Annals of Arid Zone 59(3&4): 67-72, 2020

Farmers' Adaptation Strategies to Rainfall Variability in Oljoro-Orok Ward, Kenya

Amon Mwangi Karanja*

Egerton University, Department of Geography, P.O. Box, 536-20115 Egerton, Kenya

Received: June 2020

Abstract: The paper analyzed farmers' adaptation strategies to rainfall variability in Oljoro-orok Ward in Nyandarua County, Kenya. The major crop grown in Oljoro-orok Ward is Irish potatoes. Stratified proportionate random sampling was used to select 192 respondents from different locations in the Ward. Data was analyzed using descriptive statistics where multiple responses on the adaptation measures were accommodated in the final analyses. It was found that crop diversification was the most common adaptation measure practiced in the ward (38%) followed by timely planting (30%), off season approach (24%) and irrigation (8%). Farmers practiced crop diversification where they planted other crops such as animal feeds and vegetables such as onions and carrots that mature faster in times of unfavorable rainfall. The Ministry of Agriculture and County Government of Nyandarua should create more avenues to reach out to all farmers and educate them on the importance of adopting scientific practices to increase Irish potato production in light of rainfall variability in Oljoro-orok Ward. Kenya Agriculture and Livestock Research Organization should make hybrid potato seeds accessible and affordable to all farmers in Oljoro-orok Ward. The Kenya Meteorological Department should enhance relay of seasonal weather forecast to reach more farmers within a short period at the beginning of every season to allow timely planting.

Key word: Adaptation strategy, crop diversification, rainfall variability.

Agriculture is the most climate-sensitive sector as the nature of crop production is mainly dependent on weather (SeinnSeinn *et al*., 2015). Among the most vulnerable regions of the world to bear the impacts of climate variability and drought is Africa (Wambua *et al*., 2014). In sub-Saharan Africa, climate change has drastically reduced agricultural production through extreme weather events, such as recurrent droughts and floods (Nhemachena and Hassan, 2007 and Deressa *et al*., 2009). Year to year and season to season rainfall variability is persistent in East Africa, a phenomenon that continues to present a challenge to agriculture production (Shisanya, 1996; Seleshi and Zanke, 2004). In arid and semi-arid regions where both the amount and frequency of rainfall occurrence is low, it is essential to take into account the unique rainfall characteristics so as to be able to optimally utilize the low rainfall areas for agricultural purposes (Tilahun, 2006).

In Kenya, frequent droughts and floods have not only claimed lives but have also decimated livestock and reduced farm output (GoK, 2007; USAID, 2007 and Obunde *et al*., 2007). Kenya has in the last 100 years recorded 28 major droughts with three of them having occurred during the last decade (Maitima *et al*., 2009). Rain-fed agriculture is the major source of livelihood in Oljoro-orok Ward and rainfall variability is a challenge to the farmers. The crop growing seasons are largely determined by rainfall patterns.

In Oljoro-orok there are two distinct rain seasons occurring between March-April-May (MAM; long rain season) and October-November-December (OND; short rain season) (Kaguongo *et al*., 2007). Irish potato is planted in both seasons of the year and takes between 90 and 120 days to mature. With rainfall variability, crop growing seasons are no longer predictable- early or delayed onset and cessation of rainfall are common that disrupts the farmers' cropping calendar. In most cases, severe drought due to climate change and variability leads to severe food shortages, food insecurity and hunger (Hashimu, 2013). Rainfall variation and lack of quality seeds are the main threats to potato farming in Oljoro-orok Ward where majority of the respondents (45%) agreed that rainfall variation is the main cause of decreased Irish potato yields

*E-mail: amon.karanja@egerton.ac.ke

in the Ward (Karanja *et al*., 2014a). Annual rainfall amount in Oljoro-orok Ward shows an increasing trend between 1999 and 2009 while season rainfall has shown a decreasing trend during the long rain and an increasing trend during short rain. Rainfall variability is significant in both seasonal and annual trends ranging from +464.97 mm in 2007 to -239.63 mm in 2009 on the annual trend, +624 mm in 2007 to -360 mm in 2008 during the long rain season and +152 mm in 2006 to -171.6 mm in 2007 during the short rain season (Karanja *et al*., 2014b). Rainfall variation in Oljoro-orok Ward has affected potato growing seasons in the area.

Adaptation strategies remain the only viable option for farmers to maximize agricultural production under conditions of rainfall variability. Given that the majority of the rural population in Kenya depends on agriculture for income, adaptation to rainfall variability is vital in enhancing the resilience of the sector, protecting the livelihoods of poor households and ensuring their food security (Ochieng *et al*., 2017). The choice of coping options depends on social and biophysical elements such as socio-economic characteristics of farm households (farm size, level of education, household income), access to extension services, credit supply and the existing resources (Adeniji *et al*., 2013). Adoption of technology requires substantial amounts of investment of labor, human and financial resources and the institutional credit from government and other organizations (SeinnSeinn *et al*., 2015). In Sikonge district, Tanzania farmers responded to the climate change and variability by adopting different adaptation and coping strategies, popular ones being sale of livestock and growing drought tolerant, high yielding and early maturing crop varieties.

Most of the adaptation strategies adopted by farmers were those related to decreasing household vulnerability both in short and long term. Off-farm activities were significant contributors of household food security. Income generated from off-farm activities enabled most households to supplement their food needs hence graduated from food insecurity (Hashimu, 2013). In the above background, the current study analyzed the adaptation measures to rainfall variability in Oljoro-orok Ward.

Materials and Methods

Study site

Oljoro-orok Ward, Nyandarua County is situated in the central part of Kenya. The Ward lies within latitude 0°8′ north and 0°40′ south and longitudes 35°13′ east and 36°22′ east in between the Rift Valley and Aberdare Ranges (Fig. 1). Farming is the main economic activity within the ward. Irish Potatoes (*Solanum tuberosum*) are the major cash crop in the ward. The lower zone of the ward namely Lesirko and lower side of Oraimutia have laterites as the predominant soils. Nyairoko and Oraimutia locations are humid while Lesirko is a semi-humid zone. Land size per household varies across the wards but with an average of 2 hectares. The crop growing seasons are largely determined by rainfall patterns (Kaguongo *et al*., 2007).

Sampling method

The study used stratified proportionate random sampling to determine the sample size. This approach seeks to collect data from 10% of the total population. The population was 3000 household in Oljoro-orok Ward (KNBS, 2009) and in this regards 300 households were targeted as respondents of the study. Areas were clustered into location forming, the basis of selecting the sample population in each location. The sample in each location was computed based on the proportion using the following formula;

$$n = p/\mu \times 300 \quad \ldots 1$$

where, n is the sampled households of each ward; n = 82 Oraimutia Location; n = 48 Nyairoko Location; n = 170 Lesirko Location; p is the number of the household in the location; μ is the total households in the ward.

Three hundred questionnaires were administered to the respondents and allowed one week to fill them. The researcher went back after a week and collected the filled questionnaires. Out of the 300 questionnaires, 192 were filled and returned while the rest were either incomplete or not returned and were therefore not considered during data analysis. This represented 65% response rate, which is considered satisfactory to make conclusions for the study. According to Mugenda and Mugenda (2003) a 50% response rate is adequate, 60%

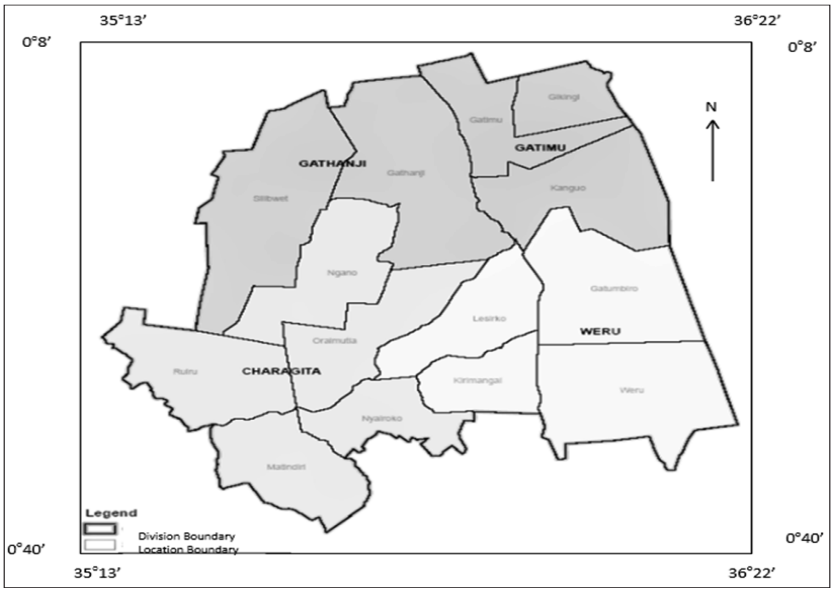

Fig. 1. Map of the study area showing the study sites.
Source: Nyandarua West District Agriculture Office (2012).

good and above 70% response rate very good. The total sample size for the present study was 192 farm households.

Data analysis and characterization

The data were analyzed using statistical software namely SPSS version 17 and SAS for windows version 8. Frequencies were used in interpreting the respondents' perception of issues raised in the questionnaire. Multiple responses on different adaptation measures were accommodated in the analysis since farmers used more than one adaptation measure.

Results and Discussion

Household characteristics

Results in showed that 83% of the respondents were between 23-65 years of age while 17% were above 65 years (Table 1). This indicated that the farmers were in their productive years. The farmers have the capacity to apply rainfall adaptation measures that requires their labor which is available. The high population of farmers who are in their working years is a resource that when well utilized will address the challenges of small land size through intensive farming. The findings support the earlier argument that availability of family labor is vital to farm production especially in terms of the amount of land that can be brought under cultivation. Although, labor alone is not a sufficient factor. Availability and access to land and other productive resources are critical (Moock, 1973). Results showed that majority of the respondents (77%) were married, 19% were single while 4% are widowed. High

Table 1. Socio-economic characteristics of the households

	Frequency	Percentage	Cumulative percentage
Age group			
23-65 years	159	83	83
Above 65 years	33	18	100
Gender			
Male	58	30	30
Female	134	70	100
Marital status			
Married	148	77	77
Single	44	23	100
Primary occupation			
Farmers	182	95	95
Teachers	10	5	100
Education level			
Formal education	126	66	66
Non-formal	66	34	100
Duration of potato farming			
Less than 1 year	9	5	5
1- 5 years	20	10	15
Over 5 years	163	85	100

number of married people is an indication that the population is likely to increase in the Ward and that increased potato production is an immediate measure to assure the Ward the sustainable food security. The primary occupation of the households in the Ward is farming (95%) while 5% of the teachers practice agriculture as their secondary occupation.

It was found that 66% of the households had formal education while 34% had non-formal education. Educated farmers are assumed to have acquired knowledge on scientific methods of farming when compared to uneducated ones (Karanja, 2018). The results also show that 85% of the households have grown crops for over 5 years, 10% have grown crops between 1-5 years while 5% have grown crops for less than one year. Inexperienced farmers face many challenges while increased farming experience enables the farmer gain more confidence and increased productivity. Farmers experience has enabled them to understand the rainfall dynamics in the Ward. Experience enhances farmers' adaptation to climate change for increased agricultural production in the Ward.

Farmers' adaptation strategies to rainfall variability

On an average crop diversification (38% farm households) is the most practiced adaptation measure in the whole ward (Table 2) followed by timely planting (30%), off season approach (24%) and irrigation (8%). In Lesirko location crop diversification (51%) is the most practiced adaptation measure followed by timely planting (23%), off season approach (17%) and irrigation (9%). In Oraimutia location, timely planting (43%) is the most practiced adaptation measure followed by crop diversification (30%), off season approach (20%) and irrigation (7%). In Nyairoko location off season approach (43%) is the most common measure practiced followed by crop diversification (26%), timely planting (23%) and irrigation (8%). In Oljoro-orok Ward on the whole, use of irrigation as an adaptation measure is not popular perhaps due to overreliance on rain fed agriculture and inadequate resource to build dams and digging of wells. Comparatively irrigation was more in Lesirko location while it was least practiced in Nyairoko. Kales, cabbages, onions, carrots and nappier are the major crops grown under irrigation in Oljoro-orok Ward using river and bore hole water. Water in Lake Olborrosat is not used to irrigate crops because it is saline. Adaptation options vary from one region to the other. For example, in Mutoko rural district in Zimbabwe, rainfall variability adaptation measures included mulching, creating large storage houses for produce and creating temporary walls on riverbanks in order to store water when the rivers dry up (Mugambiwa, 2018). The off season approach in Oljoro-orok Ward has led to fluctuations of the land under potatoes between 1999 and 2009 ranging between 1400 hectares in 1999 to 3,112 hectares in 2007. The off farm activities practiced in the Ward is seeking employment and engaging in business. Farmers practice crop diversification where they plant other crops such as napier grass, oat, cabbages, onions and carrots that matures faster under situations of unfavorable rainfall. Timely planting is important due to variations in the onset and cessation of rainfall. The onset of rainfall alternates from March to May during the long rain season and September and November during the short rain season. The cessation alternates from June to August during the long rain season and November and January during the short rain season.

Table 2. Household adaptations to rainfall variability

Adaptation measures	Respondents in each location		
	Lesirko	Oraimutia	Nyairoko
Crop diversification	98 (51%)	58 (30%)	50 (26%)
Timely planting	44 (23%)	83 (43%)	44 (23%)
Off season approach	33 (17%)	38 (20%)	83 (43%)
Irrigation	17 (9%)	13 (7%)	15 (8%)

In addition to the farmer's adaptation strategies, agriculture extension officers in Oljoro-orok Ward reach out to farmers advocating for adoption of scientific practices. The study assessed the extent of adoption of scientific practices (Table 3) that, revealed that 77 (40%) farmers plant hybrid potato seeds from Kenya Agricultural Livestock and Research Organization while the rest plant farm saved seeds in the next season. Thirty eight (20%) respondents plant according to seasonal weather forecast from the Kenya Meteorological Department while the rest plant according to tradition. Seventy seven (40%) respondents' plant potatoes using standard spacing as

Table 3. Scientific methods of farming employed by farmers

	Frequency	Per cent	Cumulative per cent
Planting of hybrid seeds from Kenya Agricultural Livestock and Research Organization (KALRO)	77	40	40
Planting according to seasonal weather forecast from Kenya Meteorological Department (KMD)	38	20	60
Planting using standard spacing as advised by field officers	77	40	100

advised by agricultural field officers while the rest planted according to their own spacing knowledge.

Conclusion and Recommendations

Adaptation to rainfall variability is not new to farmers in Oljoro-orok Ward. Farmers in the ward have adopted various measures to adapt to rainfall variability. Crop diversification was the most preferred adaptation measure in the ward followed by timely planting, off season approach and irrigation. Though off season approach is a popular adaptation measure in Nyairoko location, it is an eye opener in exploitation of other opportunities available in Oljoro-orok Ward instead of relying on Potato farming as a source of livelihoods. The Kenya meteorological department issues seasonal weather forecast at the beginning of every season yet only 20% of the farmers' plant as per the forecast. Though agriculture extension officers educate farmers on the need to plant hybrid seed, less than 50% of the farmers plant hybrid seeds. The study recommends that farmers' capacity building workshops be organized regularly to enhance the existing adaptation measures. The Ministry of Agriculture and County Government of Nyandarua should create more avenues to reach out to all farmers and educate them on the importance of adopting scientific practices to increase Irish potato production in light of rainfall variability in Oljoro-orok Ward. Kenya Agriculture and Livestock Research Organization should also make hybrid potato seeds accessible and affordable to all farmers in Oljoro-orok Ward. The Kenya Meteorological Department should enhance relaying of seasonal weather forecast to reach more farmers within a short period at the beginning of every season to allow timely planting.

Acknowledgements

This paper is drawn from my earlier research on analysis of rainfall variability on Irish potato production in Oljoro-orok division. I therefore, feel indebted to my supervisors Professor Chris Shisanya and Dr. George Makokha for their guidance in the research work.

Competing Interests

Author has declared that no competing interests exist.

References

Adeniji Oloukoi, G., Urmilla, B. and Vadi, M. 2013. Households' coping strategies for climate variability related water shortages in Oke-Ogun region, Nigeria. *Journal Environmental Development* 5: 23-38.

Deressa, T.T., Hassan, R.M., Ringler, C., Alemu, T. and Yesuf, M. 2009. Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change* 19: 248-255.

GoK 2007. *Vision 2030*. A competitive and prosperous Kenya. Government Printer, Nairobi, Kenya.

Hashimu, M. 2013. Farmers' adaptations to rainfall related climate variability risks and their implications on food security in the semi-arid Sikonge district, Tanzania *M.A. Thesis* (Un-published) Sokoine University.

Karanja, A.M., Shisanya C. and Makokha G. 2014a. Analysis of the key challenges facing potato farmers in Oljoro-orok location. *Agricultural Sciences* 5: 834-838.

Karanja, A.M., Shisanya C. and Makokha G. 2014b. Analysis of rainfall variability on potato production in Kenya: A case of Oljoro-orok Division. *Asian Journal of Applied Sciences* 2(4) ISSN: 2321-0893.

Karanja, A.M. 2018. Challenges opportunities of agricultural production in light of climate variability in Oljoro-orok Division, Kenya. *Asian Journal of Agricultural Extension, Economics & Sociology* 27(4): 1-9.

Kaguongo, W., Gildemacher, P., Demo, P., Wagoire W., Kinyua P., Andrade J., Forbes G., Thiele, G. and Fugile, K. 2007. *Farmers Practices and Adoption of Improved Potato Varieties in Kenya and Uganda*. Maastridit School of Management.

KNBS 2009. Kenya Population Census Report. Ministry of Planning and Vision 2030, Nairobi.

Moock, P. 1973. Managerial ability in small-farm production: An analysis of maize yields in the Vihiga Division of Kenya. *Ph.D. Thesis* (published) Columbia University, USA.

Maitima, J.M., Kariuki, P.C., Mugatha, S.M. and Mariene, L.W. 2009. Adapting East African ecosystems and productive systems to climate change. Report for the Economics of Climate Change Adaptations in Africa.

Mugambiwa, S.S. 2018. Adaptation measures to sustain indigenous practices and the use of indigenous knowledge systems to adapt to climate change in Mutoko rural district of Zimbabwe. *Journal of Disaster Risk Studies* 10(1): 388.

Mugenda, M.O. and Mugend, G.A. 2003. Research Methods: Quantitative and Qualitative Approaches. Nairobi African Centre for Technology Studies.

Nhemachena, C. and Hassan, R. 2007. Micro-level analysis of farmers' adaptation to climate change in Southern Africa. *IFPRI Discussion Paper No. 00714*. International Food Policy Research Institute, Washington, DC.

Obunde, P., Maitima, J.M. and Olson J. 2007. Adaptation to climate change: A case of Kenya. Climate Land Interactions Project working paper.

Ochieng, J., Kirimi, L. and Makau, J. 2017. Adapting to climate variability and change in rural Kenya: Farmer perceptions, strategies and climate trends. *Natural Resources Forum* 41: 195-208.

SeinnSeinn, M.U., Ahmad, M.M., Thapa, G.B. and Shrestha, R.P. 2015. Farmers' adaptation to rainfall variability and salinity through agronomic practices in lower Ayeyarwady Delta, Myanmar. *Journal of Earth Science and Climate Change* 6: 258.

Seleshi, Y. and Zanke, U. 2004. Recent changes in rainfall and rainy days in Ethiopia. *International Journal of Climatology* 24: 973-983.

Shisanya, C.A. 1996. Chances and risks of maize and beans growing in semi-arid areas of SE Kenya during the expected deficient, normal and above normal rainfall of the short rainy season. *Ph.D. Thesis* (published) Trier Germany.

Tilahun, K. 2006. The characterization of rainfall in the arid and semi-arid regions of Ethiopia. Water SA 32: 4728-4738.

USAID 2007. Adapting to Climate variability and change: A guidance manual for development planning. U.S. Agency for International Development, Pennsylvania, Washington.

Wambua, R.M., Mutua B.M. and Raude, J.M. 2014. Drought forecasting using indices and artificial neural networks for upper Tana River Basin, Kenya: A review concept. *Journal of Civil Environment Engineering* 4: 152.

Printed in December 2020