InJAST
Volume 7, Number 1, April 2026
Pages: 38-45

P - ISSN: 2722 - 0133
E - ISSN: 2722 - 0141
DOI: https://doi.org/10.33751/injast.v7i1.45

Impact of climate change adaptation on food security in Ukambani Region, Kenya

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Submitted 25 December 2025; Accepted 8 April 2026; Published 30 April 2026

ABSTRACT

Ukambani region falls in the Arid and Semi-Arid Lands (ASALs) in Kenya. Given the scenario, climate change adaptation strategies would become handy in alleviating food insecurity. The purpose of the study was to Evaluate the impact of climate change adaptation on food security in Ukambani. Specific objectives were to determine the climate change adaptation strategies used in Ukambani Region, to determine the effects of the climate change adaptation strategies on food production, and to determine the way forward on climate change adaptation strategies towards sustainable food security assurance in Ukambani Region. The study established that there are climate change adaptation strategies that have either impacted on food security in the region negatively or positively. Based on the study findings, it is becoming apparent that certain strategies were sustainable while others like burning charcoal as an alternative sources of livelihood and looking for government's /NGOs relief food support may not be sustainable. The findings have implications on the stakeholders and policy maker's interventions towards sustainable climate change adaptation strategies for sustainable food security.

Keywords: *Climate change adaptation; food security; Impact; Kenya; Ukambani Region*

INTRODUCTION

Climate change is a long-term shift in weather patterns driven by natural and human activities, leading to global warming and extreme weather events (Priatna & Khan, 2024). The phenomena climate change is real with all the challenges that come with it. Ukambani region is largely affected by drought, given the fact the region lies in the agro-ecological zone called Arid and Semi- Arid Lands (ASALs) of Kenya. So climate change and variability when viewed in the lens of times over the years and general weather patterns that characterize this lower Eastern part of Kenya sometimes geographically referred to as the Nyika Plateau is generally a dry region with serious water deficits, a situation that is aggravated by the persistent climatic changes. On that note studies have been done by different scholars touching of climate change for example a study by Amwata (2013) on climate variability, land use livelihoods in Kibiko-Kibwezi Observatory, Kenya was cognizant that climate change and variability are the main challenges to food security as a proxy livelihood in Makueni and Kajiado counties in Southern Rangeland. The study adopted a descriptive survey design in which data was collected through survey instruments including interviews, focused group discussions (FGDs), direct observations and recording, Key informant interviews and also from secondary information. Data collected were analyzed using both descriptive and inferential statistics. Descriptive statistics suggest a link between rainfall, households vulnerability to food insecurity (VFI). Random households in Makueni County are predominantly agro pastoral were more food insecure with high VFI of 0.27, than Kajiado with VFI of 0.59. Pastoralists households' access to resources such as climate change information ,education and income make them more vulnerable to food insecurity than their counterparts in Kajiado. Simultaneous Equation Modelling (SEM) was used to establish determinants of vulnerability to food insecurity. SEM should entail both socio-economic and climate factors influencing VFI. Variables found to have positive significant influence at $p \leq 0.05$ including land size ,household size, and rainfall for Makueni County and gender of household head ,access to climate change information and off-farm activities for Kajiado County. This implies that for Makueni County, households with large land size, large household and higher rainfall were less vulnerable to food insecurity.

Kiragu (2016a) on risk of local institutions in shaping climate risk adaptation process and practices among Semi-Arid rural households of Mwingi Region, Kenya used critical literature review observe that low and erratic rainfall and frequent droughts are the common in Mwingi area. Recent episodes and unpredictability of the onset of rains is perceived as new to the region, consequently livelihoods are lost through crop failures inaccessibility of water and death of livestock due to lack of water and decimation of livestock due to lack of pasture and water.

Kilungu et al. (2013) on exploring gender dynamics on perception of climate change on farming with focus on groups in June 2012 at Makueni and Machakos counties, Kenya. 16 Focused Group Discussions were involved in

the study with view to understanding framers' perceptions on gender role in regard to climate change in their farming system. A total of 192 farmers form 10 villages were randomly selected to participate in the FGDs. During the discussions it became clear that increased use of manure and fertilizers improved fertility of the soil. That improved seeds and fertilizers could also provide remedies to vagaries of climate change. This will improve food security amongst the households.

METHODS

This study explored the empirical literature review supported by Ferrer (1998). Other methods used included case study, survey, mixed methods, correlational studies, Hackman's Probit Model, Longitudinal studies. Food insecurity mitigational models are handy in the study of this magnitude towards finding a more food secure society where human dignity takes center stage.

Figure 1 is the map of Kenya showing the geospatial location of the Ukambani Region in the Lower Eastern section of Kenya.

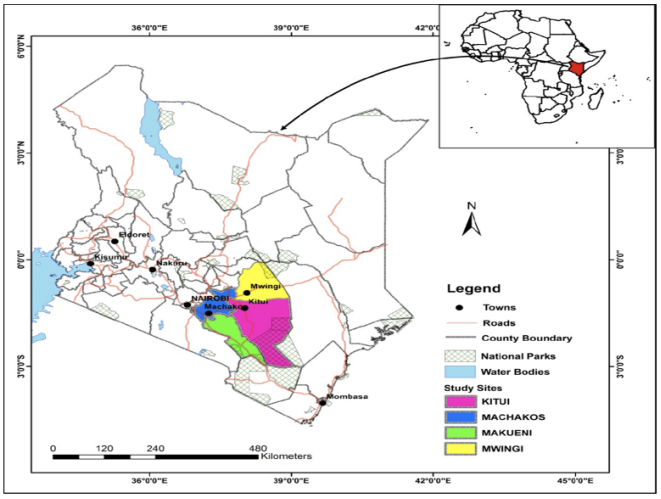

Figure 1. Map of Kenya showing the Location of Ukambani Region.

RESULTS AND DISCUSSION

Results and discussions are presented within the framework of the following study objectives:

On the Question of types of climate change adaptation strategies on Food security

Muhammad et al. (2016) on a participatory and integrated agriculture extension approach to enhancing farm resilience through innovation and gender equity used literature review with regard to challenges of grandmothers on security of land tenure weakening their efforts to provide nutrition food for grandchildren within the ASALs of Lower Eastern Kenya. Introduction of existing formal policies as well as local norms and values related to women's entitlement to land resources within Kamba Community in Lower Eastern Kenya.

Opande (2017) on cultural perspectives to climate change in Ahero Irrigation Scheme Sub-Location, Kisumu County, Kenya used Julian Steward (1955) theory and adopted a cross-sectional description design in which 945 households were targeted out of whom 105 households were sampled and surveyed. Using Kathuri & Pals (1993) formula an additional 56 participants were sampled for quantitative data. Systematic random sampling procedures were used to select respondents. Questionnaires and interviews were used to gather data. Findings showed that 81% of the respondents reported that climate change posed a great threat to human survival.

Kiragu (2016b) on underdeveloped adaptation: climate risks, vulnerability and household well-being in Mwingi, Kenya was underpinned by Amartya Sen's Capability and Antony Gidden's Structuration Theory as well as new institutionalism. Survey design adopted in which Focused Group Discussions, Key informants, interviews, observation and household survey were carried out to gather data. The findings revealed that precipitation was the main climate element featuring in local peoples' descriptions of changes in wealth specifically droughts spelt dooms to people leading to water deficits, leading to livestock, crop failures and wealth loss.

Imatari et al. (2019) on food insecurity in arid and semi- arid lands (asal) in Africa (paid) was underpinned by Chamber et.al and Theory of Diffusion of Innovations by Everett Rogers and Chambers Theory on Participatory approach. The study adopted survey design in which 95 households were sampled for study and 10 stakeholders. Data were collected through FGDs, Questionnaires, interview guides and key informant interviews with the stakeholders.

Bushby & Stites (2016) on Resilience and risk in Pastoralism areas of :Recent trends in diversified and alternative livelihoods in Karamoja, Uganda used literary review a historical approach deriving information from Feinstein International Center at Tufts University and from United States Agency for International Development (USAID) to examine resilience and risks in pastoral areas in East Africa. Households examined access profiles that accompany livelihood shifts viewed within the lens of positive and negative factors for diversification, including risk of maladaptive livelihood strategies and suggests future trends that will impact on pastoral livelihoods in Karamoja and recommends on best adaptation strategies that will elevate the pastoralists and cushion them from climate change shocks.

Simel (2015) on the effect of drought and famine on agriculutural production, living standards and education status of the people of Kitui County, Kenya used a

survey study design in which 150 respondents who were randomly sampled for the study. The Lower Yatta regions og Kitui County have been affected by drought and famine for the last over 30 years. The study established an outcry in non-involvement of stakeholders in an attempt to address drought issue and responding to drought issue has been a big challenge in the regions.

Opiyo et al. (2015) on adaptation and coping strategies among the Turkana Pastoralists of Northern Kenya used data from the Kenya Meteorological Department from between 1950-2012. The study also used survey design to sample 302 households in which data were collected through administration of interviews and Focused Group Discussions (FGDs). The study established that there have been frequent occurrence of droughts impacting negatively on pastoralists livelihoods through drying up of water pans, lack of pasture, withering of the livestock and in extreme circumstance decimation of the livestock on whose their livelihoods are dependent. That lack of pasture and scarcity of water sometimes sparks intercommunity conflicts over the scarce but valuable resources for the pastoralist.

Watson et al. (2016) on camels and climate resilience: Adaptation in Northern Kenya adopted secondary data and one of the apparent issue is challenges brought about by climate change to the communities in the northern frontier that is already naturally suffering from water deficit and hot temperatures.

Gebre & Rahut (2021) on prevalence of household food insecurity in East Africa: Linking food access with climate variability use literature review based on information provided between 2018/2019 covering cross boundary within East African region in Ethiopia, Kenya and Tanzania. The data were collected on links between household food security (access to food) and vulnerability to climate change in East Africa. Household food insecurity scale (HFIAS) was used to measure the prevalence of household food insecurity an order Probit Econometric Model to determine the factors affecting prevalence rates.

Krathi et al. (2013) on pastoralism: A critical assistance for food security under global climate change adopts a literature review in the study. Climate variability leads to lack of stability and vulnerability of the agro pastoralists to climate change and variability. Findings that climate variability is a threat to the pastoral livelihoods that are subjected to environments stresses associate with climate change and variability. The implications of the findings for key stakeholders on the need for climate change adaptation strategies.

Melketo et al. (2021) on determinants of pastoral household resilience to food insecurity in Afar Region, Ethiopia explored both secondary and primary data collected through household surveys. The researchers are cognizant that Pastoralists in Ethiopia are under increased pressure due to spiral of resource depletion and diminished resilience against shocks and stresses. Determinants of pastoral household's resilience to food insecurity in afar Ethiopia. A cross-sectional survey using structured interviews of 99 randomly selected households were conducted. Data analysis used component analysis and general linear regression. The study established that resilience capacity of households in the study area is very weak leading to food insecurity.

Mueller et al. (2021) on the contribution of Covid-19 in Kenya, Bangladesh and Nigeria used secondary Literature review are cognizant of Covid-19's effects on trade, food, employment, using longitudinal study based on information gotten from Kenya, Bangladesh, and Nigeria in the periods of October 2020-April 2021. The Covid-19 Pandemic was associated with food insecurity, job losses sand business closure and coping strategies. The situation put households to a situation of food insecurity given that people were to keep distant.

Momodou et al. (2019) on effects of Climate Variability on households' food availability among rural farmers in Central River Region, Gambia adopted descriptive survey design and also reviewed secondary data. Multi-stage sampling procedures were used to get 219 farmers' households who were surveyed, Focused Group Discussions were also held to get data and also key informants interviews were held with the household heads to get data.

Weldearregay & Dawit (2018) on impact of climate variability on household and food availability in Tigray, Ethiopia, adopted primary and secondary information in the study and looked at four components of food security namely food availability, food accaessibility, food use and food stability. Findings form the survey of 150 households indicated that households' met their daily calorific food requirements in varying percentages when analyzed form the lens of household food balance model as follows: 15.7% of households met recommended daily requirements of 2100 Kcal/adult equivalent/day while 84.3% of the households fell below daily recommended calorific intake. That 56.2% women headed households were found to be food insecure as compared to their male counterparts.

Singh (2016) on climate change and food security in India: Challenges and opportunities used secondary literature and is cognizant that achieving nutritional security in a degrading environment, with global warming leading to melting of ice and the rise in sea water levels leading to submergence of lowlands bordering the sea. These variables of temperature and precipitation variability has great threat to food security. This requires appropriate mitigation strategies towards insurance of food security.

Njoka et al. (2016) on Kenya: Country situational assessment adopts secondary data in the study and are cognizance of the vulnerability of the pastoralists to the climate change and variabilities that affect these rain

dependent communities a scenario leading to food insecurity amongst the households. Their behavior of transhumance occasioned by overstocking usually subject the otherwise naturally hostile environment towards degradation leading to more social desperation with no much traditional coping strategies coupled with rampant poverty amongst the communities.

Milelu et al. (2016) on demographic and socio-economic dimensions and determinants of available access to households' food security in Kitui County, Kenya, are cognizant of the fact that one of the sustainable development goals is nutrition and food security amongst communities of the world towards alleviating undernourishment that characterize many people on planet earth. The study adopted descriptive survey design in which 167 households were randomly sampled for the study. Multiple regression analysis was used to determine the socio-economic and demographic factors of households on food security. The study established that demographic and socio-economic determinants are not significant in explain food security in Kitui County, Kenya.

Kimani-Murage et al. (2014) on vulnerability to food insecurity in urban slums: experience from Nairobi City, Kenya adopted a survey study design in which questionnaires and key informant interviews were administered to collect data. The study established that most respondents felt the households were food insecure in the slums of Nairobi.

Adane et al. (2015) on the status of food availability in the face of climate change and variability in Choke Mountain Watershed, Central Ethiopia adopted survey study design in which households were surveyed. Data were collected through questionnaires, key informant interviews, focused Group Discussions and filed observation. Both quantitative and qualitative data were collected and analyzed accordingly.

Myers et al. (2017) on climate change and global food system: potential impacts on food security and undernutrition adopted literature review approach and are cognizance of the fact that great efforts have been undertaken toward addressing global undernourishment and improved food production. That most human influenced climate change usually influence quantity and quality of food produced and equitable pathways by which climate change may affect food production for example in fisheries, agriculture, livestock production and socio-economic factors that may impact equitable distribution of food.

On the question of effects of Climate change adaptation on food security

Wang et al. (2022) on impact of climate change on food security in Kazakhstan adopted literature review approach to data collection and are in agreement that

global food production systems today are under threat from the persistent climate change phenomena. Panel regression model. The upward trend in wind speed and potato yield through Kazakhstan was apparent. Moreover, wheat, barley increased in the South East.

El-Bilali et al. (2020) on climate change and food security used literature review approach observe that climate change is the biggest threat to food security. Food security was examined at 4 levels namely availability, access, use and stability. The findings show that climate change has impact on food security. Extreme weather events have equal destructive proportions of the magnitude of food insecurity.

Yadav et al. (2019) on food security and climate change adopts literary review and cognizant of the contribution of emission of Green House Gases (GHGs) on global warming and the climate change that threatens food security. The change impact food security systems in all sectors of production including livestock, crop, fisheries and all other aspect that appertains to food production with the net result of food insecurity. This will call for comprehensive and sustainable climate change adaptation strategies towards guaranteeing food security. That emission of GHGs in the atmosphere are largely due to human interference with the environment.

Aleymayehn & Bewket (2019) on smallholder farmers' coping and adaptation strategy on climate change and variability in Central Highlands of Ethiopia adopted a descriptive survey design in which 200 smallholder farmers drawn from three districts of Ethiopia were conducted to household surveys. Three Focused Group Discussion were held each drawn from one of three districts in the area of study. The findings were that climate change and variability has negatively impacted food security. Implications of this findings for key stakeholders toward appropriate mitigation strategy towards food security.

Legesse et al. (2020) on smallholder farmers' perceptions and adaptation to climate variability and change in Doba District, Ethiopia used descriptive survey design in which 160 small holder farmers' households were sampled for the study through stratified random sampling procedure. Multi-menial logit model was used to determine factors influencing adaptation strategies amongst the households to climate change and variability.

Siedenburg (2021) on Perils facing Kenyan Pastoralists' livelihoods innovation and wider impacts: Learning form Project Experience adopts an empirical study seven development projects ongoing at the time of the study that supported remote pastoralist facing food insecurity and other environmental challenges such as land degradation and climate change. The projects were aimed at addressing the challenges of the pastoralists livelihoods innovations in partnership with the project financiers. The study established insecurity in the North

Eastern region characterized by cattle rustling which usually spark intercommunity conflicts.

Galenah et al. (2022) on food security status and determinants in North Eastern Rift Valley of Ethiopia adopts survey design and empirical literature review and are in agreement that just like in other tropical nations, rain fed farming is the order of the day and therefore food production in such countries, Ethiopia not exceptional are vulnerable to climate change and variability phenomena. The findings showed 64% of the surveyed households were food insecure. Based on the Logit Regression Model, age, marital status, and family size were negatively affected households' food security status.

Watete & Wambui (2021) on Gauging food insecurity Resilience among pastoralist community: a case study of Kenya adopted FAO resilience model which identifies food resilience indicators and broadly group them into income, access to food and basic services, social safety nets, asset, adaptive capacity and food stability. Muti-stage approach was used to validated to determine food resilience among households. The study sample consisted of 300 participants and 360 participant households drawn from Mandera and Turkana Counties, respectively. Questionnaires were administered to capture households' socio-economic characteristics and data on food security indicators examined to identify resilience of households to food insecurity.

Agoya (2015) on Assessment of food insecurity in Budalangi –Busia County, Kenya adopted descriptive survey design in which 200 households were sampled from the study. Findings were that causes of food insecurity in this area are socio-economic underdevelopment and rampant poverty levels.

Osundwa et al. (2020) on factors influencing adoption of recommended soil fertility replenishing technology by maize far famers in the North Rift Region of Kenya adopted descriptive survey design in which 384 household heads were surveyed on factors affecting adoption of SFRT by maize farmers in Uasin Gishu and Trans Nzoia Counties. Findings revealed that gender had negative coefficient by -1.844,-2.015 and -1.688($p<0.05$,$p<0.05$,$p<0.001$) effect on the adoption of FURP, FURPL, and NAAIAP technology by 1.960.1.948 & 1.469 ($p<0.05$), respectively.

Wetende et al. (2018) on perception of Climate Change and adaptation strategies on small holder draining farming systems: Insights from Siaya Sub-County, Kenya used descriptive survey design in which 100 households were sampled and surveyed and Focused Group Discussions (FGDs). Inferential and descriptive statistics kind of data were collected.

Feleke et al. (2020) on effects of small scale irrigation on household income and its implications on livelihood sustainability in the drought Prone Central Rift Valley of Ethiopia adopted descriptive survey design in which small holder farmers were surveyed. The study established that use of irrigation had significant positive relationship with household's food security and sustainable livelihoods.

Iddrisu et al. (2017) on effect of input credit on smallholder farmers' output and income: evidence for Northern Ghana explored cross-sectional data to estimate the effect of project participation on farm output, yield and income using propensity score model (PSM). The findings were that project participation is skewed towards farmers with big parcels of land and households.

Wekesa et al. (2018) on effect of climate smart-agriculture on practices on household food security on smallholder production systems: micro-level evidence from Kenya adopts literature review and are cognizance of the potential of climate smart agriculture (CSA)in reversing the trend because of the triple potential benefits of improved of improved productivity and income.

Kenduiywo et al. (2023) on mapping climate insecurity hotspots :Enhancing climate peace and security decision making in East Africa and Greater Horn of Africa analyze empirical literature on the horn of Africa ASALs zones of transhumance practice pastoralists communities the traditional livestock keepers whose socio-economic livelihood is threatened by climate change causing what shortages, pastoral shortages culminating into intercommunity conflicts over the scarce resources, apart from livestock rustling with proliferation of complicated weapons used by the rustlers to violently take and drive away the animals to their desired destinations.

Abebe (2021) on food insecurity in the horn of Africa and its impact on peace in Kenya are cognizance of the pastoralists occupying the horn of Africa such as Afar, Issa, Somlai, Borana, Rndile, Gabra, and Turkana of Northern Kenya have been practicing transhumance in the region. Climate change and associated challenges such as scarcity of water and pasture that are held dear by the pastoralists when we go by their livestock keeping usually results into conflicts which today other practices such as cattle rustling with complicated arms like AK 47, M16 amongst other complex rifles make the region usually quite volatile in terms of conflicts and hence insecurity.

Okoti et al. (2014) on impact of climate variability and pastoralists adaptation strategies in Garissa County, Kenya. adopts secondary literature in the study and recognizes the fact that climate change and variability have really made the pastoralists vulnerable as they depend on rain fed pastoralism towards acquiring water and pasture for their animals in their oscillatory seasonal movements guided by the weather and climatic patterns all depending on the availability of water and pasture in the areas moved to with the livestock.

On the question regarding way forward on climate change adaptation strategies

Mutu (2019) on drought coping strategies amongst the Turkana pastoralist community of Northern Kenya adopted a descriptive survey in which households of 424 were sampled for survey The study population consisted of household heads, chiefs, managers of Non-Governmental Organizations in the area (NGOs) and county disaster preparedness officers. Data were collected through administering questionnaires, key informant interviews, focused Group Discusions. Findings indicated that extreme and frequent droughts make the pastoralists vulnerable to climate change thereby negatively impacting their livelihoods.

Degfe & Mauser (2017) on socio-economic and environmental impacts of large scale agricultural investments in Gambella Region, Ethiopia adopted a literature review and was cognizant of small-scale farmers' overdependence on rain-fed agriculture amidst climatic changes, making them more vulnerable and contributing to food insecurity amongst them.

Saada et al. (2020) on determinants of pastoralists' participation on commercial fodder markets for household resilience in the drylands of Northern Kenya: a case of Isiolo County adopted both secondary and primary data. Primary data were gathered from 201 sampled pastoralists households on factors' influencing pastoralist' participation on fodder markets in Isiolo County, Kenya. Both descriptive and Heckman's two-step model were used in the data analysis. Findings that pastoralists fodder production is influenced by access to credit, weather patterns, market information, land tenure, system, exposure top climate change and variation shocks, and holding of livestock.

CONCLUSION

The study established that there are a variety of climate change adaptation strategies towards food security in the Lower Eastern Region of Kenya, some of which are sustainable while some like burning charcoal as an alternative means of livelihood would aggravate the climate change issue and likely to lead to more environmental challenges. Looking up to the Government/NGO for famine relief food may not be sustainable in the long run. This calls for sustainable interventions of climate change adaptation strategies towards food security.

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