the CGIAR Research Programme on Climate Change, Agriculture, and Food Security (CCAFS), as part of the Kenya Adaptation to Climate Change in Arid and Semi-Arid Lands (KACCAL) project, supported by a grant from the Global Environmental Facility (GEF)/ Special Climate Change Fund (SCCF) through the World Bank (WB).

The document has been developed under the coordination of Robin Buruchara (CIAT) and Francis Muthami (National Project Coordinator, MoALF-KAPP), under the technical leadership of Evan Givertz (CIAT) and with contributions from (in alphabetical order): Harold Achicanoy, Colm Duffy, Jessica Koge, Ivy Kinyua, Miguel Lizarazo, Elizabeth Mbau, Vail Miller, John Yumbya Mutua, Caroline Mwongera, An Notenbaert, Andreea Nowak, Wendy Okolo, Jamleck Osiemo, Julian Ramirez-Villegas, and Boaz Waswa. Infographics and layout: Fernanda Rubiano and Carolina Rubiano.

We acknowledge the contribution of the KAPP team: Mary Maingi, Edwin Caleb Ikitoo, Naomi Migwi, and Ann N. Mang'eni. We also express gratitude for the following institutions for providing information to this study: Department of Agriculture and Animal Resources, Anglican Development Service (ADS), Busia Local Poultry Cooperative Society, Lugulu Meat Value Chain Self Help Group (Local Poultry), Edama Local Poultry Vegetable Self Help Group, Association for the Physically Disabled in Kenya ((APDK), Agricultural Sector Development Support Programme (ASDSP), Kenya Agricultural and Livestock Research Organization (KALRO), Kenya Meteorological Department, Busia (MD) and National Environmental Management Authority (NEMA).

This document should be cited as:

MoALF. 2016. Climate Risk Profile for Busia. Kenya County Climate Risk Profile Series. The Kenya Ministry of Agriculture, Livestock and Fisheries (MoALF), Nairobi, Kenya.