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Potentials of Agricultural Production in Light of Climate Variability in Oljoro-Orok Division, Kenya

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

The paper analyzed agricultural production potential in light of climate variability in Oljoro-orok division in Kenya. The objective of the paper was to evaluate the available opportunities and assess the challenges that may limit agricultural production in light of climate variability threats in the division. Climate variability variables such as severe drought and frequent flooding has caused a lot of suffering to human being and animals in the world today due to hunger, increased cases of diseases and destruction of their habitats. Households' adaptations and responses to climate change cannot be seen in isolation from the state in which they operate in. External adaptations practices fail to reflect local needs and priorities, leading to low adoption of external interventions. The study explored the strength, weaknesses, opportunities and threat in Oljoro-orok division in place to adapt to climate change using a SWOT analysis. SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. A SWOT matrix was developed using matching and conversion method and used in the analysis of the adaptive capacity of the division. The study found that there are strengths and opportunities which when well utilised will help counter the

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weaknesses and threats and adapts to climate change and increase agricultural production.

Keywords: Agriculture; climate variability; households; adaptations' and responses; adaptive capacity.

1. INTRODUCTION

Climate variability is one of the biggest issues facing the world today [1]. Climate change and variability is expected to increase the frequency and the severity of extreme weather events, such as extreme precipitation, heat waves, and extreme drought, but possibly also storms, tornadoes, and hail [2]. Higher growing season temperatures significantly impact agricultural productivity, farm incomes and food security [3]. These in turn will affect human land-use and livelihoods and have the potential to make pastoralists more vulnerable [4]. This is due to greater vulnerability of Africa's economy, such as crop production, livestock keeping and tourism, to climatic variation, geographic exposure and low incomes [5,6]. While farmers are often flexible in dealing with weather and year-to-year variability, there is nevertheless a high degree of adaptation to the local climate in the form of established infrastructure, local farming practice and individual experience [7]. Oljoro-orok division is vulnerable to climate variability due to overreliance on rain fed agriculture and poverty. The division is already experiencing the effects of climate variability hence necessitating the current study of challenges and opportunities in light of climate change for agricultural production in the division.

2. MATERIALS AND METHODOLOGY

The study was conducted in Oljoro-orok division, Nyandarua County situated in the central part of Kenya. The division lies between Latitude 0° 8' north and 0° 40' south and between 35° 13' east and 36° 22' east between the Rift Valley and Aberdare Ranges. The division was selected because it's one of the major potato producers in Kenya and any threat to potato production could spell doom for food security in Kenya. Household data was collected by use of structured questionnaire from 192 farmers household sampled. The 192 farmers' households were identified from each location by use of proportionate random sampling. The sampled households represented 10% of the total households within the division according to the 1999 population census report. [8] Suggests 10% as an adequate sample. SWOT matrix was developed using matching and conversion methods and used to analyse the households responses on issues raised. SWOT is an acronym for Strengths, Weaknesses,

Opportunities and Threats. Strengths and Weaknesses are considered to be internal factors over which you have some measure of control. Opportunities and Threats are considered to be external factors over which you have essentially no control [9]. SWOT analysis was selected because it presents an overall assessment of the potential of the division just like in a project to predict its preparedness in the light of climate variability. Frequencies, percentages and proportions were also used in interpreting the respondents' perception of issues raised in the questionnaire. The data was presented using tables, line and bar graphs, pie-charts.

3. RESULTS AND DISCUSSION

SWOT matrix was developed from the household responses using matching and conversion method as shown on Table 1.

3.1 Analysis of Strengths vs. Weaknesses

The study established that the division has strengths as well as weaknesses facing agricultural production. If well utilized the strengths are able to address the weaknesses hence increasing agricultural production in the division. According to the Kenya National Bureau of Statistics the Population in the division has continued to increase 65,229 in 1999 to 85825 in [10]. This is likely to put more strain on the already strained resources leading to more land fragmentation and more mouths to feed. As shown in Table 2, majority of the respondents, 148 (77.1%) are married, 36 (18.8%) are single while 8 (4.2%) are widowed. High number of married people is an indication that the population is likely to increase in the division and that increased agricultural production is an immediate measure to assure the division sustainable food security. The high food demand due increase in population in the division is addressed by the farmers specialisation on farming in Oljoro-orok as shown in Table 2, where 182 (94.8%) are specialised farmers while 10 (5.2%) are teachers and other professionals. Specialization on farming means that increased production will help farmers to not only feed the growing population but also earn income after selling surplus.

The study found as shown on Fig. 1, that 161 (83.9%) of the respondents are crop farmers, 137 (71.4%) specialising in potato farming, 10 (5.2%) engaging in maize farming, 14 (7.3%) are vegetable farmers and 31 (16.1%) are dairy farmers. This is an indication that potato farming is the main economic activity in Oljoro-orok Division. The crop is the main source of food and income to the farmers, source of employment to the middlemen, and drivers who transport the yields to the market and source of revenue to the government. This finding supports the argument by [11] that potatoes are important food and cash crops in many parts of Kenya and an important source of income and employment in the rural areas. The decline in potato yield and low potato prices leaves farmers with inadequate capital to buy the necessary inputs in the next season. Inadequate capital is a weakness to crop production because for high yields to be realised heavy investment in terms of resources has to be pumped to crop farming. Farmers require capital to be able to purchase clean seeds, fertilizers, pesticides, irrigation pumps to be used during the dry spell and other inputs. This is supported by [12] that cash constraints and small land sizes are the two most important factors that inhibit realization of higher farm incomes and optimal production at farm level. There is need for policies that spur investment in public

infrastructure, rural financial markets, private investment, and support institutions to address the problems of high transaction costs to investors, and reduce risks faced by farmers.

Inadequate capital can be addressed by the high literacy levels in the division. Education is important in all human activities. The study found that majority of the respondents as shown on Table 2, that 126 (65.6%) were literate (have gone through formal education) while 66 (34.4%) were illiterate (have not gone through formal education). An educated farmer cannot be compared to uneducated one. These educated farmers are in a position to apply for loans and other credit facilities from the various banks in the County and use their title deeds as security. Education helps farmers in making well informed decision enabling them increase production and adapt to weather uncertainties. This is supported by Ogola O. [13] that formal education broadens the outlook and knowledge of the farmers and thus educated farmers are more receptive to innovations and more likely to adapt to climate change. A high literacy level in the division is an indication that farmers supplied with the right information have the potential of increasing agricultural production in Oljoro-orok hence addressing the challenges of small land size as shown on Fig. 2.

Table 1. SWOT matrix

Strengths	Weaknesses
<ul style="list-style-type: none"> • Farmers are educated and experienced in • Farming • Farmers are in their productive age • Availability of land and labour • Specialized in potato farming 	<ul style="list-style-type: none"> • Inadequate capital • Water logging in the lower side of the division • Small land size • Soil is not uniform • Crop diseases
Opportunities	Threats
<ul style="list-style-type: none"> • Presence of Kenya Agriculture Research Institute in the neighboring Gathanji division and Nyahururu Meteorological Station • Presence of Jacob, Gichaka and Ngara Dams whose water flows within and outside the division • Presence of Farmers Training Centre in the neighboring Gatimu division • Ready market-located near urban centers' such as Nyahururu, Nakuru, Nyeri and Nairobi • Annual farmers field day organized by Farmers Training Centre in the neighboring Gatimu division. • Improved communication and technology 	<ul style="list-style-type: none"> • Farmers planting according to season and not following seasonal weather forecast • Few Agricultural field officers • Mobility of labour as a result of men migration to the urban centers • Competition from other potato producing regions leading to price fluctuations. • rainfall Variability • Seed quality • Poor market • Poor roads

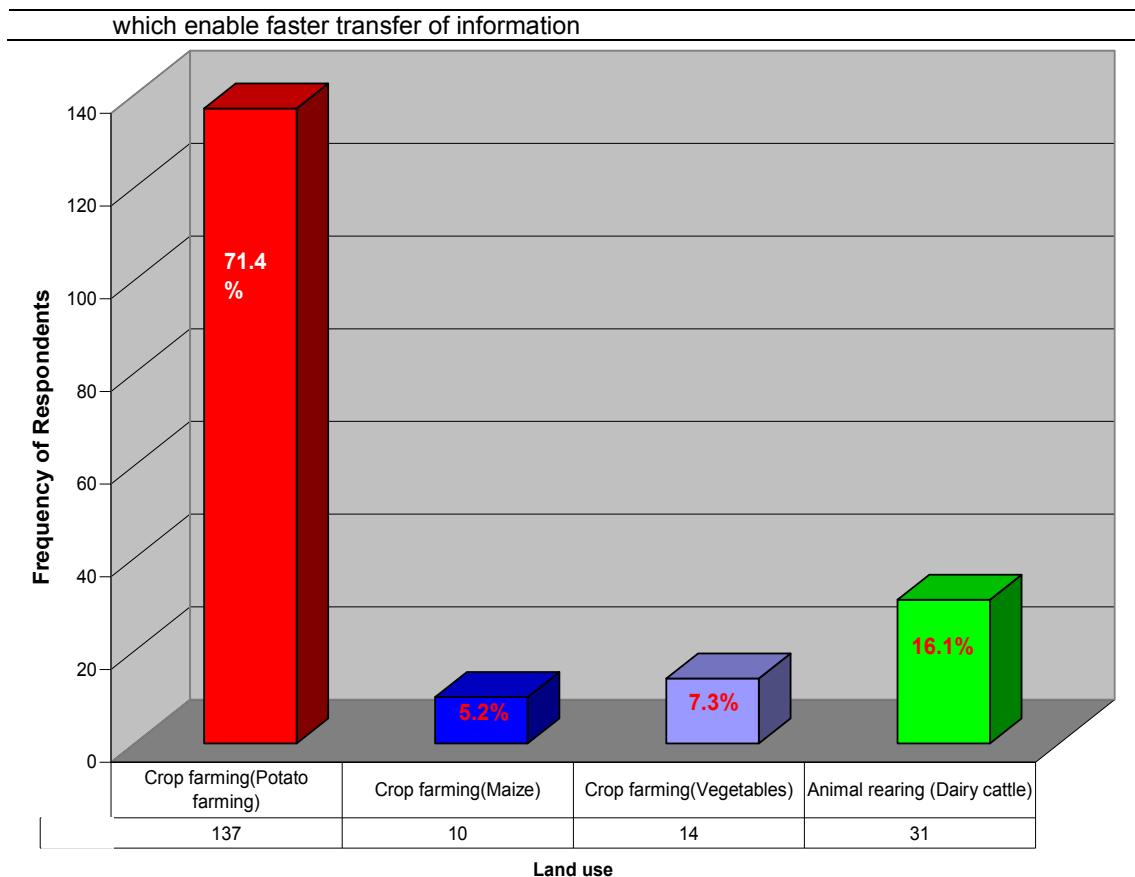


Fig. 1. Type of activities carried out by the land user

The study found that the division has enough human resource needed to improved agricultural production. Results as in Table 3, show that majority of the respondents 159 (82.8%) were between 23-65 years of age while 33 (17.2%) were above 65 years. This is an indication that the farmers are in their productive years. The farmers have the capacity to apply any climate change adaptation measures that requires their labour 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 labour is vital to farm production especially in terms of the amount of land that can be brought under cultivation [14].

Availability of land is important to a meaningful farming in Oljoro-orok division. Majority of the farmers own the land as shown on Table 4, where 168 (87.5%) of the respondents own the

land, 22 (11.5%) had leased the land while 2 (1%) own the land communally. This means that more farmers don't incur extra charges on leasing the land which would reduce their profit margin. Farmers who are planting on leased land incur more losses in times of crop failure due to weather variability and are less receptive to adaptation measures because their stay on the land is not determined. They only use short time approaches such as crop diversification where they plant other crops like vegetables that can mature fast on the bases of their lease agreement and cannot afford long term measures such as off season approaches because their stay in the land is limited.

Experience enable farmer to learn new trends of weather patterns, pest and diseases and the best time of planting to realise profit because of the market forces. The results found in Table 5, show that majority of the respondents 163 (84.9%) have grown crops for over 5 years, 20

(10.4%) have grown crops for between 1-5 years while 9 (4.7%) 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. The experience of the farmers has enabled them understand the rainfall dynamics in the division. Experience will enhance farmers' adaptation to climate change for increased agricultural production in the division.

Although land is available in Oljoro-orok division majority of the people own small sizes of land thus the need to use the land to the maximum so that potato yields can be enough to cater for their needs. As shown in Fig. 2, 20.8% of the respondents own between 1-2 acres of land, 20.8% own between 2-3 acres, 19.27% own between 4-5 acres, 18.23% own between 3-4

acres, 7.8% own 0-1 acres while 13% own above 5 acres of land. Farmers in the division need to maximally invest on the available land to increase production because land for expansion is limited in the division. This finding is supported by McCalla A. F. [15] that small land size is an indication that intensive farming is the only option to enhance production. The study found that there is limited land for expansion in the division which leave farmers with only an option to invest on maximising production. The results are supported by [16] and [17] that new land that can be put under agriculture is limited, contrary to the last three decades, where the bulk of food production in Sub-Saharan Africa came from expansion of agricultural lands. The opportunities to increase crop yields under rain-fed agriculture strongly rest on focusing our attention on maximizing yield per unit of water applied.

Table 2. Respondents background information

	Frequency	Percent	Cumulative percent
Marital status			
Married	148	77.1	77.1
Single	36	18.8	95.8
Widowed	8	4.2	100.0
Total	192	100.0	
Occupation			
Farmer	182	94.8	94.8
Teacher	10	5.2	100.0
Total	192	100.0	
Education level			
Literate (have formal Education)	126	65.6	65.6
Illiterate(have no formal Education)	66	34.4	100.0
Total	100.0		

Table 3. Respondents background information cont

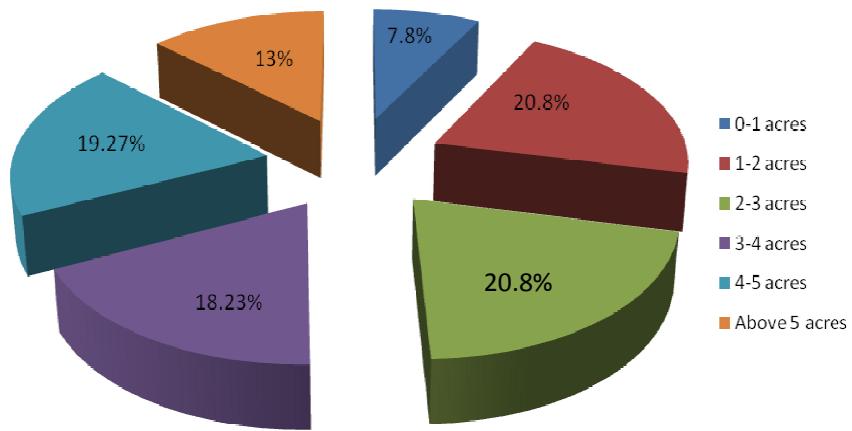
	Frequency	Percent	Cumulative percent
Age group			
23- 65 years	159	82.8	82.8
Above 65 years	33	17.2	100.0
Total	192	100.0	
Gender			
Male	58	30.2	30.2
Female	134	69.8	100.0
Total	192	100.0	

Table 4. Type of land ownership

	Frequency	Percent	Cumulative percent
Communal	2	1.0	1.0
Lease	22	11.5	12.5
Owner	168	87.5	100.0
Total	192	100.0	

Table 5. The duration the respondents have grown crop farming in Oljoro-Orok

	Frequency	Percent	Cumulative percent
Less than 1 year	9	4.7	4.7
1- 5 years	20	10.4	15.1
Over 5 years	163	84.9	100.0
Total	192	100.0	

**Fig. 2. Distribution of the land holding**

3.2 Analysis of Opportunities vs. Threats

The study established that the division has Opportunities as well as threats facing agricultural production. If well utilized the opportunities are able to address the threats hence increasing agricultural production in the division. Seed quality is a threat to increased potato production in Oljoro-orok division. Planting clean seeds helps in preventing the passing of negative traits from one season to the next. As shown on Fig. 3, 71.4% of the respondents' plant indigenous potato species (immediately harvested from fellow farmers and not certified ones from Kenya Agricultural research institute). The challenge of seed quality can be addressed by the presence Kenya Agricultural Research Institute in the neighbouring Gathanji division where farmers can buy quality seeds and also seek advice on the suitability of seeds in the division. The study found that, twenty five percent (25%) of the respondents plant their crops according to traditions and don't rely on the seasonal weather forecasts from Kenya Meteorological Department. The respondents plant according to a tradition that is planting during a certain time when they have been planting as the start of the season each year. Three point six percent (3.6%) of the

respondents plant using their own spacing and not as advised by agriculture field officers. They use the knowledge of planting passed from one generation to the next. Planting according to tradition exposes farmers to great losses when weather changes. From the findings farmers don't plant according to seasonal weather forecasts from Kenya Meteorological Department and this leads to decreased potato yields or total crop failure in case of changes on the onset of rainfall. Farmers in Oljoro-orok division needs to embrace modern technology and follow the seasonal weather forecast from the meteorological department. Improved communication and technology will enable faster transfer of information and reach many farmers within a short period of time. The time of planting is very important for it gives the plant an opportunity to mature before the dry spell. The presence of Nyahururu Meteorological Station in the division will help farmers receive seasonal weather forecast on time for them to decide when to plant based on the onset dates from Meteorological department. The presence of Jacob, Gichaka and Ngara Dams whose water flows within and outside the division when well utilised will help solve the challenges of climate change through irrigation.

As discussed above majority of the farmers plant the same harvested seeds as opposed to clean highbred seeds. Table 6, shows that only 77 (40.1%) of farmers plant hybrid clean seeds from Kenya Agricultural Research institute while the rest plant the very harvested seeds in the next season. Very few farmers 38 (19.8%) plant according to seasonal weather forecast from the Kenya Meteorological Department while the rest plant according to tradition. 77 (40.1%) of the respondents plant potatoes using standard spacing as advised by Agricultural field officers

while the rest plant according to their own spacing knowledge. The findings supports the arguments by Uphoff N. T. [18] that all channels of communication should be utilised to ensure that the farmers receive the vital information on time to enable them plan well. This will reduce climate variability impact on Oljoro-orok farmers by distributing seasonal weather forecasts (based on short-term and long-term forecasts) so that they can make more informed farming decisions and adapt to the changing weather conditions.

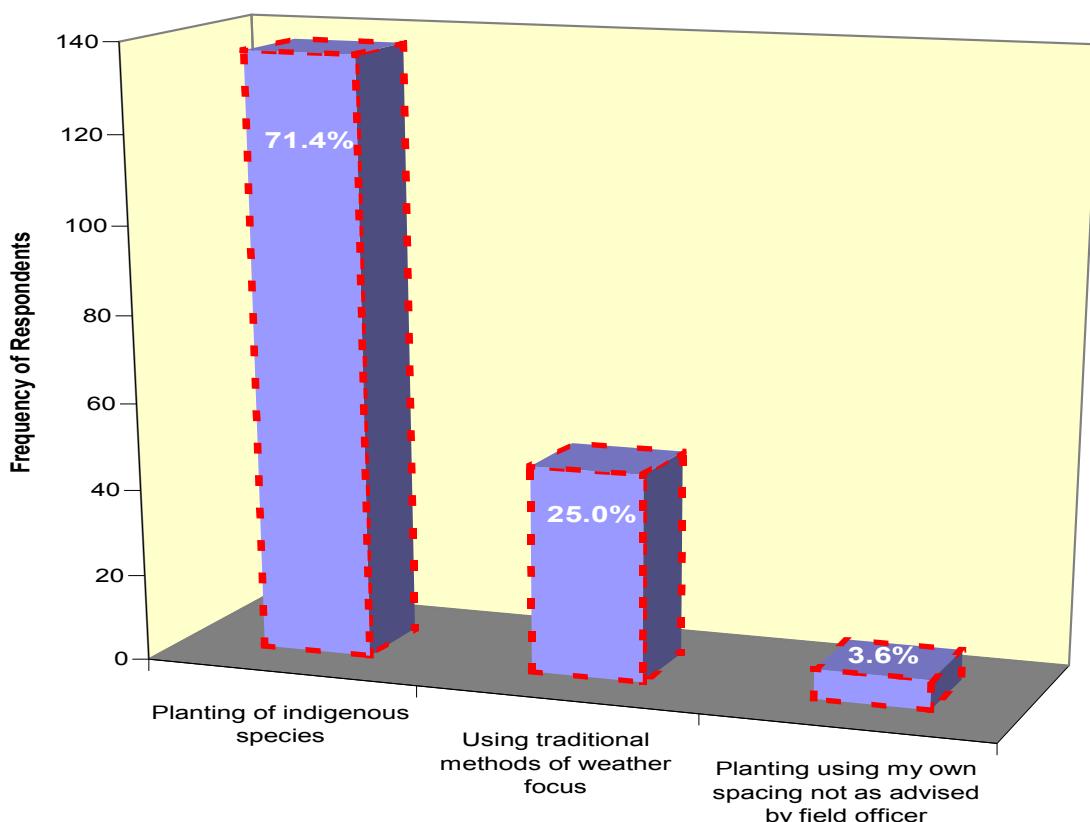


Fig. 3. The indigenous methods of farming employed in the farms according to the respondents

Table 6. Scientific methods of farming employed by farmers

	Frequency	Percent	Cumulative percent
Planting of hybrid seeds from Kenya Agricultural Research Institute	77	40.1	40.1
Planting according to seasonal weather focus from Kenya Meteorological Department	38	19.8	59.9
Planting using standards spacing as advised by field officers	77	40.1	100.
Total	192	100.0	

Though labour is available there is a threat of male migration to urban areas as shows on Table 3 above where majority of the respondents 134 (69.8%) were women while 58 (30.2%) were male. The migration of men was as results of variations in agricultural production which is their main source of income due to climate variability forcing them to seek an alternative source of income through employment. This findings supports argument by Peacock C et al. [19] that agriculture is becoming predominantly a female sector as a consequence of faster male out-migration. There are tasks that women cannot do alone without the help of men and therefore combined efforts between men and women will help improve agricultural production. The annual farmers field day organized by Farmers Training College in the neighbouring Gatimu division is an important event that should be utilized to educate farmers on the best farming practices. The field day is an opportunity where farmers should learn the emerging types of seeds, methods of planting and new technologies. All farmers should be sensitized on the importance of attending the event because the products displayed there are mostly meant to benefit the division hence making farming attractive and reduce migrations. The study also found competition and poor market as threats to produce marketing. Competition from other producing regions has continued threaten Oljoro-orok farmers in the markets such as 'Wakulima' in Nairobi. However the division is strategically located near major urban centres such as Nyahururu, Nakuru, and Nyeri. These towns offer ready market and they are near. Although the division is strategically located inaccessibility still remains the major challenge. Most of the feeder roads are normally impassable during the rainy season and this will worsen because of climate change. Inaccessibility makes it difficult for farmers to sell their produce hence incurring losses.

4. CONCLUSION AND RECOMMENDATION

The division is vulnerable to climate change due to overreliance on rain fed agriculture, poverty due to low yields and inaccessibility. However there are strengths and opportunities when well utilised will help counter the weaknesses and threats and adapts to climate change and increase agricultural production. The study recommends the following; The Agricultural field officers should liaise with Nyahururu Meteorological and advice farmers on the onset

and cessation of rainfall so that they don't incur losses that can arise in case of rainfall variations. The farmers' field day organized by Farmers Training College should be organized more frequently to enable more farmers to attend and advise them on the appropriate adaptation. Farming needs to be made more attractive to help reduce migration of men who do so to look for better opportunities. The Kenya government and the County government of Nyandarua should rehabilitate the feeder roads to enable farmers transport their produce to the market throughout the year.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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