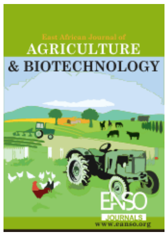
East African Journal of Agriculture and Biotechnology, Volume 8, Issue 1, 2025
Article DOI : https://doi.org/10.37284/eajab.8.1.2791



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

Adaptive Strategies for Enhancing Finger Millet (Eleusine coracana) Productivity in Response to Climate Variability in Kericho County

Enneth Chepkorir[1] & Dr. Catherine Sang, PhD[2]*

[1] University of Nairobi, P. O. Box 30197-00100, Nairobi, Kenya.
[2] University of Eldoret, P. O. Box 1125-30100, Eldoret, Kenya.
* Author for Correspondence ORCID ID; https://orcid.org/0000-0002-4693-2298; Email: chepkorirenneth@gmail.com

Article DOI : https://doi.org/10.37284/eajab.8.1.2791

Date Published:

20 March 2025

Keywords:

Indigenous Foods, Socio-cultural Significance, Climate Change, Climate Variability, Finger Millet (Eleusine coracana), Adaptive Strategies, R Programming Language, Statistical Package for Social Sciences (SPSS), NVIVO Analytical Tool, Qualitative and Quantitative Data, Trend Analysis, Temperature and Rainfall Changes, Finger Millet Productivity, Precipitation/Rainfall, Statistical Significance.

ABSTRACT

Indigenous foods have salient socio-cultural significance among many communities in Africa. In Kenya, certain food crops are essential for cultural ceremonial functions. However, the food crops are relatively under threat in their availability due to climate change impacts and development. The purpose of this study was to establish the adaptive strategies that Finger millet (Eleusine coracana) farmers have adopted in response to climate variability effects in Kericho County. The R- programming language statistical package was used to analyse qualitative data. The statistical package for social sciences (SPSS) statistical tool was used to analyse the quantitative data obtained. Trend analysis from the focus groups was chronicled by notes taking and analysed using the NVIVO analytical tool, which analysed both qualitative and quantitative data. Results were discussed and presented in charts, tables and graphs. The findings showed a significant impact of extreme temperature and rainfall changes on finger millet productivity. The responses were tested by adopting statistical significance of $p \leq 0.05$ where p-value = 0.041 and <0.05 at 95% confidence level, Precipitation/Rainfall has a positive significant impact on finger millet productivity. Also, p-value = 0.027 for Average Temperature implies there is statistical significance. The study also revealed that adaptative strategies have a significant positive effect on finger millet productivity. Strategies established include the use of certified and weather tolerant varieties, working in groups to ease the intense finger millet management processes, use of agrochemicals to manage pests and diseases, intercropping and crop rotation, adopting and utilizing weather forecasting information and writing proposals to the ministry of agriculture for support. Research institutes such as Kenya Agricultural and Livestock and Research Organization should breed climate-tolerant varieties and farmers to adopt strategies such as changing planting seasons and adopting two planting seasons in a year to increase yields. Farmers could adopt drip irrigation during the dry seasons. The risk of floods could be managed by intercropping finger millet with stronger crops such as maize. Large finger millet farms could use new

Article DOI : https://doi.org/10.37284/eajab.8.1.2791

technology/ machines in finger millet management as this requires fewer human resources. The study recommends that farmers should consider buying insurance covers to take care of climatic extremes risks.

APA CITATION

Chepkorir, E. & Sang, C. (2025). Adaptive Strategies for Enhancing Finger Millet (Eleusine coracana) Productivity in Response to Climate Variability in Kericho County. *East African Journal of Agriculture and Biotechnology*, *8*(1), 165-172. https://doi.org/10.37284/eajab.8.1.2791

CHICAGO CITATION

Chepkorir, Enneth and Catherine Sang. 2025. "Adaptive Strategies for Enhancing Finger Millet (Eleusine coracana) Productivity in Response to Climate Variability in Kericho County". *East African Journal of Agriculture and Biotechnology* 8 (1), 165-172. https://doi.org/10.37284/eajab.8.1.2791

HARVARD CITATION

Chepkorir, E. & Sang, C. (2025) "Adaptive Strategies for Enhancing Finger Millet (Eleusine coracana) Productivity in Response to Climate Variability in Kericho County", *East African Journal of Agriculture and Biotechnology*, 8(1), pp. 165-172. doi: 10.37284/eajab.8.1.2791.

IEEE CITATION

E. Chepkorir & C. Sang "Adaptive Strategies for Enhancing Finger Millet (Eleusine coracana) Productivity in Response to Climate Variability in Kericho County", *EAJAB*, vol. 8, no. 1, pp. 165-172, Mar. 2025.

MLA CITATION

Chepkorir, Enneth & Catherine Sang. "Adaptive Strategies for Enhancing Finger Millet (Eleusine coracana) Productivity in Response to Climate Variability in Kericho County". *East African Journal of Agriculture and Biotechnology*, Vol. 8, no. 1, Mar. 2025, pp. 165-172, doi:10.37284/eajab.8.1.2791

INTRODUCTION

According to (Moseley, 2011) many smallholder farmers are vulnerable to adverse effects of climate change due to their low adaptive capacity. The agricultural sector is traditionally small-scale and dependent on rainfall, which makes it highly vulnerable to erratic rainfall and rising temperatures. In response to these climate change threats, some smallholder farmers use agricultural adaptation strategies, which have evolved from traditional practices (Douxchamps et al., 2016). These adaptation strategies include the application of organic fertilizers, changing planting dates and growing short-duration crop varieties. The application of organic fertilizers increases crop yields by improving soil moisture content and supply of nutrients to crops (Below et al. 2015). Farmers change their planting dates in response to the rainfall pattern. Improved crop varieties, notably short-duration varieties are drought tolerant, which produce better yields even during drying seasons (Below et al. 2015). Bearing in mind the prospects of cumulative incidence of occurrences in future, premeditated planning leading to the expansion of adaptive abilities of farmers will remain supreme to warrant safeguarding lives depending on agriculture (MoALF, 2017).

According to (Leblois et al., 2014), insurance policies may slightly intensify the use of risk-increasing inputs such as fertilizers and improved cultivars and hence improve average yields, which remain very low in the region. According to (Marteau et al., 2011), the strategy of the farmers sowing their field during or just after the first significant wet spell, is combined with using varieties that are photoperiodic to provide the best-suited response to the spatial and temporal variability of the onset of the rainy season. Community participation in climate change adaption policies at all levels, with emphasis on food-based capital, able to enlighten besides fortifying the capacity of societies and executives of the governmental resource to discourse adaptation measures to climatic change effects and improve resilience (Cohen et al., 2008). The Climate Smart Agriculture (CSA) production structures were invented to escalate food supply, adjust the pliability of food production to ecological changes

Article DOI : https://doi.org/10.37284/eajab.8.1.2791

and alleviate climatic fluctuations (FAO, 2010). It also embraces numerous field- and farm-scale agricultural systems renowned and extensively used, such as agroforestry, conservation tillage, water harvesting, crop residue management, agrobiodiversity conservation and use (World Bank, 2011; FAO, 2013). Locals encounter similar challenges experienced globally (Maldonado et al., 2013). Adjustment to increases in climatic changes and erraticism requires robust strategic intervention to modify activities across various segments. Climatic changes stand to affect species and biodiversity including traditional foods significant to communities' economy and cultural values (Muluneh, 2021). Since evidence of climate change and variability over the years has been documented in Kericho County, this study intended to establish adaptive measures that increase finger millet production in the study area.

MATERIALS AND METHODS

The study incorporated mixed methods this is because, by protecting the advantages of one form of data from the disadvantages of another, the use of both qualitative and quantitative data improves assessment (Rahman, 2016). Temperature and precipitation data were collected and a statistical package for social sciences (SPSS) was utilised for data analysis, inferential and descriptive statistics were also obtained. The collection of qualitative data was from individual interviews, participatory focus group discussions and observations. Techniques used were written description, video recordings and photography. This data was transcribed and analysed using content/thematic analysis and secondary data from documented literature. Quantitative data was analysed using SPSS while qualitative data employed the r-programming language analysis tools as well as NVIVO software, a software program used for qualitative and mixed-methods research. NVIVO is specifically used for analysing videos, audio and image data such as interviews, surveys, focus groups, journals and social media articles.

RESULTS

Adaptive Measures that Could be Implemented to Increase Finger Millet (Eleusine coracana) Productivity in Response to Climate Variability in Kericho County.

The lower regions of Soin, Sigowet and Kipkelion West Counties receive depressed rainfall which affects finger millet production, as reported by the key informant (KI)/the farmers including the Quality Assurance and Standards Officer, Kenya Climate Smart Projects, Kericho County. Heavy and extended rainfall especially during harvesting seasons results in high post-harvest losses caused by grain moulds and seed germination hence loss of nutrients since they get depleted. Heavy rains have also affected the traditional land preparation process of burning soil, hence leading to reduced productivity. Winch, (2006) confirms that frostbite is so devastating particularly Head Smut and Leaf Rust which are the major diseases responsible for low yields in Millet in Kericho County. These harsh weather conditions sometimes lead to total yield loss and the emergence of high pest and disease incidences; especially a fungal disease locally called (*chelaliit*) directly translated from 'burnt ear' a name given to a condition characterized by drying of some finger millet heads just after flowering leading to complete failure in seed development (Bett, 2018). The condition results in reduced productivity per unit, high losses and low returns. R-language analysis for the relationship between rainfall variability in Kericho County and finger millet productivity indicated that variability of rainfall and temperature has a significant and positive effect on finger millet productivity. Since p-value = 0.041 and <0.05 at 95% confidence level, Precipitation/Rainfall has a positive significant impact on finger millet productivity. Also, p-value = 0.027 for Average Temperature implies there is statistical significance.

Climate Smart Agriculture (CSA)

Agriculture is the pillar of most countries in the COMESA region. They are challenged by reduced

Article DOI : https://doi.org/10.37284/eajab.8.1.2791

agricultural produce, ecosystem depletion, drought, and skirmishes. They reduce the capability of societies to adjust to climatic changes. Over 95 % of agriculture in the region depends on rainfall and CSA and is geared to sustainably increase production, resilience (adaptation), decrease or eliminate GHGs (mitigation), and boost the success of development goals as well as food (FAO, 2010). In collaboration with COMESA, EAC and SADC to address Climate Change, CAS aims to significantly increase livelihoods and food security profits to 1.2 million low-productive farmers through crop production with agroforestry and livestock management (World Bank, 2011). Kenya announced drought as a national disaster in 2017 where appeal for local and international support was sought. The Kenya Climate Smart Agriculture Strategy (KCSAS) was initiated to advance guided investments and implementation of CSA practices ensuring productivity and food security while focusing on climatic changes adaptations and mitigations (MoALF, 2017). Climate-associated afflictions have triggered Kericho County to adopt the CSA to alleviate food security. A system devised to raise food security, enrich the flexibility of agriculture to ecological changes and alleviate climatic changes (FAO, 2010).

Climate Change Adaptation Strategies and Finger Millet Production

The study revealed that climatic variation adaptation strategies positively influence the productivity of finger millet. The study also revealed that climatic variation adaptation strategies positively and significantly influence the productivity of finger millet (Jerop et al., 2020) in the county of Kericho. Some of the strategies agreed upon between the farmers and the researcher to be effective in increasing finger millet productivity include the following: use of weather tolerant/certified varieties, working in groups, use of agrochemicals to manage pests and diseases, intercropping and crop rotation, adopting weather forecasting, writing proposals to the ministry of agriculture for support.

Use of Weather Tolerant/Certified Varieties

The study found that the use of certified finger millet seeds from KALRO and Climate Smart Organization enabled the farmers to actualize better yields. Kapchebinyal self-help group embraced the use of certified finger millet seeds, P224 variety and they realized improved yield as well as tolerance to harsh weather this year as explained by one of the group members.

> *"This year 2021, we planted certified variety (P224) and we never experienced frostbite which had been a great challenge in finger millet farming in the past. We were also able to harvest more crops compared to last year, quite a few farmers are interested in the new variety, though the seeds are a bit expensive".*

Though there are farmers who have adopted the use of certified varieties, quite a lot of farmers still use recycled seeds where production for such farmers is still low because the seeds are not tolerant to harsh weather conditions and frost bites. The study revealed that finger millet farmers growing weather tolerant/certified crop varieties that withstand the adverse climate change impacts realized better harvests. Some of the farmers have negative opinions on the certified seeds as explained by one of the farmers from an FGD.

> *"These seeds grow tall and when wind blows, they bend hence leading to loss of crop because once they are in contact with the ground before harvest they germinate while still on stalks. We like the dwarf variety because windy weather does not affect them.*

Working in Groups

Providing group labour during planting, weeding and harvesting has proved to be very effective since finger millet production and processing is quite intense (Jaybhaye et al., 2014) right from planting through processing and storage. One of the

Article DOI : https://doi.org/10.37284/eajab.8.1.2791

Members from FGD from the Kapchebinyal self-help group explained that the Climate Smart project officers have been of great assistance to them. She explained that,

> "*They have trained us on ways of planting, they usually come they are not far from here. We do planting, weeding and harvesting as a group".*

Use of Agrochemicals in Order to Manage Pests and Diseases

The study found that finger millet farmers use combined biological, chemical and physical pest management methods (Shubhashree & Sowmyalatha 2019). One of the farmers from the Kebeneti area Soin Sigowet region explained that she used recycled seeds and applied top dressing fertilizer to improve production.

Intercropping and Crop Rotation

The study established that farmers used intercropping to manage the damage caused by birds and to act as windbreaks (B Teli, 2023). The study found that farmers use the inclusion of other crops, and other economic activities to support finger millet production.

Adopt Weather Forecasting

In addition, some farmers have adopted forecasting of weather for crop management planning (Muita et al., 2021). The Climate Smart project department plays a big role in the provision of agro-weather information through early warning systems to self-help groups and organizations.

Write Proposals for Support to the Ministry of Agriculture,

The Ministry of Agriculture supports finger millet farmers in various ways such as supporting vulnerable groups with grants through proposal development, to support in the purchase of certified seeds fertilizers and equipment, training farmers on agronomic practices and value addition, organizing the vulnerable groups into self-help groups and organizations and provision of Agro-weather information through early warning systems. Other strategies would include supporting finger millet farmers through county bursary funds, introduction of mechanization, offering training and extension services, market from Kenya Cereals Board and subsidized farm inputs and equipment.

Table 1: Services Needed by Farmers to Adapt to Climate Change

Most needed service for community efforts to adapt to climate change	**Frequency (n)**	**Percent (%)**
Provision of credit facilities	93	25.3
Climate information services	71	19.3
Agriculture mechanization	58	15.8
Review of land tenure system	54	14.7
Health services	54	14.7
Irrigation Development	32	8.7
Other	5	1.4
No response	1	0.3
Total	**368**	**100.0**

CONCLUSION

The Ministry of Agriculture of Kericho County confirmed that climate change affects finger millet production in the region. Finger millet has been recognized to be of great beneficial value and it has been identified by the ministry to be a drought-tolerant crop. However, the findings clearly indicate that there is a significant impact of extreme temperature and rainfall changes on finger millet productivity. The findings agree with (Krishnamurthy et al., 2012) that rising temperatures and declining rainfall patterns are detrimental to crop yields, especially cereals such as

Article DOI : https://doi.org/10.37284/eajab.8.1.2791

maize and finger millet, which require more water. This leads to a reduced food supply as well as overall availability of food. Due to the benefits of finger millet, the Ministry of Agriculture and the community have seen it necessary to implement adaptive measures to increase its production. Some of the adaptation measures that are employed by the Ministry of Water and Ministry of Agriculture and the community in order to increase finger millet production include; the use of certified seeds and agronomic practices such as the use of drought tolerant varieties, support of small-scale irrigation, use of conservation agriculture (CA) (Acevedo et al., 2020), the use of Agro-weather information from the Kenya meteorological department (KMD). The ministry also works hand in hand with KMD to advise farmers on appropriate times for planting. The Ministry of Agriculture works together with the United Nations Environmental Program (UNEP) in engaging service providers who develop innovations in technology transfers.

Recommendations

The study found that extreme rainfall like frequent drought and floods have a negative effect on the productivity of finger millet in the County of Kericho. The study recommends that finger millet farmers should adopt adaptation strategies such as changing planting seasons as well as adopting two planting seasons in a year to improve yields. In addition, farmers should use other strategies such as the installation of drip irrigation to provide water to the seedlings during the dry seasons. In addition, to reduce the risk of flooding, farmers should intercrop finger millet with other stronger crops such as maize.

The study found that extreme temperatures, both high and low, negatively affect finger millet production in the county of Kericho. This study recommends that research institutes such as Kenya Agricultural Livestock and Research Organization (KALRO) should research and develop better varieties of finger millet with lower sensitivity to temperature and rainfall variability. The study found that finger millet management such as planting, thinning, harvesting and processing is quite intense. The study therefore recommends that large finger millet farms should adopt the new technology of mechanization in finger millet management as this requires a few human resources. Due to the uncertainty that comes with extreme conditions (drought and floods) that are more recurrent than in the past, the study recommends that farmers should consider insurance covers to take care of the risks of climatic extremes.

Acknowledgement

This study was limited to the effects of climate variability on finger millet production in the county of Kericho. The study was limited to one County, findings can therefore not be generalized to other finger millet-producing counties in Kenya. This study was limited to two climate components those were temperature and rainfall. For this reason, other studies should be conducted on the effect of soil and soil properties on finger millet production in the County of Kericho. A comparative study should be conducted on climate variability on finger millet producing Counties like Migori, Kisii and Kisumu among others. In addition, the findings of this study cannot be generalized to other types of farm products. This is because different crops require different climatic conditions, management strategies and adaptive measures. Therefore, further studies should be conducted on the effect of variability in climate on the production of other farm products such as sorghum, beans, flowers, maize and even livestock and their production.

REFERENCES

Acevedo, M., Pixley, K., Zinyengere, N., Meng, S., Tufan, H., Cichy, K., & Porciello, J. (2020). A scoping review of adoption of climate-resilient crops by small-scale producers in low- and middle-income countries. *Nature Plants, 6*(10), 1231–1241. https://doi.org/10.1038/s41585-020-00373-9

Article DOI : https://doi.org/10.37284/eajab.8.1.2791

Bett, G. K. (2018). *An assessment of the effects of climate variability on tea production in Kericho County: A case study of James Finlay's (Kenya) Limited tea estates, Kericho, Kenya* (Doctoral dissertation, University of Nairobi).

Below, T. B., Schmid, J. C., & Sieber, S. (2015). Farmers' knowledge and perception of climatic risks and options for climate change adaptation: a case study from two Tanzanian villages. *Regional environmental change*, *15*, 1169-1180.

B Teli, S. (2023). Millet-Based Agroforestry: A Nature-Positive Farming to Achieve Climate-Resilience and Food Security in India and Africa.

Cohen, M. J., Tirado, C., Aberman, N. L., & Thompson, B. (2008). Impact of climate change and bioenergy on nutrition.

Douxchamps, S., Van Wijk, M. T., Silvestri, S., Moussa, A. S., Quiros, C., Ndour, N. Y. B., & Rufino, M. C. (2016). Linking agricultural adaptation strategies, food security and vulnerability: evidence from West Africa. *Regional Environmental Change*, *16*, 1305-1317.

FAO. (2010). *The state of food insecurity in the world: Addressing food insecurity in protracted crises*. FAO.

FAO. (2013). *The state of food insecurity in the world: The multiple dimensions of food security*. FAO.

Jaybhaye, R. V., Pardeshi, I. L., Vengaiah, P. C., & Srivastav, P. P. (2014). Processing and technology for milletbased food products: a review. *Journal of ready to eat food*, *1*(2), 32-48.

Jerop, R., Owuor, G., Mshenga, P., & Kimurto, P. (2020). Effects of finger millet innovations on productivity in Kenya. *Cogent Food & Agriculture*, *6*(1), 1830476.

Krishnamurthy, K. P., Lewis, K., & Richard, J. C. (2012). *Climate impacts on food security and nutrition: A review of existing knowledge*. World Food Programme & Met Office.

Leblois, A., Quirion, P., Alhassane, A., & Traoré, S. (2014). Weather index drought insurance: an ex ante evaluation for millet growers in Niger. *Environmental and Resource Economics*, *57*, 527-551.

Maldonado, J. K., Colombi, B., & Pandya, R. (Eds.). (2016). *Climate change and Indigenous peoples in the United States* (Vol. 93). Springer.

Marteau, R., Sultan, B., Moron, V., Alhassane, A., Baron, C., & Traoré, S. B. (2011). The onset of the rainy season and farmers' sowing strategy for pearl millet cultivation in Southwest Niger. *Agricultural and forest meteorology*, *151*(10), 1356-1369.

MoALF. 2017. Climate Risk Profile for Kericho County. Kenya County Climate Risk Profile Series. The Ministry of Agriculture, Livestock and Fisheries (MoALF), Nairobi, Kenya

Moseley, W. G. (2016). Agriculture on the brink: climate change, labor and smallholder farming in Botswana. *Land*, *5*(3), 21.

Muita, R., Dougill, A., Mutemi, J., Aura, S., Graham, R., Awolala, D., & Opijah, F. (2021). Understanding the role of user needs and perceptions related to sub-seasonal and seasonal forecasts on farmers' decisions in Kenya: a systematic review. *Frontiers in Climate*, *3*, 580556.

Muluneh, M. G. (2021). Impact of climate change on biodiversity and food security: a global perspective—a review article. *Agriculture & Food Security*, *10*(1), 1-25.

Radeny, M., Ogada, M. J., Recha, J., Kimeli, P., Rao, E. J., & Solomon, D. (2018). Uptake and impact of climate-smart agriculture on food security, incomes, and assets in East Africa.

Article DOI : https://doi.org/10.37284/eajab.8.1.2791

World Development, *113*, 358–370. https://doi.org/10.1016/j.worlddev.2018.09.002

Rahman, M. S. (2016). The advantages and disadvantages of using qualitative and quantitative approaches and methods in language "testing and assessment" research: A literature review. *Journal of education and learning*, *6*(1).

Shubhashree, K. S., & Sowmyalatha, B. S. (2019). Integrated weed management approach for direct seeded finger millet (Eleusine coracana L.). *International Journal of Agriculture Sciences*, *ISSN*, 0975-3710.

Winch, T. (2006). Section 2: Description and characteristics of the main food crops. In *Growing Food: A Guide to Food Production* (pp. 104–287).

World Bank. (2011). *World development report: Conflict, security, and development (WDR '11)*. World Bank.

