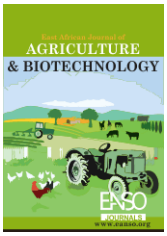
East African Journal of Agriculture and Biotechnology, Volume 8, Issue 1, 2025
Article DOI : https://doi.org/10.37284/eajab.8.1.3373



East African Journal of Agriculture and Biotechnology
eajab.eanso.org
Volume 8, Issue 1, 2025
p-ISSN: 2707-4293 | e-ISSN: 2707-4307
Title DOI: https://doi.org/10.37284/2707-4307

EAST AFRICAN NATURE & SCIENCE ORGANIZATION

Original Article

Agro-Pastoral Community of West Pokot County, Kenya: Challenges and Opportunities for Sustainable Climate Change Adaptation

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Article DOI: https://doi.org/10.37284/eajab.8.1.3373

Date Published:

22 July 2025

Keywords:

Agro-Pastoral, Challenges, Climate Change Adaptation, Opportunities, West Pokot, Kenya.

ABSTRACT

Climate change is now a reality and is one of the most important environmental and developmental challenges to the achievement of sustainable development goals, with implications for small-scale agro-pastoral productions. This study investigates the challenges and opportunities small-scale agro-pastoralists face in trying to attain sustainable climate change adaptation in West Pokot County, Kenya. The study used a stratified, purposive and random sampling technique. Primary data was collected from a sample of 384 household heads and validated through focused group discussions, key informant interviews and observations. Data were analysed using the Statistical Package for Social Sciences (SPSS V22) and Microsoft Excel. Data collected on perceptions of climate change were coded and analysed using descriptive and qualitative content analysis. The small-scale agro-pastoral community employs a variety of strategies to respond to the adverse effects of climate variability and change. Alternative livelihoods, migration, water harvesting, irrigation, planting drought-tolerant and early maturing crops, early land preparation and delayed planting are all examples of local responses and interventions. Others are staying away from flooded areas, uptake of soil and water conservation measures. However, the study identified a number of barriers to adaptation to climate variability and change, including crop failure, crop water stress, crop damage, insufficient water storage facilities, high costs, food shortages, livestock deaths, pests, and diseases. The opportunities available are strengthening the capacity of small-scale agro-pastoralists on information and climate-smart agricultural technologies, innovations and management practices. The results are crucial in planning appropriate adaptation mechanisms in support of enhancing the resilience of the small-scale agro-pastoral communities to tackle climate variability and change.

Article DOI : https://doi.org/10.37284/eajab.8.1.3373

APA CITATION

Kiplagat, W. K., Ouma, G. O., Ali, A. A. & Omondi, P. (2025). Agro-Pastoral Community of West Pokot County, Kenya: Challenges and Opportunities for Sustainable Climate Change Adaptation. *East African Journal of Agriculture and Biotechnology*, *8*(1), 575-603. https://doi.org/10.37284/eajab.8.1.3373

CHICAGO CITATION

Kiplagat, Willy Kibet, Gilbert Ong'isa Ouma, Ali Adan Ali and Philip Omondi. 2025. "Agro-Pastoral Community of West Pokot County, Kenya: Challenges and Opportunities for Sustainable Climate Change Adaptation." *East African Journal of Agriculture and Biotechnology* 8 (1), 575-603. https://doi.org/10.37284/eajab.8.1.3373.

HARVARD CITATION

Kiplagat, W. K., Ouma, G. O., Ali, A. A. & Omondi, P. (2025), "Agro-Pastoral Community of West Pokot County, Kenya: Challenges and Opportunities for Sustainable Climate Change Adaptation", *East African Journal of Agriculture and Biotechnology*, 8(1), pp. 575-603. doi: 10.37284/eajab.8.1.3373.

IEEE CITATION

W. K., Kiplagat, G. O., Ouma, A. A., Ali & P., Omondi "Agro-Pastoral Community of West Pokot County, Kenya: Challenges and Opportunities for Sustainable Climate Change Adaptation", *EAJAB*, vol. 8, no. 1, pp. 575-603, Jul. 2025.

MLA CITATION

Kiplagat, Willy Kibet, Gilbert Ong'isa Ouma, Ali Adan Ali & Philip Omondi. "Agro-Pastoral Community of West Pokot County, Kenya: Challenges and Opportunities for Sustainable Climate Change Adaptation". *East African Journal of Agriculture and Biotechnology*, Vol. 8, no. 1, Jul. 2025, pp. 575-603, doi:10.37284/eajab.8.1.3373

INTRODUCTION

Climate change is one of the biggest global threats to achieving the Sustainable Development Goals (SDGs), especially those focused on ending poverty and hunger, building sustainable communities, and addressing climate impacts (Morton *et al.,* 2017). It affects multiple climate-sensitive sectors, including agriculture, forestry, the environment, infrastructure, water, tourism, health, energy, and coastal regions in both developed and developing countries (IPCC, 2014).

It has both positive and negative effects on the natural resources that support agriculture. Since agriculture depends heavily on biodiversity and environmental conditions, it is highly vulnerable. The impacts of climate change on agriculture are becoming increasingly evident over time. According to the IPCC (2014), climate change is already happening and will continue in the foreseeable future, regardless of future greenhouse gas emissions. Its negative effects on agriculture outweigh any potential benefits, making adaptation a critical challenge.

Increasingly frequent and intense climatic events, including droughts, floods, and erratic rainfall, are disrupting food production systems and exacerbating existing vulnerabilities (IPCC, 2022). Furthermore, climate change impacts occur alongside other stressors such as population growth, urbanisation, rising income levels, land use changes, shifting gender roles, natural resource depletion, insecurity, and conflict (Bennett *et al.,* 2015; van Ginkel *et al.,* 2013). These factors contribute to the rise of complex and changing social-ecological systems (Bennett *et al.,* 2015; Colding & Barthel, 2019; Petrosillo *et al.,* 2015). Agro-pastoral systems are one such example, and studying them offers valuable insights into how small-scale crop and livestock farmers are adapting and transforming in response to climate change.

Agro-pastoralist systems in Africa, particularly in Sub-Saharan regions, are among the most vulnerable to climate variability and change (Niang *et al.,* 2014). These systems, which integrate livestock rearing with subsistence crop farming, are highly dependent on predictable rainfall and are therefore acutely sensitive to fluctuations in precipitation, land degradation and water scarcity. The adaptive capacity of agro-pastoralist communities is often constrained by limited access to climate-resilient technologies, agricultural extension services, and critical infrastructure (FAO, 2019). Although regional and national adaptation

Article DOI : https://doi.org/10.37284/eajab.8.1.3373

policies, for instance, the African Union's Climate Strategy (AU, 2022) and Kenya's National Adaptation Plan (GoK, 2016), seek to address these challenges, implementation remains inconsistent. This is particularly true in arid and semi-arid lands (ASALs), where institutional support is weak, and communities face persistent socio-economic marginalisation (Kabubo-Mariara & Karanja, 2007).

In Kenya, there is clear evidence of rising temperatures and increasingly erratic rainfall (GoK, 2010). Heavy downpours causing floods often alternate with periods of severe drought. Since the 1960s, daily temperatures have steadily increased, leading to widespread climate-related losses across the country. In West Pokot County, small-scale farmers are highly vulnerable to climate change due to their strong reliance on the environment (Arukulem *et al.,* 2015; Lolemtum *et al.,* 2017; Muriithi *et al.,*2017). Their agro-pastoral systems are facing reduced yields because of unpredictable rainfall and frequent extreme weather events, occurring every 2 to 3 years. These conditions have led to repeated crop and pasture failures, causing food and nutrition insecurity. Farmers' ability to adapt is limited by financial, technological, and environmental constraints.

Adaptation is, and continues to be, one of the most practical ways to address the impacts of climate change on agriculture both globally and locally (Thornton *et al.,* 2018). For instance, in the Kigezi highlands of Kabale district in Uganda, farmers are adapting to climate change by using early-maturing and improved crop varieties, practising small-scale irrigation, and adjusting planting dates (Twagiramaria *et al.,* 2018). Poor farming households also cope by adopting drought-resistant and virus-free crops (Ilukor *et al.,* 2014).

In Kenya, agriculture is highly affected by climate variability and change since it mainly depends on rain. About 75% of the rural population, mostly small-scale farmers, rely on agriculture for food and income. The sector directly contributes 33% and indirectly 27% to the GDP, provides around 60% of jobs, and accounts for 60% of exports (ASTGS, 2019). Livestock farming, mostly in arid and semi-arid areas, supports over 30% of the population and holds about 60% of the country's livestock (Kabubo-Mariara, 2009).

West Pokot County often faces drought and food insecurity, making it essential for smallholder agro-pastoralists to adopt adaptation strategies to protect their livelihoods from the effects of climate variability and change. According to Nyberg et al. (2015), efforts to rehabilitate Southern West Pokot, mainly led by the NGO Vi Agroforestry, have helped the community through practices like enclosures and agroforestry. These enclosures have supported the shift from traditional pastoralism to agro-pastoralism by improving land rehabilitation, fodder supply, and livestock production. They also help combat climate change by increasing vegetation cover and soil carbon. As a result, there has been greater agricultural diversification and growth in agribusiness, creating both opportunities and challenges, especially for women.

However, the way small-scale agro-pastoralists cope and respond to the negative effects of climate variability is still not very clear. There is therefore a need for a better understanding of how small-scale agro-pastoralists cope and respond. Furthermore, there is a need to understand the challenges and opportunities presented by climate variability and climat change.
This will aid policymakers and stakeholders in dev eloping appropriate strategies for dealing with the effects of climate variability. The focus of this study is the ASALs, the most hard hit by the effects of climate variability, particularly West Pokot County, where no study has been carried out on the response to climate variability. Furthermore, the study focuses on both crop and livestock production, as well as the actual response mechanisms, as opposed to previous studies that focused on crop or livestock either in isolation or separately, potentially masking some important

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information that may emerge from the correlation between crop and livestock strategies. Small-scale farmers in ASALs use multiple strategies to deal with the problem of climate variability, so the decision to adopt a response is interdependent. The goal of the study is to explore the challenges and the opportunities small-scale agro-pastoralists face in trying to attain sustainable climate change adaptation in West Pokot County, Kenya. Specifically, the study identifies the response strategies used by small-scale agro-pastoralists to cope with and respond to the effects of climate variability and change.

MATERIALS AND METHODS

Study Area

The study area was the agro-pastoral communities of West Pokot County (Figure 1). The area was chosen purposely due to the fragility of the environment being susceptible to variations in climatic conditions, and agro-pastoralism as the main source of livelihood and sustenance for the community. It is adversely affected by climate variability and its extremes – droughts, floods and landslides (BBC, 2019; Petley, 2019). The county lies within longitudes 34° 47'and 35° 49' East and latitudes 1° and 2° North and covers an area of approximately 9,123.2 km^2 (CGWP, 2013). From Figure 1, the county is located in the North Rift along Kenya's Western boundary with Uganda border (CGWP, 2013), and it borders Turkana County to the North and North East, Trans Nzoia County to the South, Elgeyo Marakwet County and Baringo County to the South East and East respectively (CGWP, 2013).

The county has mainly a semi-arid climate and two rainy seasons (Sombroek *et al.*, 1982; Jaetzold *et al.*, 2011). The long rains fall from March – July, peaking in May. The short rains fall from September to early November. The annual rainfall varies from 500 to 1,600 mm, being higher in the highlands than in the lowlands, while the annual mean temperatures range from 15.0 to 35.0 ºC in the lowlands and highlands, respectively (Jaetzold *et al.,* 2011; CGWP, 2013). The total population in the county was 621,241 persons (an average of 5.3 persons per household), growing at the rate of 5.2% in comparison to the national average of 2.2 % as per the 2019 census (KPHC, 2019).

The county has three different agro-ecological zones – AEZ (III, IV and V) with variations in soils, rainfall amounts, temperature and the type of crops grown as well as livestock kept (CGWP, 2017). AEZ III has a higher potential, allowing the production of various crops and livestock, unlike zones IV and V, mainly inhabited by the agro-pastoralists and pastoralists and faced with crop and livestock production risks.

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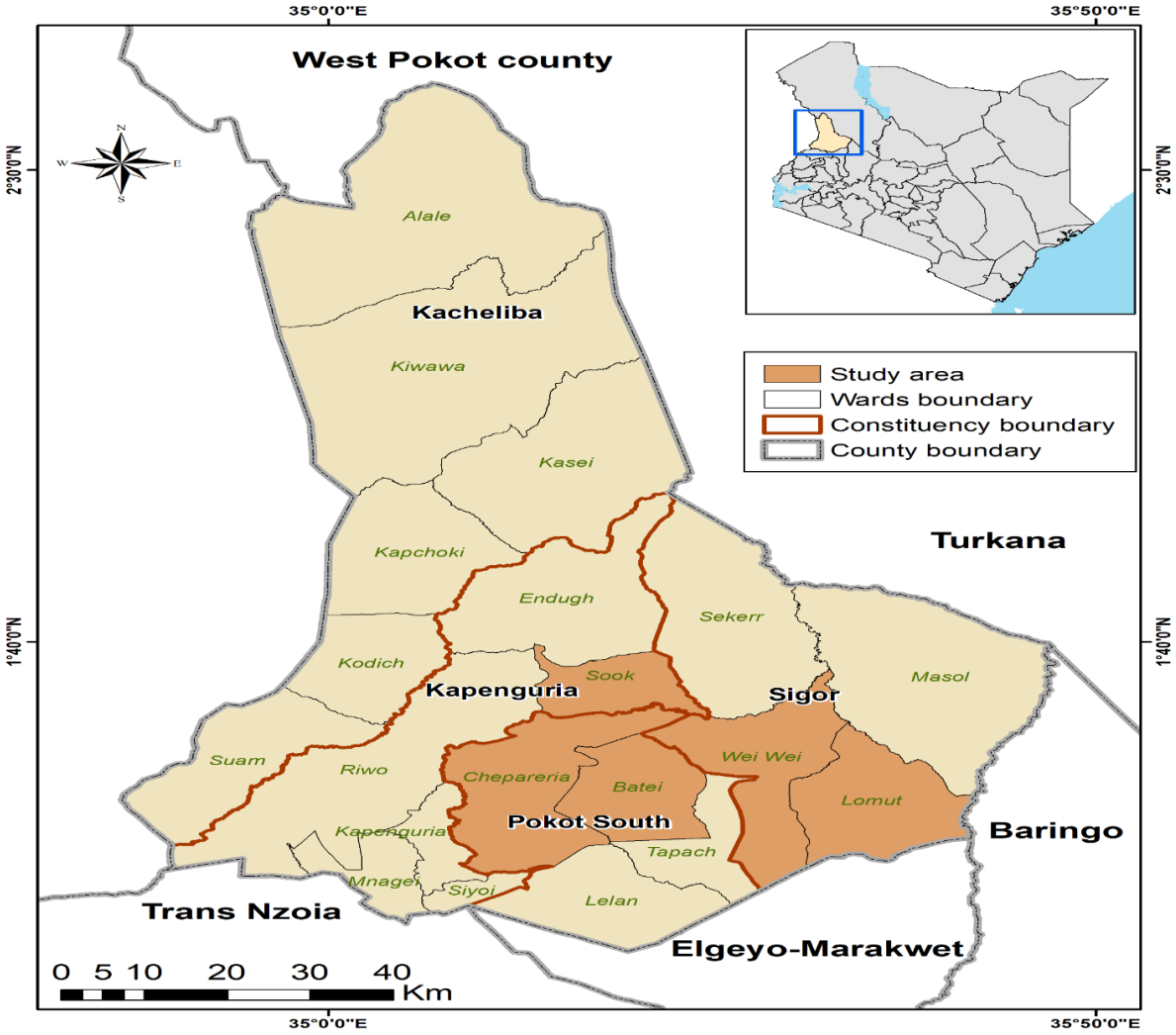
Figure 1: The Map of the Study Area Showing the Agro-pastoral Community in West Pokot County



Data Source, Sampling Procedure and Sample Size Determination

Primary and secondary data sources were used in the study. The quantitative and qualitative sources of primary data were collected using a household questionnaire survey, focused group discussions and key informant interviews. Secondary data sources, such as published and unpublished national and county reports, refereed journals, and online resources, were gathered to supplement the primary sources.

The study employed stratified sampling. The county has twenty administrative ward units, each representing a stratum. Only five administrative ward units (Batei, Chepareria, Lomut, Sook and Weiwei) representing the agro-pastoral community were purposively considered for the study. The agro-pastoral community has a population of 203,798 persons, 36,613 households and an area of 2,158.6 Km^2 (KPHC, 2019). Proportionate stratified sampling was then used to assign the 36,613 households into the various agro-ecological zones in the agro-pastoral community. In each agro-ecological zone, systematic random sampling was then employed, where every third household was selected from the list of the population members.

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A sample of small-scale agro-pastoralists was taken to represent the population of small-scale agro-pastoralists in the West Pokot County. Since the West Pokot County agro-pastoral community has a target population of 36,613 households (KPHC, 2019), the sample size was determined using Krejcie & Morgan's (1970) formula (Equation 1). The formula is frequently used to calculate a sample size from a given finite population (P) such that the sample size is within plus or minus 0.05 of the population proportion with a 95 % level of confidence.

$$S = X^2NP\,(1-P) \div d^2(N-1) + X^2P(1-P) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{(1)}$$

Where **S** = required sample size; $\mathbf{X^2}$ = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841); N = the population size; P = the population proportion (assumed to be 0.50 since this would provide the maximum sample size) and d = the degree of accuracy expressed as a proportion (0.05). This gave **384** households as the sample size for the study.

The questionnaire consisted of open and closed-ended questions and was administered to the 384 households to collect primary data. The data collected had information on household and socio-economic characteristics, climate change perceptions, vulnerability and adaptation strategies. The study also employed the Participatory Vulnerability Profiles (PVP) approach (Haan *et al.,* 2001), targeting present vulnerabilities, current and future climate risk of present and future climatic variations and responses to reduce present vulnerability and improve resiliency to future risks.

Face-to-face interviews were carried out by nine trained research assistants aimed at reducing bias and errors while collecting data, and were acquainted with the research objectives and tools used and sourced from within the community using the structured questionnaires that had been pretested for validity. The questionnaire was programmed into the Open Data Kit (ODK) platform and deployed on computers, which allowed the utilisation of in-built checks on data validity that restrict the entry and submission of data that does not meet the required criteria.

The data collected through the household questionnaire were further triangulated through Focused Group Discussions (FGDs), informal interviews and general observations. Using a structured guide, a total of 4 FGDs, each consisting of 12 community members, were carried out to get a balanced position on the climate change situation in the targeted areas.

Data Analysis

Data collected on the perception of small-scale agro-pastoral farmers to climate change over time were coded and analysed using descriptive and qualitative content analysis. The collected data was analysed by use of quantitative and qualitative techniques using Statistical Package for Social Sciences (SPSS V22). Frequency counts, means, and percentages were calculated for all quantitative data and results were presented using frequency-distribution tables. Qualitative content analysis was used to analyse the qualitative data collected during the FGDs and KIIs. The transcriptions of the audio recordings were translated from the Pokot/Kiswahili language into English. Research assistants were instrumental during the translation of the languages used and transcription. The transcriptions were studied repeatedly to develop an analysis structure. This basically involves constructing the emerging topics, categories, relationships, and conclusions drawn in line with the study objectives (Hsieh & Shannon, 2005). The results from FGD were illustrated by direct quotes and recounts, particularly relevant experiences and the views of small-scale agro-pastoralists for authenticity (Newing, 2011).

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RESULTS AND DISCUSSION

Demographic and Socio-Economic Characteristics

In terms of household demographics and socioeconomic characteristics (Table 1), the majority of the households are headed by males, 77.3%, while 22.7% are headed by females. This shows that most of the households are male-headed. Most of the households (89.9%) consist of people in a stable marriage. Most of the households (44.5%) are adults aged between 35 – 49 years, while 21.4% were mature adults aged between 50 – 64 years, and 20.3% were young adults aged 25 – 34 years. The average age of the households was 42.13 ± 13.04 years, with the youngest aged 18 years, while the oldest was 81 years. The majority of the small-scale agro-pastoralists who participate in agriculture are aged between 35 to 64 years. This agrees with the report of Birch (2018), where the mean age of farmers in Kenya is 60 years. Agriculture, therefore, could be an opportunity for the youth to venture into (Brooks *et al.,* 2013). A majority (43.0%) of the households had lived in the community for over 20 years, followed by those that had lived for between 5 to 10 years (22.4%) and those that have stayed in the community for between 11 to 20 years, and less than 5 years were more or less similar being 17.7 % and 16.9 % respectively.

Most of the household sizes had between 5 to 9 members (50.5%), followed by those with between 1 to 4 members (38.5%) and least for those that had between 10 to 13 members. This is consistent with the findings of Nyang'au *et al.* (2021), who found that the majority of the households had 4 to 6 members. With respect to education, the majority of the households had no formal education (40.1%), while those that attained primary education were 29.9% and 14.1% for those that reached secondary level. This implies that education levels are still very low, as most of the households have not fully embraced education. The low literacy levels reflect a challenge to effectively increase the level of awareness, access and uptake of any new alternative or scientific technology, knowledge or information, including early warning systems and climate forecasts by the small-scale agro-pastoralists (Cherotich *et al.,* 2012; Ochieng *et al.,* 2017).

Semi-permanent with iron sheets is the majorly occupied housing type owned by the households at 55.7% due to its affordability and durability, unlike mud-walled grass thatched houses at 37.0%. The findings corroborate with KPHC (2019). This could be an opportunity for the households and the community to use the iron sheets to harvest water during the rainy season for household use (Wamuongo *et al.,* 2015). The majority of the households (98.4%) use firewood as the main cooking fuel, as it is readily available as compared to a few households using charcoal and gas, since it is moderately expensive. The results corroborate the findings of other studies, which reported that firewood is the main source of energy at the household level (Githiomi & Oduor, 2012; Wamuongo *et al.,* 2015; Githiomi *et al.,* 2012; KPHC, 2019; Petersen *et al.,* 2021).

Use of firewood as a household energy is a challenge as it not only exacerbates deforestation, degradation of the land and releases stored greenhouse gases into the atmosphere, thereby contributing to climate change, but also emits smoke particles that lead to respiratory illnesses, increasing household health risks (IPCC, 2014). It also threatens the sustainability of the environment, halting progress made towards the achievement of poverty and hunger eradication. However, there exists an opportunity in the promotion and adoption of clean energy-efficient technologies such as cooking stoves, improved earth kilns for charcoal production by the community, in addition to solar power and charcoal briquettes as alternative energy sources (Githiomi & Oduor, 2012; Githiomi *et al.,* 2012; Wamuongo *et al.,* 2015). Furthermore, with improved water and seed access, there is an opportunity for the small-scale agro-pastoralists to establish tree nurseries and plant trees to generate

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income through the sale of carbon credits (Kagombe *et al.,* 2018).

Table 1: Demographic and Socio–Economic Household Characteristics in the Agro-pastoral Community

Demographic and Socio-Economic Characteristics	Frequency (n=384)	Percentage (%)
Gender		
Male	297	77.3
Female	87	22.7
Marital Status		
Single	17	4.4
Married	345	89.9
Separated	18	4.7
Widowed	4	1.0
Age (Years)		
Youth (15 – 24)	28	7.3
Young adults (25 – 34)	78	20.3
Adults (35 – 49)	171	44.5
Mature adults (50 – 64)	82	21.4
Aged population (over 65)	25	6.5
Duration of community stay		
Less than 5 years	65	16.9
5 – 10 years	86	22.4
11 – 20 years	68	17.7
Over 20 years	165	43.0
Household Size		
1 – 4 members	148	38.5
5 – 9 members	194	50.5
10 – 13 members	42	10.9
Education level		
None	154	40.1
Primary	115	29.9
Secondary	54	14.1
Tertiary	33	8.6
University	28	7.3
Housing kind		
Mud-walled with grass thatched	142	37.0
Semi-permanent with iron sheets	214	55.7
Permanent stone-walled	28	7.3
Cooking fuel		
Firewood	378	98.4
Charcoal	5	1.3
Gas	1	0.3

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Figure 2: Household Perception of the Kind of Assets Owned

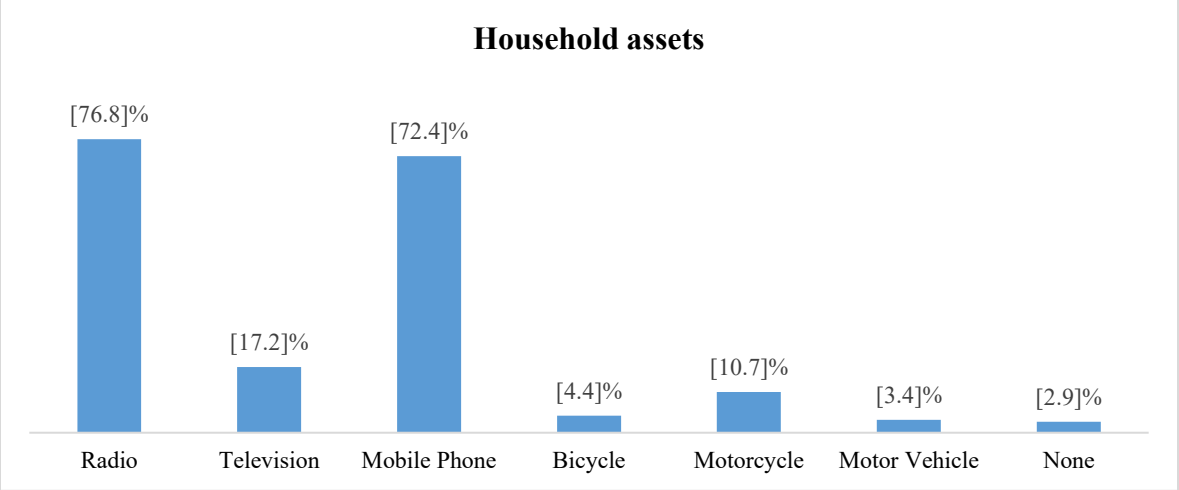

Figure 2 indicates that radio and mobile phones are the popular assets owned by the majority, with 76.8% and 72.4% of the households, respectively. Radio and mobile phones can offer opportunities not only in knowledge transfer and information on issues affecting agriculture but also in addressing the problems associated with current challenges brought by climate variability and change. The use of information and communication technologies in agricultural extension services particularly mobile phones and radios to provide information on agricultural technologies, innovations and management practices in addition to advisories, insurance, market, weather and climate for context specific decision making in support of livelihood improvement strategies (Baumüller, 2016; Mwantimwa, 2017; Yohannis *et al.,* 2019).

Major Occupation and Experience of the Household

In Table 2, food crop farming is the major activity/occupation practised by the households (48.2%), followed by cash crop farming (10.4%) and salaried/fixed employment (10.2%). The average period of farming experience ranged from 6.9 to 20.5 years for casual labour and beef farming, respectively, while the mean average farming period was 11.8 years.

Table 2: Household Farming Experience Based on Major Activity/Occupation

Major activity/occupation	Frequency (N=384)	Percentage (%)	Average period involved in years
Cash crop farming	40	10.4	10.0
Food crop farming	185	48.2	13.2
Dairy farming	1	0.3	10.0
Beef farming	4	1.0	20.5
Poultry keeping	3	0.8	8.3
Both cash/food crop and dairy/beef farming	34	8.9	15.1
Small business/trade	30	7.8	8.9
Casual labour	38	9.9	6.9
Employed	39	10.2	10.8
Others	10	2.6	11.2
Mean	**384**	**100**	**11.8** with Std Dev **8.9**

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Table 3 below shows the kind of agriculture, income sources, farming types and off-farm activities practised in the agro-pastoral community. The majority (77.6%) of the households still rely on rainfed agricultural production, making them highly vulnerable to climate variability and change. Most (59.4%) of the households still rely on farming as the major source of income, while those that depend on off-farming activities were 40.6 %. This is an indication that the majority of the small-scale agro-pastoralists rely on rain-fed agriculture, with farming being the main source of income, as compared to a handful that rely on off-farm activities. This finding agrees with the work of Wamuongo *et al.* (2015), which reported that Kenyan agriculture still relies on rain-fed agriculture.

A majority (53.9%) of the households still practice crop and livestock farming, 39.5% practice crop farming and a meagre 6.6% practice livestock farming. This indicates that the households are diversifying risks with a changing climate. The results are consistent with the research of Ulrich *et al.* (2012). Adoption of drought-tolerant crop varieties and livestock breeds is vital in addressing issues of climate variability and change. The low percentage of small-scale agro-pastoralists is occasioned by overpopulation, bringing about pressure on grazing land, and hence, land for pasture decreases over time. Furthermore, due to harsh climatic conditions, such as drought, many livestock have died, forcing the majority of households to rely on crop farming as their primary source of income. As a result, the small plots of land are used for crop farming. For off-farm activities practised, a majority (34.0%) practice small businesses, 32.1% rely on salaried employment, 18.6% practice casual labour, and 7.7% involved in other activities.

Small-scale businesses are the most popular among households, particularly retail shops, hotels, and maize grain stores concentrated in trading centres. A few of the households are engaged in salaried employment, e.g. teachers in primary and secondary schools, others work in the security sector, while others work in the County Government Departments. The casual labourers are engaged in providing labour in farming and construction activities. Their proportion is moderately low due to insufficient opportunities. Charcoal burning is practised in the drier areas of the agro-pastoral community. Efforts by the government and other environmental players have rendered charcoal burning to diminish since it leads to the destruction of the environment through the cutting down of trees for charcoal. Some of the households are in artisan activities, e.g. masonry, welding and plumbing. The other activities include government cash transfer programmes, e.g. for the old members, gold mining, boda boda riding, which bridges the gap in the transport sector by moving goods and people in areas that vehicles may not access and traditional medicinal activities, which may include the sale of herbs and roots from plants.

FGD discussant revealed that ‘‘the community does small businesses like sale of vegetables and livestock from the farm and small kiosks, crop and livestock diversification, use of generators to pump water for farming, reliance on savings and internal lending and credit for farming and paying school fees. The extraction of aloe vera and traditional medicine, and river bank pegging proposed by the community elders to counter the changing climate’’.

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Table 3: The Kind of Agriculture, Source of Income, Farming Type and Off-farm Activities Practised by the Household

Variable	Response	Percentage
Kind of agriculture practised	Rainfed agriculture	77.6 %
	Both rainfed and irrigated	19.8 %
	Irrigated	2.6 %
Source of income	Farming	59.4 %
	Off-farm	40.6 %
Type of farming practised	Crop and livestock farming	53.9 %
	Crop farming	39.5 %
	Livestock farming	6.6 %
Off-farm activities practised	Small-scale businesses	34.0 %
	Salaried/fixed employment	32.1 %
	Casual labour	18.6 %
	Mixed	3.2 %
	Charcoal burning	3.2 %
	Artisan	1.3 %
	Others	7.7 %

Household On-farm and Off-farm Income Activities

Table 4 indicates the monthly income made by the households based on-farm and off-farm activities. Crop farming is the most important source of income, earning a monthly income of Kshs 9,831.11 with a standard deviation of Kshs 9,496.02, followed by crop and livestock farming at Kshs 9,299.19 with a standard deviation of Kshs 10,507.95, and the least was livestock farming at Kshs 4,433.33 with a standard deviation of Kshs 3,110.27. For off-farm activities, the average monthly income for charcoal burning was Kshs 2,000 with a standard deviation of Kshs 1,224.74, followed by casual labour with Kshs 3,998.28 and a standard deviation of Kshs 3,968.77. Artisan was Kshs 7,000 with a standard deviation of Kshs 1,414.21. Other farm activities was Kshs 8,375 with a standard deviation of Kshs 8,068.25, small-scale business was Kshs 9,716.98 with a standard deviation of Kshs 7,372.97. Mixed was Kshs 21,500 with a standard deviation of Kshs 16,492.42, and salaried/fixed employment was Kshs 39,140.00 with a standard deviation of Kshs 23,799.34. The results indicate substantial disparities in the source of income from both farm and off-farm activities.

Table 4: Household Monthly Income Based On-farm and Off-farm Activities

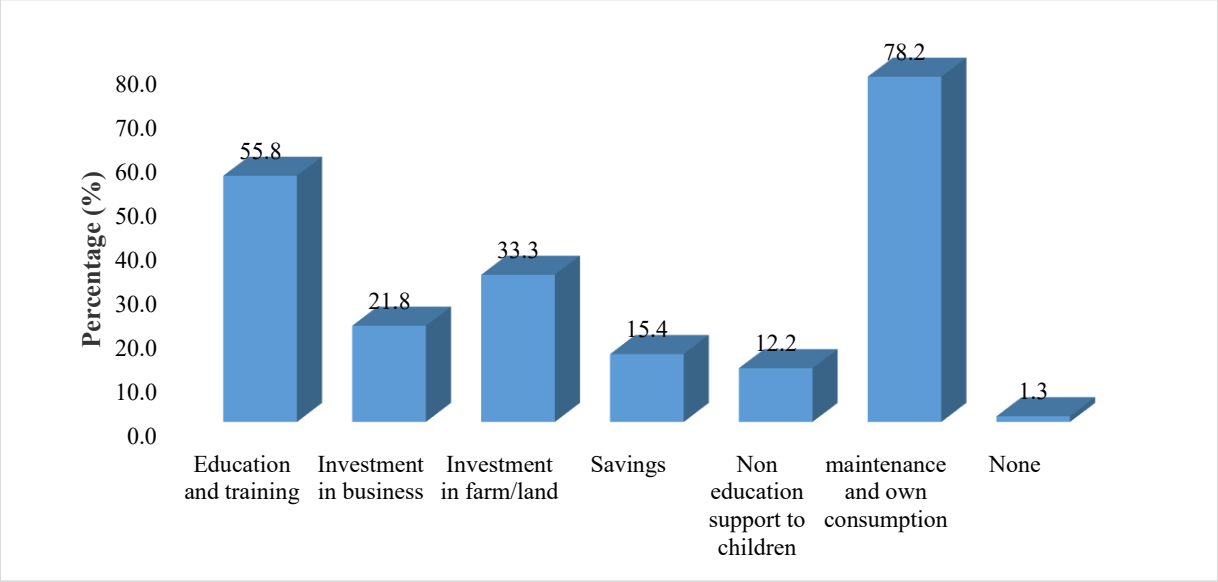
Source of income	Farm/Off-farm Activities Practised	Minimum	Maximum	Monthly Income Value (Kshs)	SE of Mean	Standard Deviation
Farm Activities	Crop farming (n=90)	500	50,000	9,831.11	1,000.97	9,496.02
	Livestock farming (n=15)	500	10,000	4,433.33	803.07	3,110.27
	Crop and livestock farming (n=123)	600	60,000	9,299.19	947.47	10,507.95
Off-farm Activities	Small-scale business (n=53)	1,000	30,000	9,716.98	1,012.76	7,372.97
	Artisan (n=2)	6,000	8,000	7,000	1,000.00	1,414.21
	Casual labour (n=29)	200	15,000	3,998.28	736.98	3,968.77

Article DOI : https://doi.org/10.37284/eajab.8.1.3373

Source of income	Farm/Off-farm Activities Practised	Minimum	Maximum	Monthly Income Value (Kshs)	SE of Mean	Standard Deviation
	Salaried/fixed employment (n=50)	5,000	140,000	39,140.00	3,365.73	23,799.34
	Charcoal burning (n=5)	1,000	4,000	2,000.00	547.72	1,224.74
	Mixed (n=5)	10,000	50,000	21,500.00	7,375.64	16,492.42
	Others (n=12)	1,000	25,000	8,375.00	2,329.10	8,068.25

Figure 3 depicts the household utilisation of the income accrued from off-farm activities. Most (78.2%) of the households use it for maintenance and own consumption, 55.8% use it for education and training, 33.3% for investment in farm/land, 21.8% for business investment, 15.4% use it for savings while 12.2% for non-education support to children and 1.3% didn't use the off farm income.

Figure 3: Household Use of the Income Accrued from Off-farm Activities



Household Participation in Decision Making in the Agro-pastoral Community

Table 5 shows the participation of the household members in social groups and decision-making. The results showed that most, 53.1% of the households, participate in social groups, the majority of whom are affiliated with savings and internal loans and credit (67.2%). Savings and internal loans, and credit are gaining momentum, offering cheap member loans under a revolving fund largely from member contributions. At the end of the twelve months, the members come together for a share-out calculated from member contributions and interest accrued from advanced loans. A few of the households participate in self-help groups (26.0%), consisting of members with common interests segregated by age and location. A significant number of the households (60.7%) hold positions in the social groups. The positions are varied, where 48.1% are members, 24.1% are treasurers, 15.7% are secretaries, 11.1% are chairpersons, and a meagre 0.9% are deputy chairpersons. A higher percentage of households (69.7%) participate in making decisions in the various social groups attributed to their social status in the agro-pastoral

Article DOI : https://doi.org/10.37284/eajab.8.1.3373

community. However, the participation of households in producer organisations is very low at 2.9% (Table 5).

Table 5: Household Participation in Social Groups and Decision-making

Variable	Response	Frequency (n=384)	Percentage (%)
Participation in Social Group	Yes	204	53.1
	No	180	46.9
Type of Social Group Participation	Self-Help Group	99	26.0
	Vulnerable and Marginalised Group	8	2.0
	Saving and Internal Loans and Credit	258	67.2
	Village Committee	17	4.4
	Clan/Family Committee	2	0.5
Position Holding in the Social Group	Yes	233	60.7
	No	151	39.3
Distribution of positions in the Social Groups	Chairperson	47	11.1
	Deputy Chairperson	2	0.9
	Secretary	60	15.7
	Treasurer	93	24.1
	Member	185	48.1
Participation in Social Group Decision Making	Yes	277	69.7
	No	107	30.3
Participation in Producer Organisation	Yes	11	2.9
	No	373	97.1

Land Tenure and Acquisition Status

Table 6: Land Ownership and Possession of Title Deed/allotment Letter

	Land Ownership status (n=384)						Land title/allotment letter (n=362)					
	Frequency			Percentage (%)			Frequency			Percentage (%)		
	Male	Female		Male	Female	Total	Male	Female	Total	Male	Female	Total
Yes	280	82	362	72.9	21.4	94.3	79	35	114	21.8	9.7	31.5
No	17	5	22	4.4	1.3	5.7	201	47	248	55.5	13.0	68.5
Total	297	87	384	77.3	22.7	100.0	280	82	362	77.3	22.7	100.0

Table 6 shows the household land ownership. The majority (94.3%) own land, out of which 72.9% were males and females 21.4%. 5.7% do not own land. This implies that a majority of the households own land size averaged 2.2 hectares. However, a significant number of the farmlands are not registered, as depicted by 68.5% of the households.

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Figure 4: The Household Land Tenure Arrangements

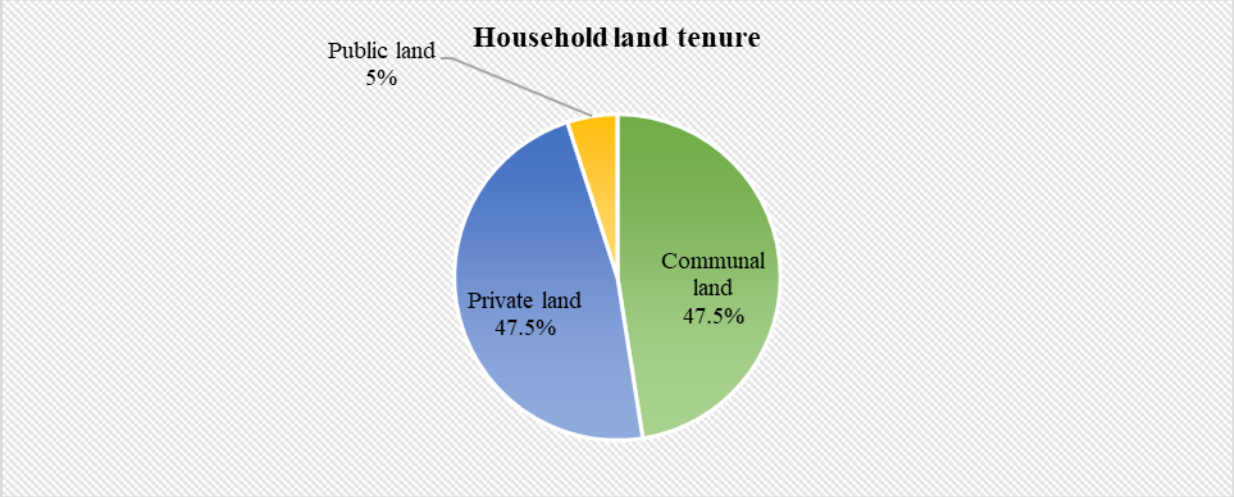
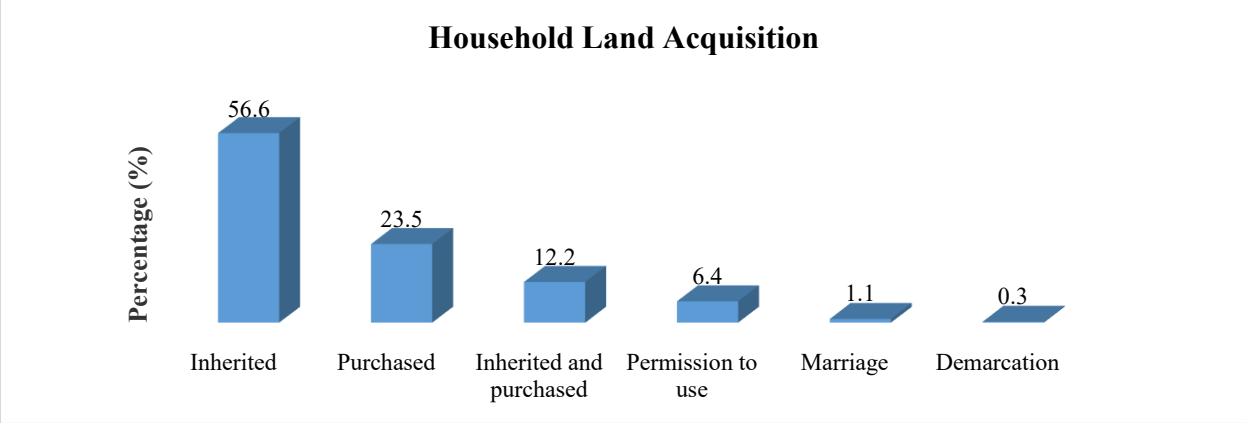


Figure 4 illustrates the distribution of household land tenure arrangements. Land as a factor of production is both communally and privately owned, as indicated in Figure 4.

Figure 5: Household Perception on Land Acquisition Status



In Figure 5, most (56.6%) of the households inherited land, 23.5% purchased land, while 12.2% acquired land through inheritance and purchasing, and 6.4% had permission to utilise the land. The other ways of acquiring land were through marriage and demarcation. Communal land is largely traditional and acquired through inheritance, and is particularly dictated by the clans as compared to privately owned land, which is acquired through purchasing. The implication of this is that the adaptation of climate change initiatives in the privately owned land would be higher than in the communally owned land.

Access to Agricultural Extension Services

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Figure 6: Household Farm Visits by Agricultural Extension Officers

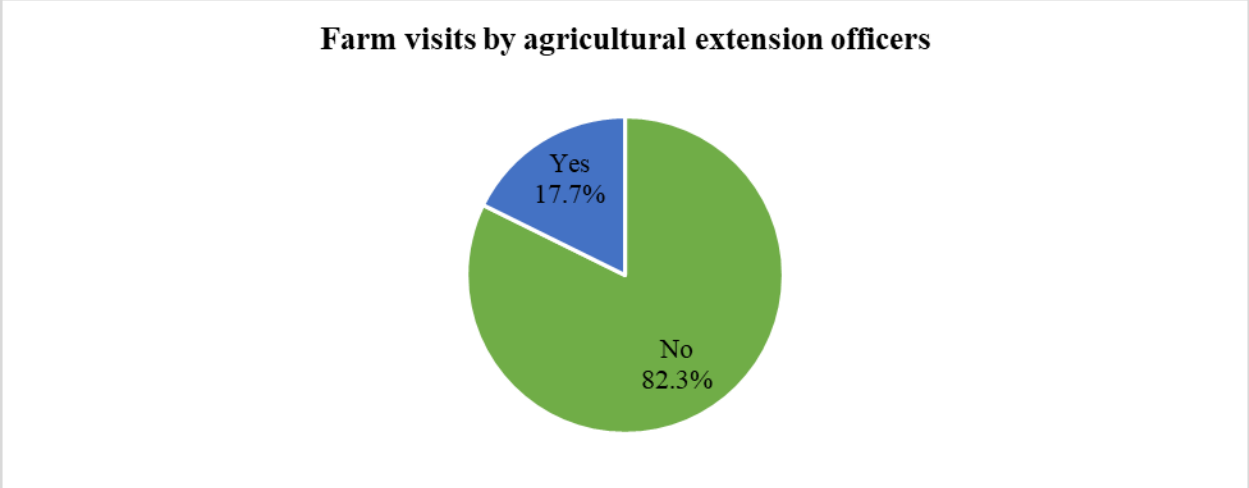
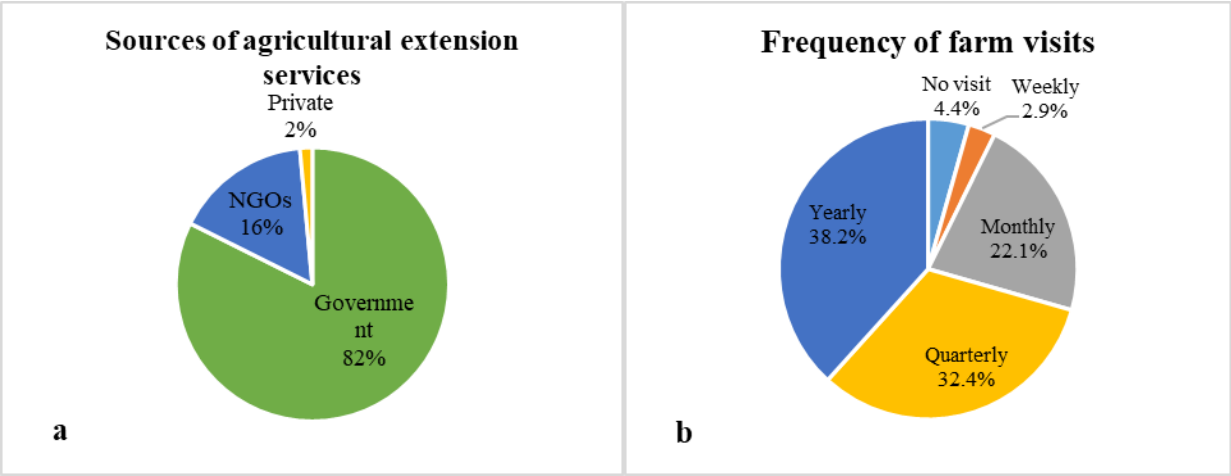


Figure 6 depicts household access to agricultural extension services. Only a meagre 17.7% of the households access agricultural extension services, unlike the 82.3% who don't. This implies that access to agricultural extension services is still very low. This could be attributed not only to the vastness of the agro-pastoral land but the county as well, coupled with the wide distribution of the agro-pastoralists. In addition, low staffing levels of government extension workers, who are the majority, make it difficult to reach every small-scale agro-pastoralist, as shown in Figure 7a. This, in essence, reduces the frequency of accessing extension services to a quarterly basis and even sometimes once a year, as indicated in Figure 7b. Productive areas may receive monthly or even weekly visits as a result of accessibility and close proximity to the agricultural extension officers (Figure 7 b).

Despite the low access to agricultural extension services, there exists, however, an opportunity for the County Government of West Pokot and other stakeholders to increase the capacity of agricultural extension in the delivery of weather and climate information and climate smart agriculture technologies, innovations and management practices to the small-scale agro-pastoralists (CGWP, 2013).

Figure 7: Household Perception on the Frequency of the Source (a) and the Access (b) of Agricultural Extension Services



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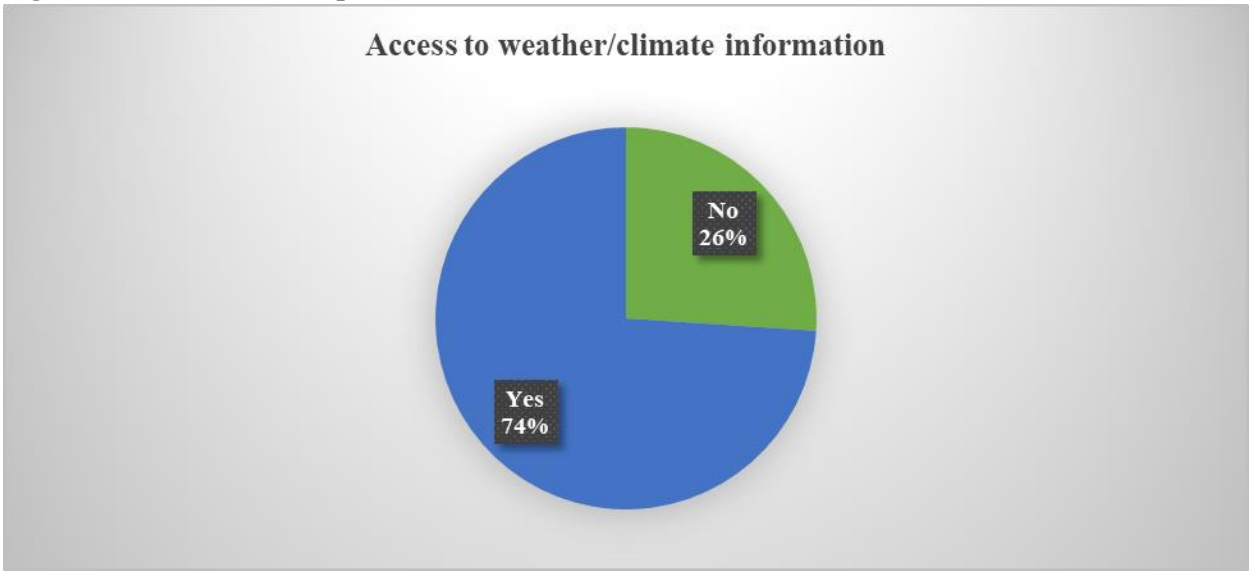
Access to Weather and Climate Information

Figure 8: Household Perception of Access to Weather/Climate Information



Most households (74%) access weather/climate information compared to 26% who do not (Figure 8). From Figure 9, the most common weather/climate information accessed is rainfall (98.6%), followed by temperature (27.5%).

Figure 9: Household Perception on the Type of Weather/Climate Information Accessed

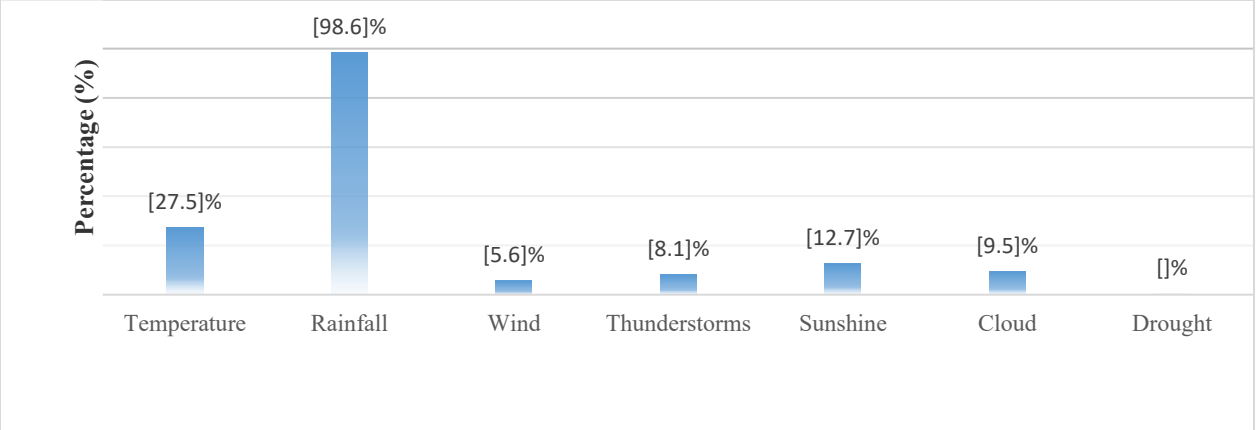


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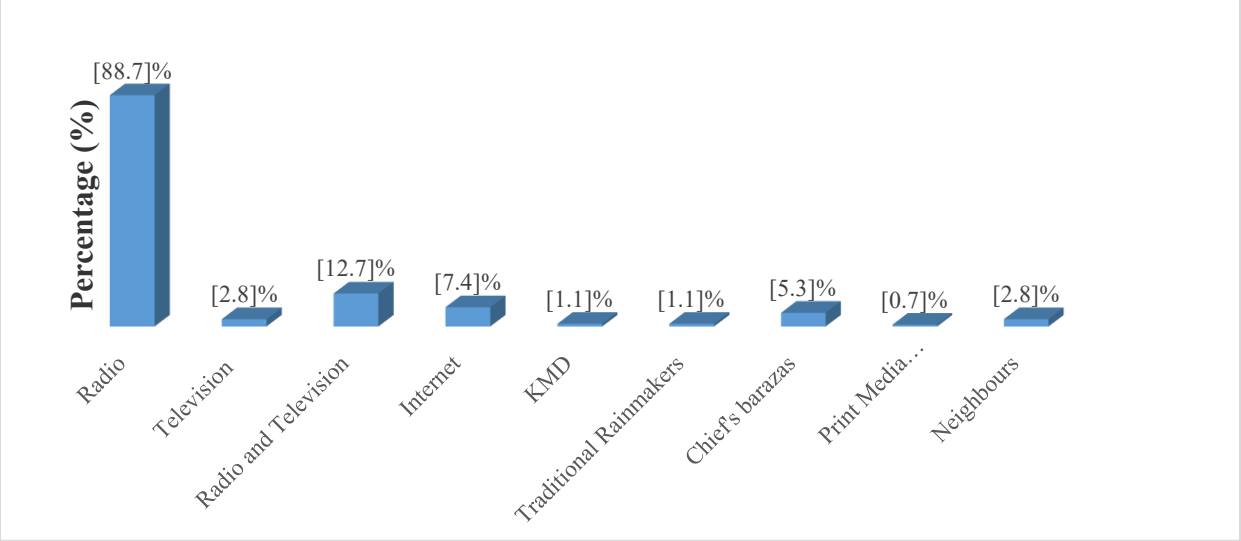
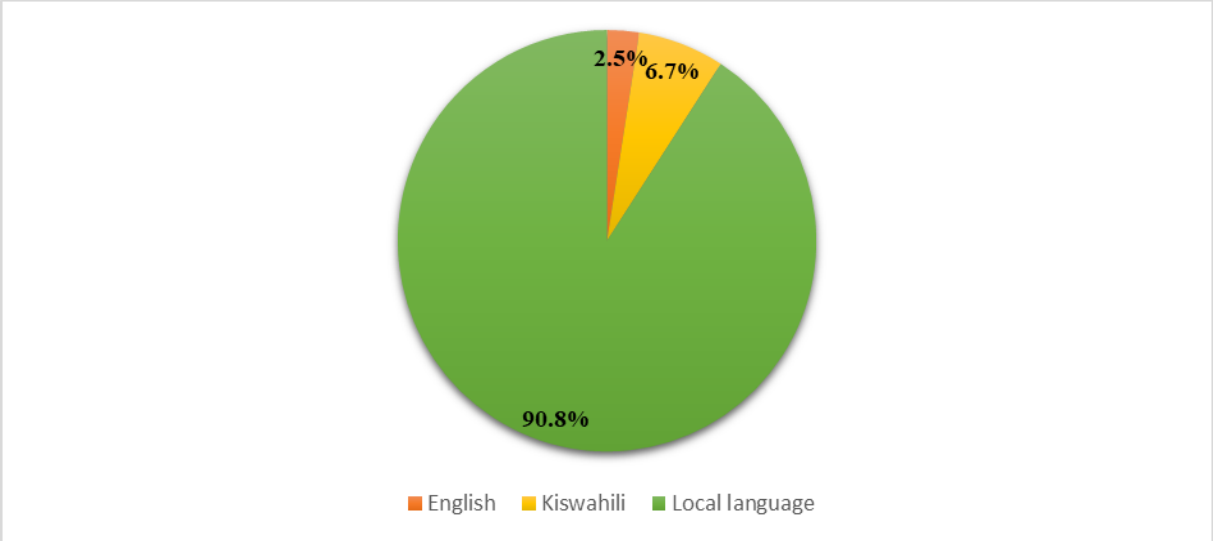
Figure 10: Household Perception of Sources of Weather/Climate Information Accessed



Radio (88.7%) is still the most common and effective source of accessing weather/climate information (Figure 10). The implication is that radio should be the target as the main source of weather and climate information. Radio is the most widely used medium in rural areas, as can be shown by the majority of the households (76.8%) that own radios (Figure 2). Moreover, radio broadcasts are in local (vernacular) language (90.8%), thereby, weather and climate information is easily understood (Figure 11). The results agree with the findings of Oyekale (2015) and Muema *et al.* (2018).

Figure 11: Household Perception of the Language Used in Providing Weather/Climate Information



The frequency of accessing the weather and climate information is monthly and, to some extent, quarterly (Table 7). Furthermore, the weather and climate information is readily available (60.2%), readily accessible (62.0%), sometimes relevant 51.1%), reliable (86.6%), and all the members of the household receive it (80.3%). Access to the weather and climate information has assisted the community to decide on how to adapt to climate variability in terms of planning their farming activities, including

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crop planting dates, selection of crop and variety types and harvesting time.

Table 7: Showing the Frequency, Availability, Accessibility, Relevance, Reliability and Who Receives the Weather and Climate Information

Variables	Response	Frequency (N=384)	Percentage (%)
Frequency	Daily	34	8.8
	Weekly	49	12.7
	Monthly	190	49.6
	Quarterly	66	17.3
	Semi Annually	36	9.5
	Yearly	9	2.1
Availability	Readily Available	231	60.2
	Often Available	132	34.5
	Not Available	21	5.3
Accessibility	Readily Accessible	238	62.0
	Rarely Accessible	127	33.1
	Not Accessible	19	4.9
Relevance	Always Relevant	174	45.4
	Sometimes Relevant	196	51.1
	Never Relevant	14	3.5
Reliability	Reliable	333	86.6
	Not Reliable	51	13.4
Who Receives	Household Head	70	18.3
	Women	4	1.1
	Children	2	0.4
	All	308	80.3

Table 8: Household Perception on the Timeliness, Usefulness and Understanding of the Weather/Climate Information

	Timeliness		Usefulness		Understanding	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	216	76.1 %	225	79.2 %	25	8.8 %
No	68	23.9 %	59	20.8 %	259	91.2 %
Total	284	100 %	284	100 %	284	100 %

The timeliness, usefulness and understanding of the provided weather/climate information by the household are presented in Table 8. The results indicate very high levels of timeliness (76.1%) and usefulness (79.2%) of weather and climate information for crop and livestock farming activities. However, despite the high percentage of accessing the weather and climate information, there is a challenge in the way information is processed and the understanding of the weather and climate information received. This can be seen in the level of understanding weather/climate information, which is very low (8.8%) as compared to the majority (91.2%) who had difficulty in understanding (Table 8). The majority (92%) attributed it to the manner in which channels of communicating the weather and climate information were provided, as can be seen in Figure 12. The finding confirms the study by Cherotich *et al. (*2012), who found that small-scale farmers find it difficult to understand the weather and climate information received. Communicating weather and climate information in the local vernacular language could be an opportunity to improve small-scale

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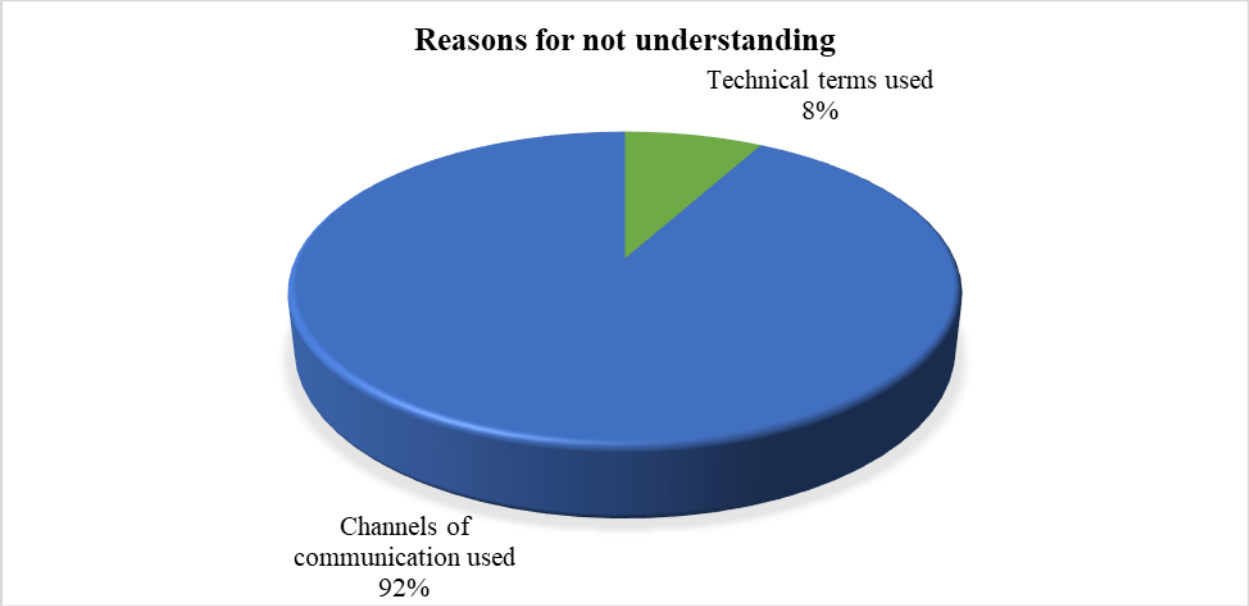
farmers' level of understanding, as confirmed by Ndavula & Lungahi (2018).

Figure 12: Household Perception on the Reasons for Not Understanding Weather and Climate Information

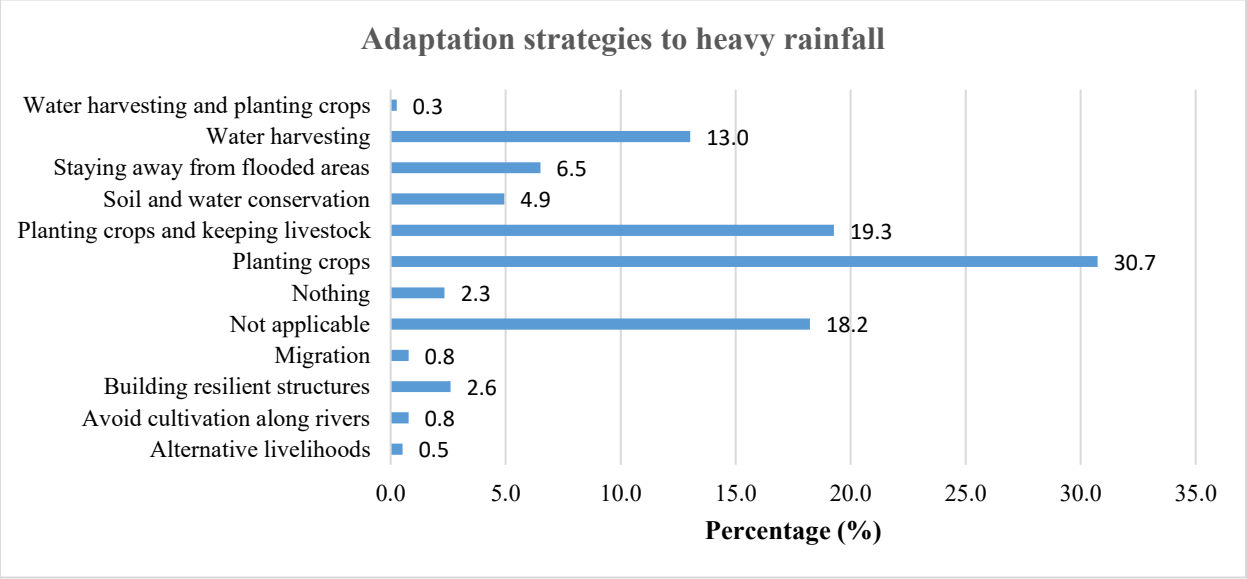


Household Response to the Challenge of Climate Variability and Change

Household Response to the Challenge of Heavy Rainfall

The response of the households to the challenge of heavy rainfall is as shown in Figure 13. Results reveal that the majority experienced the challenge of heavy rainfall responded by planting crops (30.7%), while 19.3% planted crops and kept livestock and 13.0% practised water harvesting (Figure 13).

Figure 13: Household Response to the Challenge of Heavy Rainfall



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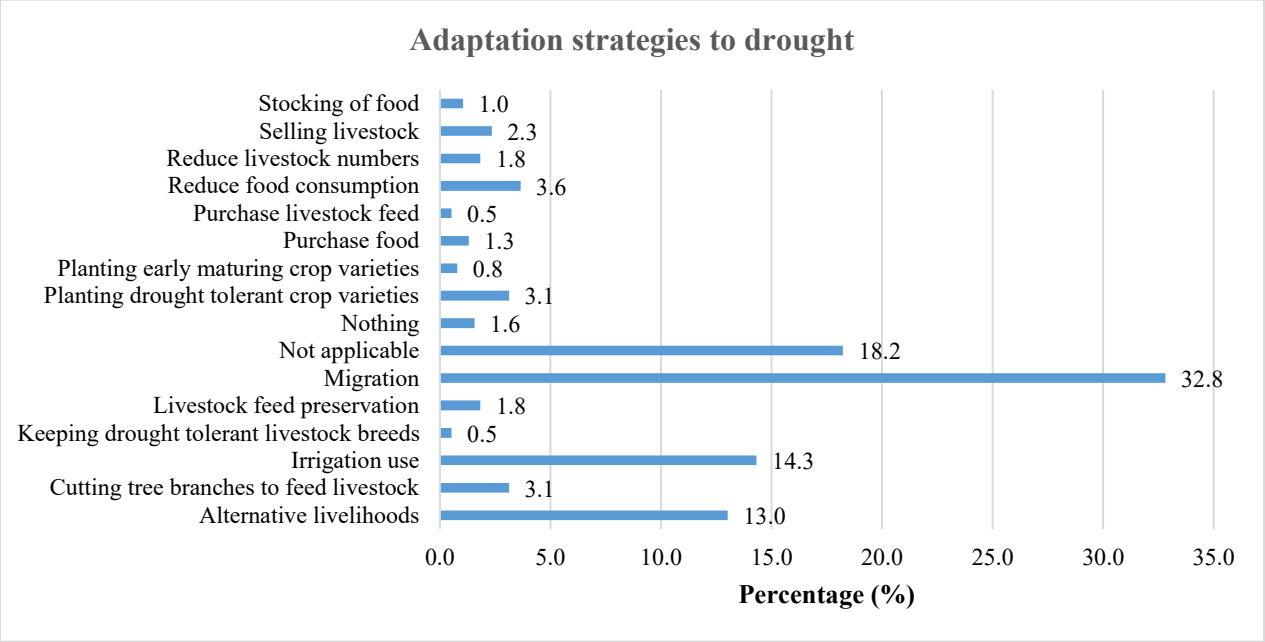
Household Response to the Challenge of Drought

Figure 14 presents the adaptation strategies employed by the households to respond to the challenge of drought. Most households adopted migration (32.8%), while 14.3% used irrigation water and 13.0% used alternative livelihoods.

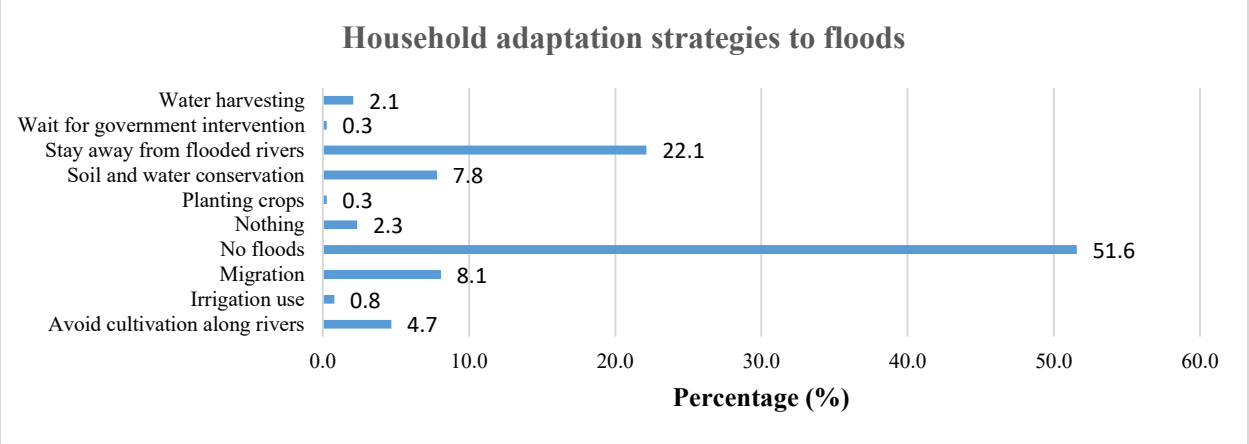
Figure 14: Household Adaptation Strategies to the Challenge of Drought



Household Response to the Challenge of Floods

The adaptation strategies used by the households to respond to the challenge of floods are shown in Figure 15. Most households, 22.1% stayed away from flooded areas, while 8.1% migrated and 7.8% practised soil and water conservation measures.

Figure 15: Household Response to the Challenge of Floods



Household Response to the Challenge of the Landslide

Figure 16 shows the household responses to the challenge of landslides in the agro-pastoral community. The majority of the households, 7.0% responded by relocating to safe areas, 3.1% planted trees, and 2.6% migrated. The results agree with the measures proposed to tackle the challenge of

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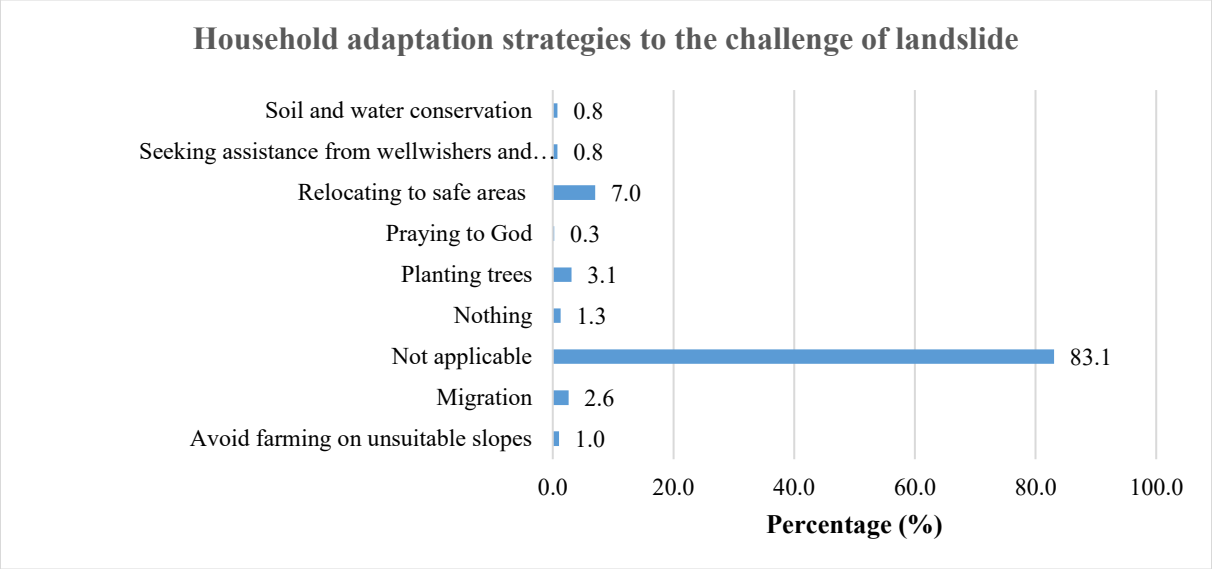
landslides, such as establishing structures on safer grounds and encouraging agroforestry (Maina-Gichaba *et al.,* 2013).

Figure 16: Household Adaptation Strategies to the Challenge of Landslides



Focused Group Discussants held with the agro-pastoral community revealed that the available opportunities are land, permanent rivers to access water for irrigation of high-value crops, e.g. watermelons, tomatoes, bulb onions and green grams. Availability of suitable early maturing and drought-tolerant crops, e.g. Sungura, Duma, DH 04 and Tosheka varieties of maize; Canadian variety of beans and KS 20 of green grams. Improvement of livestock through the adoption of livestock-tolerant breeds, e.g. camels, Dorper sheep. Improved indigenous chicken, Sahiwal, and Galla goats. The other opportunities are tree planting to conserve farms, establishment of pasture and land enclosures to increase pasture, availability of a ready market and diversification of crop and livestock enterprises.

Key informant interviews (KII) held revealed that early maturing and drought-tolerant crops, drought-resistant livestock, irrigation agriculture, in situ water harvesting for fruit production, tree planting, pasture establishment and conservation, and market-oriented farming are some of the opportunities offered to small-scale agro-pastoralists by climate variability and change. Furthermore, capacity building, provision of information on early warning systems, resource mobilisation, formation of producer cooperatives and provision of input seed subsidy are some of the opportunities that could improve the livelihoods of small-scale agropastoral communities.

Challenges

Household Challenges Due to Heavy Rainfall

The household challenges as a result of heavy rainfall are indicated in Figure 17. Crop damage was the most important challenge as reported by 24.2% of the households, 12.6% inadequate water storage facilities, 10.0% farm structures destroyed, 9.5% high costs, 8.4% soil erosion, 7.9% pests and diseases and 6.3% floods. To address the challenges brought by heavy rainfall, there is an opportunity to strengthen the capacity of the small-scale agro-pastoral community on climate information and climate-smart agricultural technologies, innovations and management practices. Such as adoption of water harvesting technologies (such as water pans, boreholes, sub-surface dams, shallow wells and tanks, etc.), and techniques (such as water

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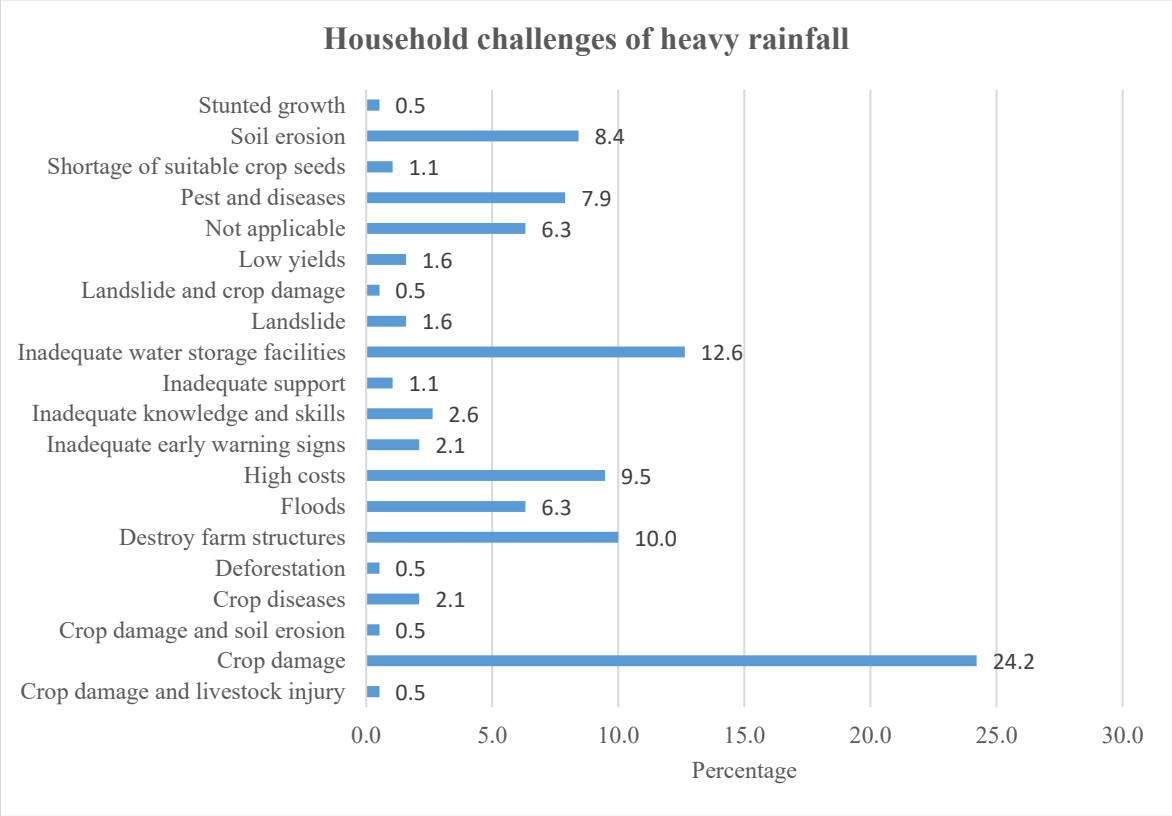
retention ditches, negarims and trapezoidal bunds) to harvest the water for irrigation use and also help reduce soil and water erosion.

Figure 17: Household Perception of the Heavy Rainfall Challenges



Household Challenges Due to Drought

Results from Figure 18 show the challenges faced by the households as a result of the drought. Livestock deaths (30.6%), followed by shortage of food (14.4%) and crop failure (11.1% are the most common challenges reported by the households. One of the consequences of the changing climate is the fluctuation of rainfall that results in dry spells and drought, which eventually culminate in the reduction of agricultural production and productivity. There is an opportunity to strengthen the capacity of the small-scale agro-pastoral community on climate information and climate-smart agricultural technologies, innovations and management practices. According to Dabasso (2021), this includes the provision of early warning information that predicts future climatic conditions of pasture and water, the supplementary feeding of livestock towards maintaining the body condition and the provision of veterinary services to protect or treat breeding livestock against diseases (such as Foot and Mouth Disease, Contagious Caprine Pleuro Pneumonia, Contagious Bovine Pleuro Pneumonia, Newcastle disease), the adoption of early maturing and drought tolerant crop varieties and livestock resilient breeds.

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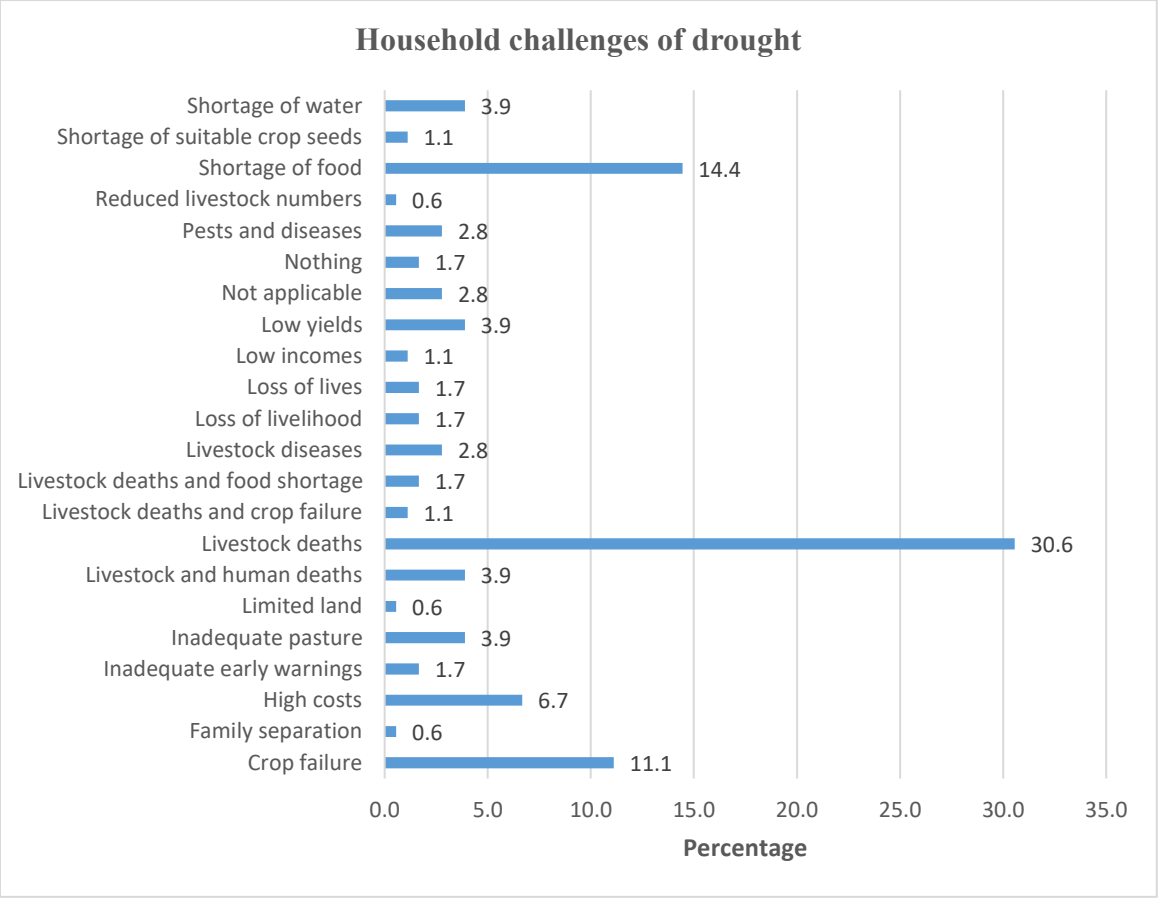
Figure 18: Household Perception of Drought Challenges



Household challenges due to floods

Figure 19 shows that soil erosion (30.1%) and deaths (22.3%) are the major challenges faced by households due to floods. Soil erosion by wind and water decreases soil fertility, which negatively affects crop yields. Moreover, eroded sediments prevent the smooth flow of rivers and streams, leading to floods. According to IPCC (2019), the rate at which soil is eroded in cultivated farms is 100 times higher than the rate at which it is formed, causing land to be unsuitable for agriculture, thereby contributing to climate change. To address the flood challenges, better land use management through soil and water conservation measures, including terraces, cover cropping, agroforestry and building of climate-proofed infrastructure such as bridges and markets, can be an opportunity that the agro-pastoral community can embrace together with other relevant stakeholders.

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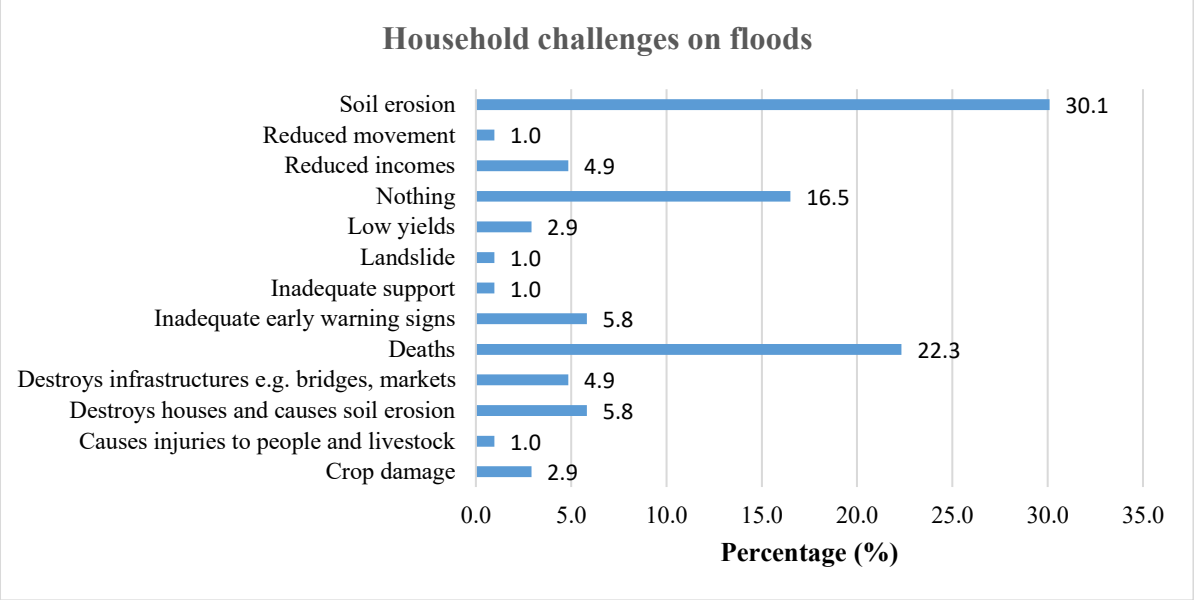
Figure 19: Household Perception of Flood Challenges



Household Challenges due to the Landslide

Figure 20 illustrates the challenges faced by the household regarding the landslide. 17.0% of the households were displaced, 8.5% experienced low yields, 6.4% talked of deaths, another 6.4% talked of human deaths and 6.4% experienced human deaths and displacement.

Focused Group Discussants revealed that the challenges towards sustainable climate change adaptation are multiple. FGD ranked highly inadequate water, high incidences of crop pests and diseases, e.g. desert locust invasion, fall armyworm and maize lethal necrosis disease that affected maize. Livestock diseases, e.g. Newcastle disease of indigenous chicken, Peste des Petits Ruminantes ('Losir') and Contagious Caprine Pleuro Pneumonia ('Loukoi') for goats and sheep, Contagious Bovine Pleuro Pneumonia ('Loukoi'), and Foot and Mouth Disease ('Ngorion') for cattle. Inadequate early maturing and drought-tolerant crop seeds and drought-tolerant livestock breeds such as Galla goats, Sahiwal, improved indigenous chicken, Dorper sheep and camels and inadequate knowledge of good agricultural practices. The other equally important challenges are high costs of inputs, high post-harvest losses, inadequate pastures, and an increase in human diseases (malaria, cholera, typhoid, brucellosis). Inadequate funds, poor infrastructure, fluctuating market prices, and the emergence of aggressive tree species, e.g. *Acacia senegal* ('Panyarit') and *A. mellifera* ('Talamogh) and *Parthenium hysterophorous* L. ('Karelmet'), which makes milk taste bitter and is allergic to humans, are some of the challenges towards sustainable climate change adaptation.

Key informant interviews held indicated that lack of knowledge and skills on appropriate agricultural technologies to adopt, lack of financial support, high costs of inputs, land tenure, market and value addition are some of the challenges small-scale agro-pastoralists face in trying to attain sustainable climate change adaptation. To overcome these challenges, proper policy legislation, strengthening early warning systems, capacity building on agricultural technologies, innovations and management practices, provision of funds and index-based insurance schemes are some of the strategies to overcome the challenges.

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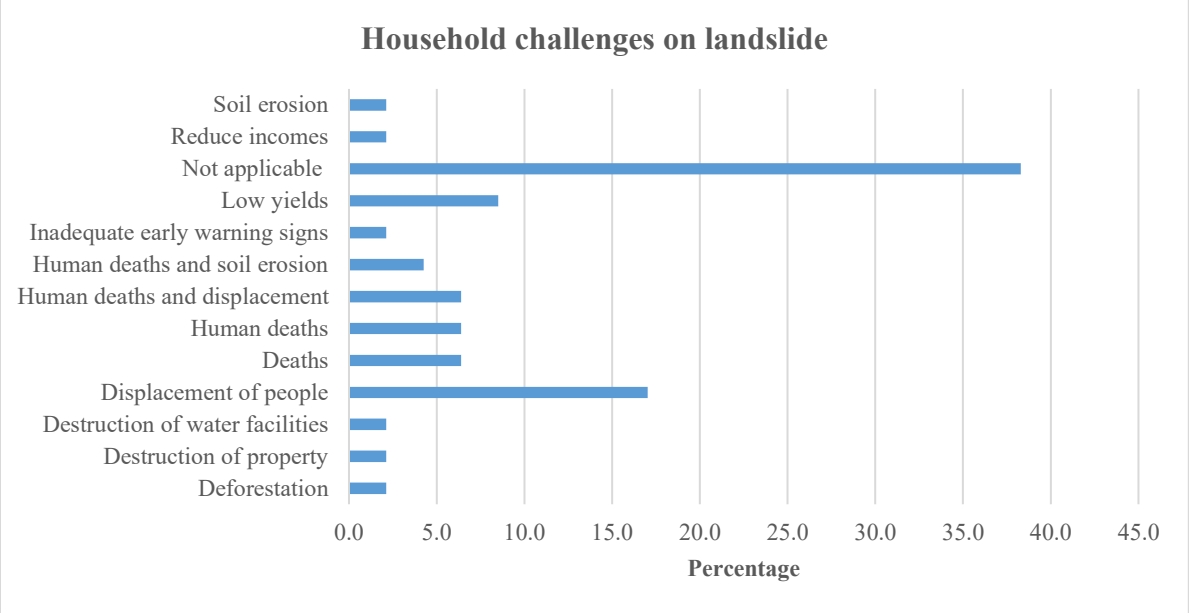
Figure 20: Household Perception of Landslide Challenges



CONCLUSION AND RECOMMENDATIONS

The study reveals that there is a gradual transition from subsistence pastoralism to small-scale settled and market-oriented crop and livestock farming. Rainfed agriculture is still the dominant, and to some extent, irrigated agriculture is practised with significant income disparities sourced from on and off-farm activities. Most of the households face varied challenges and use multiple responses to tackle climate variability and change in the agro-pastoral community, which is patriarchal, with the involvement of women being very low.

This study contributes to the growing body of knowledge on climate variability and change by providing localised, evidence-based insights into how small-scale agro-pastoralist communities in arid and semi-arid regions experience and respond to navigate climate-related risks. It further highlights the unique socio-economic, environmental, and institutional factors that shape both the constraints and opportunities for sustainable climate adaptation. The findings will inform climate-resilient planning and programming, where traditional knowledge systems and adaptation strategies remain under-researched yet vital to building resilience in the face of increasing climate variability. Finally, the study not only enhances scholarly understanding of climate vulnerability in dryland systems but also provides practical recommendations for policymakers, development practitioners, and local communities seeking to advance sustainable and equitable climate resilience.

Acknowledgement

The authors thank all the household respondents who participated in providing data through interviews and focus group discussions. This work was supported by funds from the World Bank through the Kenya Climate Smart Agriculture Project. The assistance and support from the Department of Earth and Climate Sciences at the University of Nairobi and the County Department of Agriculture, Irrigation, Livestock and Fisheries in the County Government of West Pokot are also highly acknowledged.

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