Climate Variability and Temperature Trends in West Pokot County, Kenya: A 34-Year Analysis (1990-2023)

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Abstract- ***Climate change poses significant challenges to vulnerable regions in East Africa, with pastoral and agricultural communities bearing disproportionate impacts. This study analyzed climate variability and trends in West Pokot County, Kenya, over a 34-year period (1990-2023) using CHIRPS v3.0 precipitation data and meteorological temperature records. Analysis examined annual and seasonal patterns across four seasons: MAM, JJA, SON, and DJF. Results revealed mean annual precipitation of 890.43 mm with an increasing trend of 6.31 mm/year. MAM and JJA seasons contributed 36.04% and 31.46% of annual precipitation respectively. Both minimum and maximum temperatures increased by 1.13°C over the study period. Severe droughts occurred in 2000, 2009, 2014, and 2018, while 2020 recorded exceptional rainfall (1,435.55 mm). These findings confirm significant climate change impacts with implications for agricultural productivity, water resources, and pastoral livelihoods, providing essential baseline data for climate adaptation strategies.***

Indexed Terms- ***Climate variability, Temperature trends, Precipitation patterns, West Pokot County***

I. INTRODUCTION

Climate change represents one of the most pressing challenges of the 21st century, with disproportionate impacts on vulnerable populations in developing countries (IPCC, 2021). East Africa has been identified as a climate change hotspot, experiencing increasing temperatures, altered precipitation patterns, and more frequent extreme weather events (Nicholson, 2017).

Kenya's arid and semi-arid lands (ASALs), which constitute approximately 80% of the country's landmass, are particularly vulnerable to climate variability and change (Government of Kenya, 2018). West Pokot County, located in Kenya's northwestern region, exemplifies these vulnerabilities with its predominantly pastoral and agro-pastoral communities facing increasing climate-related challenges. The county's economy relies heavily on livestock keeping and rain-fed agriculture, making it highly susceptible to climate-induced shocks (Lolemtum et al., 2020).

Despite the recognized vulnerability of West Pokot County to climate change, comprehensive analysis of long-term climate trends in the region remains limited. Previous studies have focused primarily on drought impacts and traditional coping mechanisms (Timu & Atupamoi, 2022), with less emphasis on systematic analysis of climate trends over extended periods.

This study addresses this knowledge gap by analyzing climate variability and trends in West Pokot County over a 34-year period (1990-2023). The research aims to: (1) examine long-term precipitation trends and patterns, (2) analyze temperature trends, and (3) identify seasonal variations and extreme climate events. The findings provide essential baseline information for understanding climate change impacts and developing appropriate adaptation strategies.

II. LITERATURE REVIEW

East Africa has experienced significant climate changes over the past several decades, with substantial spatial and temporal variability (Gebrechorkos et al., 2019). Regional studies have documented increasing temperatures across most of East Africa, with annual warming rates ranging from 0.02°C to 0.04°C per decade (Wainwright et al., 2019). Precipitation trends show more complex patterns with significant spatial heterogeneity. Cattani et al. (2018) reported increasing variability in the SON season across the region, while MAM

precipitation has shown declining trends in parts of eastern Kenya and Ethiopia (Wekesah et al., 2019).

Kenya's ASALs have been at the forefront of climate change impacts, experiencing increased frequency and intensity of droughts, erratic rainfall patterns, and rising temperatures (Serdeczny et al., 2017). Studies in northern Kenya have documented similar climate trends affecting pastoral communities in Turkana County (Schaafsma et al., 2021). Research in Baringo and West Pokot counties has highlighted challenges of unpredictable rainfall patterns for agro-pastoral livelihoods (Bulle et al., 2022).

Climate variability significantly affects pastoralist and agricultural communities through multiple pathways. Drought events reduce pasture availability and water resources for livestock, while erratic rainfall patterns disrupt agricultural calendars and reduce crop yields (Connolly-Boutin & Smit, 2016). Temperature increases compound these challenges by increasing evapotranspiration rates and creating heat stress for crops and livestock (Mugisha et al., 2020).
Despite growing recognition of climate change impacts in East Africa, significant knowledge gaps remain regarding local-scale climate trends. Most regional climate analyses focus on large spatial scales that may not capture local variations important for community-level adaptation planning. West Pokot County exemplifies these data limitations, with few systematic analyses of long-term climate trends despite recognized vulnerability to climate change.

III. RESEARCH METHODOLOGY

3.1 Study Area

West Pokot County is located in Kenya's northwestern region, covering approximately 9,169.4 km². The county borders Uganda to the west, Trans Nzoia County to the south, Elgeyo Marakwet and Baringo counties to the east, and Turkana County to the north. Topography varies from highlands (eastern parts) to lowlands (western and northern regions), with elevations ranging from 1,000 to 3,000 meters above sea level. Annual rainfall ranges from 400mm in lowlands to 1,500mm in highlands, with two distinct rainy seasons. The economy is predominantly pastoral and agro-pastoral.

3.2 Data Sources and Analysis

Precipitation data was obtained from the Climate Hazards Center InfraRed Precipitation with Station data (CHIRPS v3.0), providing daily rainfall estimates at 0.05-degree spatial resolution. Temperature data was compiled from meteorological station records and gridded climate datasets. Quality control procedures were applied to identify and correct data inconsistencies, outliers, and missing values.

The analysis covered 1990-2023, focusing on four seasonal periods: December-January-February (DJF), March-April-May (MAM), June-July-August (JJA), and September-October-November (SON). Climate trend analysis employed linear regression and Mann-Kendall tests for trend significance. Extreme events were identified using standardized anomalies and percentile-based thresholds. Drought years were defined as those with annual precipitation below the 25th percentile, while wet years exceeded the 75th percentile.

IV. RESULTS

4.1 Annual Precipitation Trends

Analysis revealed significant variability in West Pokot County's climate with mean annual precipitation of 890.43 mm over 1990-2023, showing a positive trend of 6.31 mm per year (total increase of 214.54 mm). Annual precipitation ranged from 642.90 mm (2000) to 1,435.55 mm (2020), with coefficient of variation of 18.3%. Notable drought years included 2000, 2014 (718.58 mm), and 2022 (741.16 mm), while exceptionally wet years occurred in 2020, 2007 (1,346.90 mm), and 2002 (1,333.20 mm). The 2009 drought was particularly severe in community impacts despite moderate precipitation deficits.

4.2 Seasonal Precipitation Patterns

Seasonal analysis revealed distinct precipitation distribution: MAM (36.04% of annual, 321.39 mm mean), JJA (31.46%, 280.60 mm), SON (24.41%, 217.69 mm), and DJF (8.09%, 72.14 mm).

MAM Season: Showed increasing trend of 2.489 mm annually (84.64 mm total increase), with peak precipitation in 2018 (662.66 mm), 2020 (504.46 mm), and 2012 (482.46 mm).

JJA Season: Demonstrated increasing trend of 1.515 mm annually (51.51 mm total increase), with highest years being 2020 (513.35 mm), 2007 (447.23 mm), and 2017 (391.05 mm).

SON Season: Showed 2.69 mm annual increase (91.37 mm total), with peaks in 2011 (384.40 mm), 2006 (355.58 mm), and 2020 (315.06 mm). Drought years included 2016 (117.75 mm), 2003 (114.98 mm), and 2018 (104.14 mm).

DJF Season: Recorded slight decreasing trend of 0.46 mm annually (15.67 mm total decrease), with peaks in 2010 (212.46 mm), 2007 (172.46 mm), and 1990 (152.45 mm).

4.3 Temperature Trends

Temperature analysis revealed consistent warming trends affecting both minimum and maximum temperatures.

Minimum Temperatures: Averaged 13.91°C with upward trend of 0.033°C per year (1.13°C total increase). Lowest temperatures in early 1990s: 1991 (13.37°C), 1993 (13.53°C), 1996 (13.85°C). Highest in recent years: 2023 (15.72°C), 2002 (15.53°C), 2009 (15.02°C).

Maximum Temperatures: Averaged 28.20°C with identical warming trend of 0.033°C per year (1.13°C total increase). Lowest recorded in 1994 (27.76°C), 1992 (27.94°C), 1990 (28.01°C). Peaks in 2023 (30.00°C), 2009 (29.43°C), 2003 (29.28°C).

4.4 Extreme Events and Variability

Analysis identified several exceptional climate periods significantly impacting local communities. The 2000 drought (642.90 mm, 28% below mean) combined with above-average temperatures created severe water stress. The 2009 drought showed moderate precipitation deficits but exceptionally high temperatures (29.43°C maximum), exacerbating impacts. Conversely, 2020 demonstrated extreme conditions with 1,435.55 mm (61% above mean), causing flooding while replenishing water resources.

Increasing frequency of extreme temperature events emerged, with five hottest years occurring after 2000: 2023, 2009, 2003, 2020, and 2016. Decadal analysis revealed evolving patterns: moderate 1990s, increased variability in 2000s with severe droughts (2000, 2009) offset by wet years (2007), continued variability in 2010s, and early 2020s marked by extremes (wet 2020, drought 2022). Temperature increases accelerated post-2000, aligning with global warming trends.

V. DISCUSSION

The climate trends identified in West Pokot County align closely with regional patterns documented across East Africa, confirming significant climate change impacts consistent with broader regional and global trends. The warming trends of 1.13°C over 34 years exceed global average warming rates, highlighting the vulnerability of semi-arid regions to accelerated climate change.

The increasing precipitation trends, particularly during MAM and JJA seasons, appear contrary to some regional projections suggesting drying in parts of East Africa. However, this increase is accompanied by greater variability and more frequent extreme events, consistent with climate change projections. The intensification of both wet and dry extremes poses significant challenges for agricultural and pastoral communities, as traditional coping mechanisms may be inadequate for increased climate variability.

The warming trends have multiple implications for local livelihoods. Higher temperatures increase evapotranspiration rates, effectively reducing water availability even when precipitation increases. This is particularly problematic during the DJF season, where slight precipitation decrease combined with warming creates increasingly harsh conditions. The seasonal timing of precipitation changes also has important implications - increasing MAM precipitation could benefit crop production if properly managed, but high variability means farmers face increased uncertainty in planting decisions.

CONCLUSION

This comprehensive analysis provides clear evidence of significant climate change affecting West Pokot County from 1990-2023. Key findings include: (1) Confirmed warming trends with 1.13°C temperature increase exceeding global averages, (2) Increasing precipitation variability with greater extreme events despite slight annual increases, (3) Seasonal pattern changes with main wet seasons (MAM, JJA) increasing but dry season (DJF) becoming drier, (4) Extreme event intensification with severe droughts (2000, 2009, 2014) and exceptional wet conditions (2020), and (5) Accelerating change with climate trends intensifying post-2000.

These findings confirm West Pokot County is experiencing substantial climate change impacts posing challenges for communities dependent on climate-sensitive livelihoods. The combination of warming temperatures and increasing precipitation variability creates a more challenging environment for both agricultural and pastoral activities.

RECOMMENDATIONS

For Local Communities and Development Partners: Develop climate-responsive agricultural practices accommodating both drought and flood conditions; invest in water harvesting infrastructure; strengthen early warning systems; support livelihood diversification.

For Policy Makers: Integrate climate trends into county and national development planning; prioritize climate adaptation investments; develop flexible agricultural policies; strengthen disaster risk management systems.

For Climate Services: Improve seasonal forecasting; develop user-friendly climate information products; strengthen partnerships between climate scientists and local communities.

This study provides essential baseline information for climate adaptation planning and demonstrates the critical importance of sustained climate monitoring in vulnerable regions.

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