

Challenges of One Acre Fund and Strategies for Enhanced Adoption of Agriculture Innovation Programs

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Abstract

Purpose: The adoption of One Acre Fund (OAF) agricultural practices has helped small-scale land holders to address food insecurity in Kenya. Efforts have been made by both the central and county governments to address food insecurity through low levels of technological acquisition to small-farm holdings. This study is prompted by declining production especially in staple foods in Bungoma South Sub-County. The paper examines challenges and strategies of adoption of One Acre Fund (OAF) agriculture innovation program adoption among smallholder maize farmers, Bungoma County. Specifically, the paper examines challenges and strategies of improving One Acre Fund agricultural innovation program in Bungoma South Sub-County.

Methodology: The paper employed descriptive survey design to accommodate qualitative and quantitative data-. Data collection was done using questionnaires, interview schedules, focus group discussions, and direct observation of 204 OAF households. The secondary data was collected from published materials. Data were analyzed using simple descriptive statistics while quantitative data was filtered, coded, and analyzed using the Social Sciences Statistical Package (SPSS). The regression analysis was used to determine the correlation between dependent and independent variables. Quantitative data was analyzed using chi-square and pairwise ranking.

Findings: Various challenges affecting the adoption of OAF program were identified such as small farm size, infertile and leached soil, climate variability, high cost of inputs and high interest on repaying of loans. Pairwise ranking was run to determine strategies for enhanced adoption. Reduced loan repayment interest, crop insurance, reduced cost of farm inputs, awareness on existing OAF innovations and increased use of fertilizers were identified as strategies for enhancing adoption. Pearson moments correlation results showed a positive relationship between OAF income generation and income improvement with correlation coefficient of $r_s = 0.5$.

Conclusion: The study concludes that adoption of OAF innovation is low among smallholder farmers. This is because of the high cost of repayment of loans on inputs. The main strategy to enhance increased adoption was reduction of loan repayment interest.

Recommendation: The study recommends the need to increase the participation of youths in the OAF Programs through mentorship and education. OAF management should scale up its program to accommodate even farmers with large farms. It should also introduce a program that tailors towards crop diversification to offer a variety to farmers to make choices on which crops to adopt.

Keywords: *Adoption, agricultural innovations, Bungoma County, one acre fund, challenges, strategies*

INTRODUCTION

Maize is the primary cereal crop grown and consumed globally (Ranum *et al.*, 2014). Maize offers nutritional security, food, and feeds to 900 million farmers and consumers in some of the world's poorest countries in Africa, Latin America, and Asia (Shiferaw *et al.*, 2011). The crop provides over 20% of total calories to humans in 21 countries. In Asia, 70% of maize produced is used for animal feed, 23% for food, and 7% for other purposes. This is in contrast to Africa, where 73% of maize produced in Eastern, Southern Africa, Central and Western Africa is solely used for food (Shiferaw *et al.*, 2011). In Asia, the demand for maize is driven by domesticated animals, while in Africa is driven by people's food.

There are several types of maize breeds cultivated all over the world that are differentiated using their colour. The colour of maize can either be red, black and white or yellow (Ranum *et al.*, 2014). Yellow maize dominates the Asian regions. However, the demand for yellow maize in Africa has been uncommon because it is associated with food aid, low social status and animal feed. Currently, the world's maize production stands at 10.14 billion metric tonnes (Food Agricultural Organization Statistics, 2021). Out of this, the United States of America contributes the largest share of 35.35 per cent of the total global production. However, Asia's maize output to the global-basket cannot be underestimated. This is because its eight major producers who are China, Indonesia, India, Pakistan, Nepal, Philippines, Thailand and Vietnam produce 26 per cent of the global maize and 98 per cent of Asia's total maize production (Erenstein, 2010). With this output, China has surpassed the United States as the world's second-largest producer of maize, accounting for 21.11 percent of worldwide totals. Brazil, Argentina, Ukraine, India, and Mexico are the other main world producers of maize, accounting for 7.82, 3.23, 2.7, 2.32, and 2.28 percent of total global production respectively (FAOSTAT, 2015).

Since the introduction of maize in Africa in the 16th century, the cereal has been of economic significance, replacing sorghum and millet (Olaniyan, 2020). Maize has been one of the food crops that has been readily accepted all over the continent due to its nutritional value and compact nature which makes it easily transportable especially in Southern Africa and West Africa. Africa's highest consumption of maize occurs in Zambia, Zimbabwe, Burkina Faso, Kenya, Tanzania and Mozambique. Southern Africa produces the highest quantities of maize in Africa, with an estimated annual production of 14.98 million tons, an equivalence of 19.36 per cent of the continent's total production. Nigeria follows with 10.79 million tons (FAOSTAT, 2020). Maize is widely grown as a staple food in sub-Saharan Africa with annual coverage of more than 33 million ha (FAO, 2021) an estimated 17 per cent of the sub-Saharan Africa total land area.

Maize production leads in terms of the Kenya's total production contributing to about 58 per cent of the total produce. This is followed by beans (17 per cent), millet (3 per cent), sorghum (3 per cent), banana (3 per cent), sukuma wiki (3 per cent), cassava (2 per cent), cowpeas (1 per cent) and others (6 per cent) (FAO, 2015). Maize has been widely accepted in the country due to its wide variety of uses. It provides rural employment, animal feed, and raw resources for agro-industries, for example. It is also important for household food security because it is grown for both subsistence and market, with smallholders selling 20% of their harvest (Shen, 2016). Furthermore, it is a staple food for more than 80% of Kenya's population.

With an annual production of close to 3.5 million tons, the current maize yield is predicted to be 1660.2 kg/ha. These results show an increase in maize productivity, which can be attributed to

more acreage planted with maize. Maize sector productivity has been influenced by increased investment in research and development, input and output policies and agro-ecological factors such as climate variability (Shen, 2016). For instance, Kenya Agricultural and Livestock Research Organization (KALRO) has introduced several modern technologies such as fertilizer application, maize open-pollinated varieties and hybrid seeds to ensure productivity scales up.

LITERATURE REVIEW

Challenges of Adoption of Agriculture Innovation Programs

The Kenyan cropland is purely rain-fed and diversified into four major food crops namely; maize, beans, sweet potatoes and finger millets (Farm Agricultural Organization, 2021). Maize farming is largely dependent on ecological factors, as such; maize smallholder farming is constrained by a lot of challenges. Firstly, climate variations have been a recent challenge affecting smallholder production across the world. Rose *et al.* (2009) noted that climate variability presented a threat to food security in Kenya particularly the unpredictable weather patterns and increasing temperatures. This climate variability also presents itself in the form of drought, which affects the rain-fed lowlands and uplands of Africa, which account for 70% of total maize production land. The problem is compounded by rising and falling temperatures (Lobell *et al.*, 2011). For example, a recent analysis of over 20,000 historical maize trial yields in Africa over eight years, combined with weather data, revealed that for every increase in daily temperatures above 30°C, maize grain yield was reduced by 1% and 1.7%, respectively, under optimal rain-fed and drought conditions (Lobell *et al.*, 2011).

Personal qualities and endowment, imperfect knowledge, risk uncertainty, institutional restrictions, input unavailability, and infrastructure economically all play a role in technology adoption (Rogers, 2003). Some of the barriers to technology adoption basing on Rodgers include imperfect information, risk uncertainty, institutional limits, input unavailability, and infrastructural constraints. Secondly, the low adoption of modern technology by farmers in Kenya and other developing countries has been a challenge that has resulted in low maize production (Umeghalu *et al.*, 2012). This challenge is supported by Wole (2015), who pointed out that the limited adoption of new agricultural systems by emerging farmers has prevented them from achieving higher agricultural production.

Thirdly, most small-scale maize farmers are also facing economic-related challenges. Smallholder farmers are confronted with several economic obstacles which according to Rosiego *et al.* (2016), included limited farm size, limited access to financing and capital, poor access to modern markets, variable food prices, and increased agriculture-related health concerns. Low production has developed as a result of these restraints. This is well exemplified by Omovbude & Udensi (2012), who noted that smallholder maize farmers in Kenya are faced with low income among households limiting the application of modern farming inputs like hybrid seeds and fertilizers. Also, personal qualities and endowment, imperfect knowledge, risk uncertainty, institutional restrictions, input unavailability, and infrastructure economically all play a role in technology adoption (Rogers, 2003). Some of the barriers to technology adoption based on Rodgers include; imperfect information, risk uncertainty, institutional limits, input unavailability, and infrastructural constraints.

Lastly, the other challenge faced when adopting programs such as One Acre Fund as noted by

Murgor, (2015), is the lack of trained and experienced technical personnel to control and manage the resources during the adoption process. The study noted that lack of theoretical knowledge and practical management "kills" projects intended to help the targeted groups such as smallholder farmers.

In summary, most of the reviewed literature explains the factors related to innovation types, adopters' characteristics, adoption status and socio-economic characteristics for adoption. It is important to note, that none of them have addressed how these factors influence the adoption of the OAF agricultural innovation programs. There are research gaps on the factors that influence the adoption of the One Acre Fund's agricultural innovations in Bungoma County as well as the types of innovations, benefits, and obstacles that the One Acre Fund faces. This study will fill these gaps by keenly scrutinizing how the discussed factors influence the adoption of the OAF agricultural innovation program.

Strategies for Increasing Adoption

To combat the aforementioned challenges, there is a need to develop improved seed varieties to help smallholder farmers boost their productivity. This is because these varieties are pest, disease and weed resistant, drought tolerant (Juma, 2010). Most researchers and organizations have prioritized this (Welch & Graham, 2004). However, Oladele (2006) argued that improved maize varieties should be accompanied by appropriate farming practices such as seed planting, seeding, fertilizing methods, weed control techniques, and storage practices for optimal performance. A study by Riesgo *et al*, (2016), gave the following summary of the strategies that need to be done in developing countries to improve smallholder farming. (i) Promotion of land rights through certification of ownership or lease rights and efficient land markets (ii) investment in agricultural research to produce more using less (iii) promoting smallholder friendly innovations (iv) closing gender gaps by creating equality in agriculture and developing young farmers by investing in infrastructure, creating new opportunities in farming and provision of farm of farm inputs on credit.

METHODOLOGY

The study used descriptive study design with data collected from Bungoma South Sub-County, Bungoma County. The study targeted all One Acre Fund smallholder maize households in Bungoma South Sub County. According to One Acre Fund field records, the Sub-county has 11,673 OAF smallholder households. The study targeted all One Acre Fund smallholder maize households in Bungoma South Sub County. The sample size was calculated using the Yamane (1967) algorithm. The desired level of precision was 5%, giving a sample frame of 204 households. This formula was deemed suitable as a result of the large population in the study area. The descriptive study design adopted allowed for a more in-depth research of the topic at hand. The study, purposively sampled Bungoma South Sub County because of declining maize production in the area and intensification of the program in the Sub County. The paper focused in Bukembe West, Bukembe East, Kibabii, West Sang'alo, East Sang'alo and Namasanda) out of ten wards found in the study area. The sample size representing each ward was selected using non-proportionate sampling. This was done by dividing the sub-county total sample size of 204 households equally among the six (6) Wards. This provided an approximate sample size of 34 respondents from each ward. A simple random sampling was used to select respondents for each ward.

This strategy was found to be effective as it provided an equal opportunity for all members of the public who were intended to participate in the study. The process involves assigning unique numbers to respondents using a computer-generated list based on OAF data entry for registered farmers. Numbers were folded into bowls and folded blindly to select one respondent at a time until each ward had 34 respondents; the selection is done independently by rotation, so wards 1, 2, 3, 4, 5, and 6. Based on this unique study area, 204 respondents assisted in obtaining information to address the research objective. The reliability of the study was determined by the triangulation. This made the research more credible. SPSS software was used to test the reliability of the research. Quantitative data was analyzed using the Statistical Package for Social Sciences (SPSS) and Microsoft Excel. Statistical tables, percentages, averages, and frequency tables were employed in the descriptive analysis. Regression analysis was used in inferential statistics to test the hypothesis in order to evaluate the correlation between adoption and socio-economic challenges of OAF agricultural innovations. Qualitative data collected was transcribed and analyzed using themes for content analysis and triangulated the quantitative findings.

The Study Area

Bungoma County is bordered by the Republic of Uganda on the north-west, Trans-Nzoia County on the north-east, Kakamega County on the east and south-east, and Busia County on the west and south-west. It is located between latitudes 0° 28' and 1° 30' north of the Equator, as well as longitudes 34° 20' and 35° 15' of the Greenwich Meridian (Kamau, 2018). The county has a total land size of 3032.4 km². Bungoma South sub-county (formerly Kanduyi Division) is located between 0° 30' and 0° 40' North latitude and 34° 20' and 34° 40' east longitude. It has a total size of 663.3km² (Kenya National Bureau of Standards, 2009). There are 98,743 agriculture households in the Sub-County (KARLO, 2013).

Bungoma County has a hot and humid climate, with temperatures ranging from 15°C to 30°C. The area has two rainy seasons with evenly distributed rainfall throughout the year, averaging 1200mm to 1800mm on average (Bungoma County Intergraded Development Plan, 2013). Maize growing is appropriate in this climate. The Sub-county has andosols and nitosols (Obura, 2008). The county's economic activities include mining, tourism, wildlife, trade, industry, forestry, fishing and beekeeping. The main economic activity is agriculture which is practiced by 270,824 farmers (BCIDP, 2018). Maize, beans, sweet potatoes, finger millet, bananas, sorghum, Irish potatoes, and assorted vegetables are among the county's food crops. Cash crops on the other hand include tea, coffee, palm oil, tobacco, sunflower, and sugarcane (BCIDP, 2018). The challenges facing agriculture in the region are the rain-fed nature of agriculture that makes farmers only plant during the rainy season and massive land fragmentation due to population pressure (BCIDP, 2018). These challenges have resulted in declining maize production in the county (Kamau, 2018). Following this, One Acre Fund has been a timely intervention by introducing an innovation package that targets only rural smallholder farmers in the county.

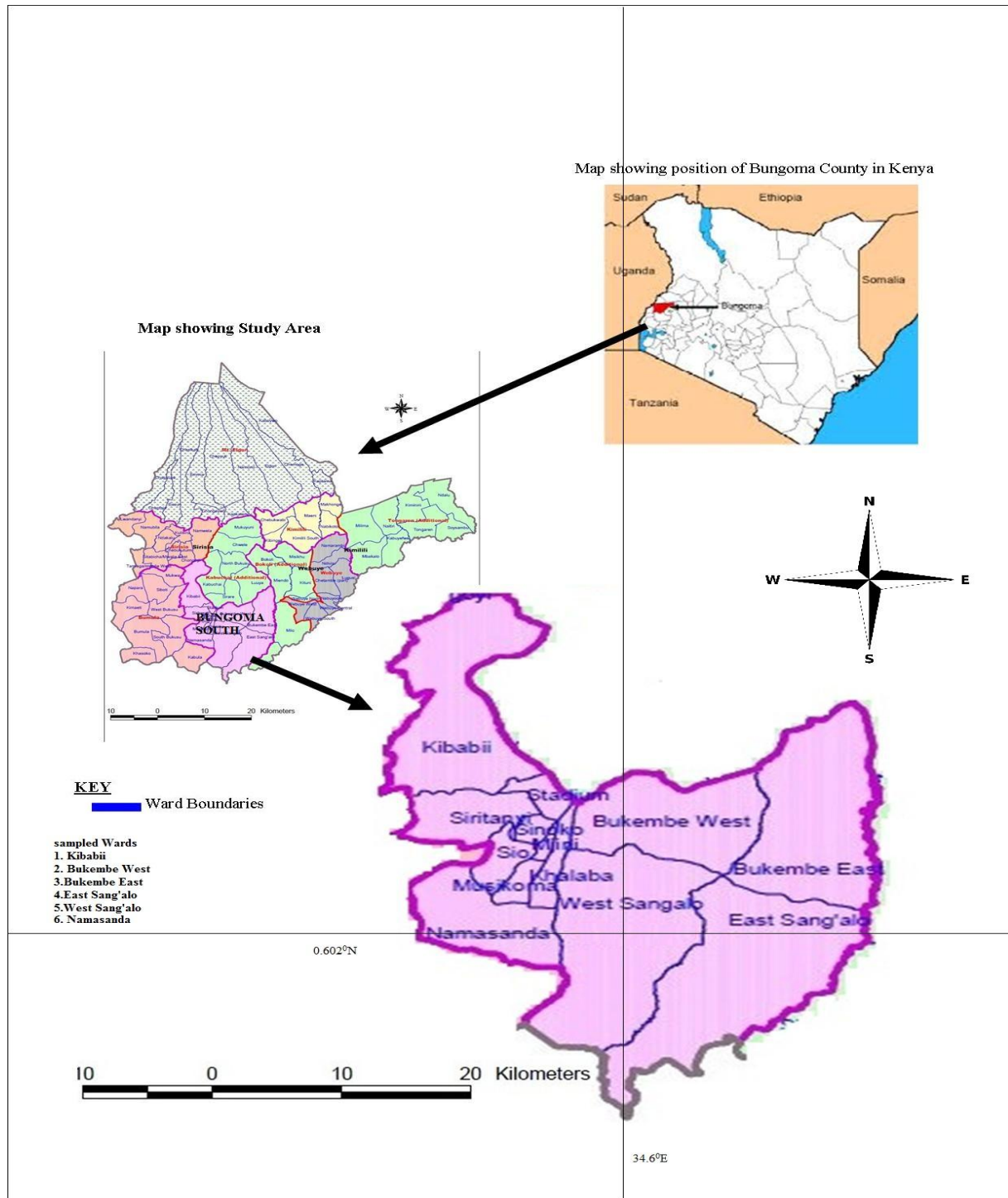


Figure 1: Map of study area

Source: BCIDP (2013)

RESULTS AND DISCUSSION

Challenges Facing Adoption of One Acre Fund

This paper presents the challenges facing OAF agricultural innovation program adoption in Bungoma County. Several challenges were identified to impede adoption of OAF programs. Therefore, this study sought to establish the challenges faced by farmers when adopting the program.

High Registration Fee

The study findings revealed that high registration fee and high cost of repaying the loan was a major constraint in adoption of OAF innovations. This was demonstrated by 68% of the respondents citing high registration cost while 90% citing high cost of repaying the loan as shown in figure 2.

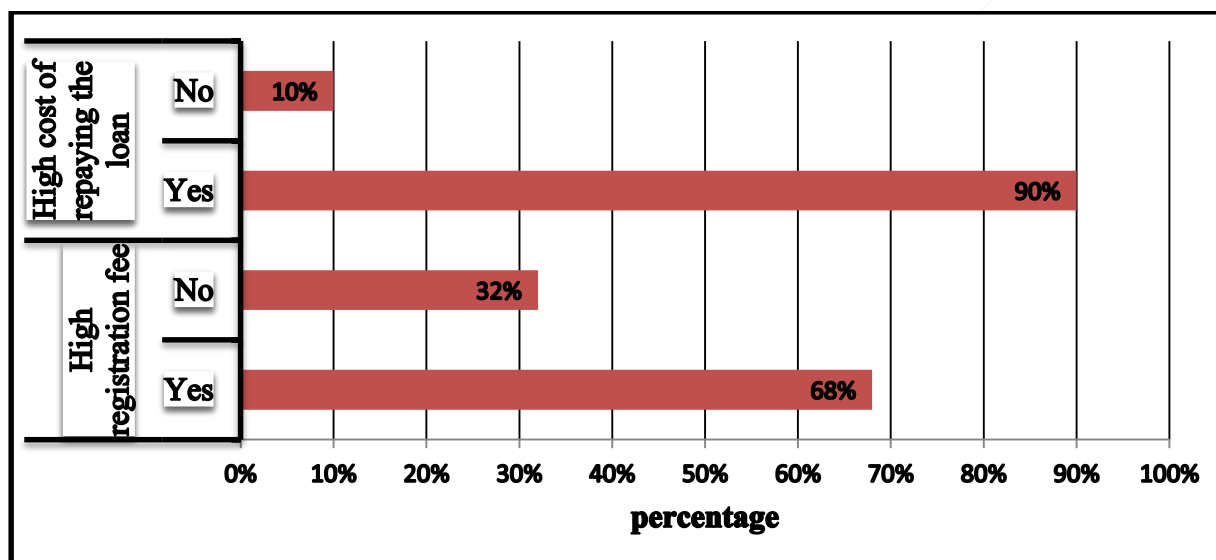


Figure 2: High loan repayment cost and high registration fee

(Source: Field Data (December, 2020))

Farmers revealed that to adopt the program package, one needed to pay a registration fee of Ksh. 500. Evidently, most farmers could not afford this amount since they were limited by high poverty level that stood at 53% with a total of 784,718 people (Kamau, 2018). In terms of cost of repaying the loan; sampled farmers revealed that much of their produce is used to repay their loan. A farmer is required to give six (6) bags of 90kg on every one-acre piece of land harvest as part of the loan. Considering the low average harvests that stand between 8 to 10 bags/acre in the study area, it implied that three-quarter of the produce ended up paying for the loan advanced to them as farm inputs.

Climatic Variations

Some respondents stated that climatic variations limited their adoption because affected plant growth. Investigation demonstrated that 67% of the sampled farmers reported occasional dry spells and heavy rainfall as the main climatic constraints. They also revealed that during heavy rainfall,

floods wash away seeds and fertilizer from the farms leading to heavy losses on the part of farmers. This was evident in the month of April and May 2020 where massive destruction by floods was witnessed in some farms owned by OAF farmers. For farmers to adopt a given innovation, they need to be aware of both rainfall and temperature variations. Farmers who are aware of these fluctuations take up innovations readily than those who are not aware. In maize production, any increase in maximum daily temperature negatively impacts maize yields than minimum night temperature. This means that the effects of temperature on the production of maize are more advanced compared to those of rainfall. These findings are similar to those of Adamgbe and Ujoh (2013) which found that high rainfall and temperature fluctuations led to maize yield variability.

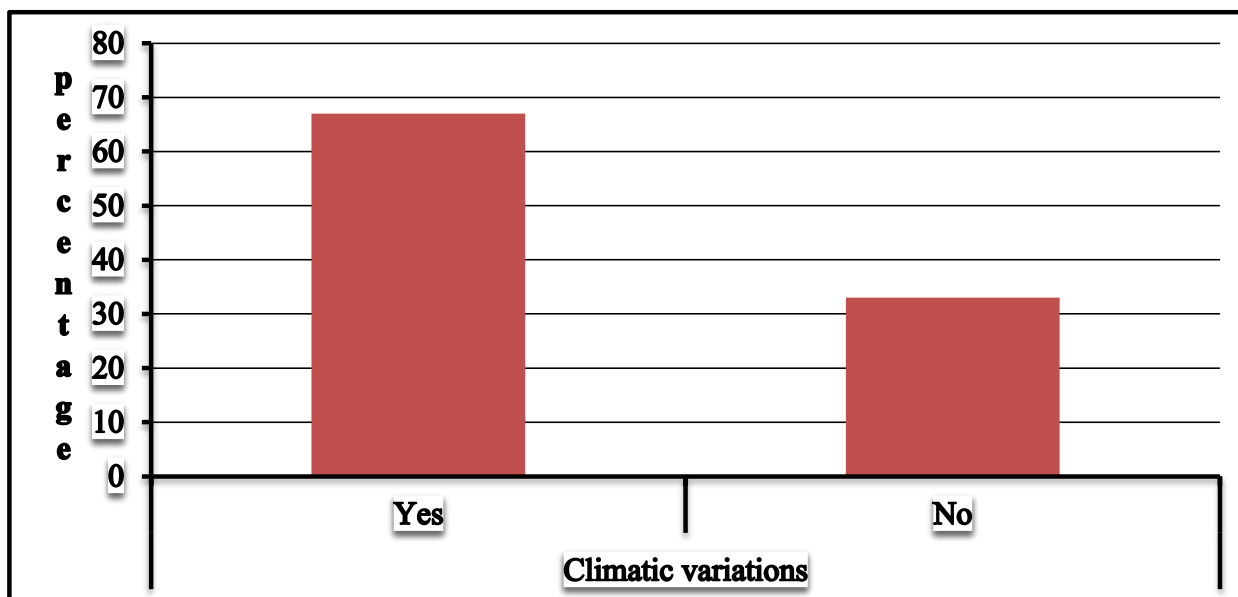


Figure 3: Climatic variations

Source: Field Data (December, 2020)

Poor Soils and Small Land Sizes

In this study infertile, leached soils were also identified as challenges facing OAF adoption as shown in figure 4.

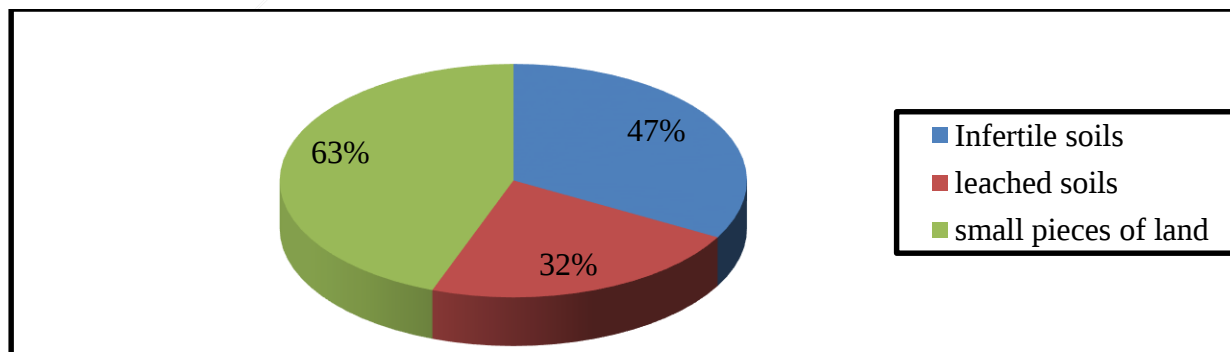


Figure 4: Poor soils and small land sizes

Source: Field Data (December 2020)

The findings from this study showed that majority of the small scale farmers in Bungoma County are faced with challenges of infertile soils (47%), leached soils (32%) and small land sizes (63%). The study observed that small land sizes were attributed to fast growing population that has resulted to massive fragmentation as required by land tenure system in the study area. Furthermore, field officer argued that small land sizes did not attract enrolment as majority of the farmers could afford the cost of farm inputs for their farms. These findings are in line with Recha *et al.*, (2013) which asserted that an increase in human population contributed to falling farm size and land degradation. According to the sampled farmers 47% and 32% agreed that the soils were poor. Farmers argued that poor soils increased the cost of farm inputs as farmers were forced to apply large amount of fertilizers in order get high yields. Results from the findings indicated that those who did not apply large amount of fertilizer, harvested insufficient quantities.

High Cost of Farm Inputs

High cost of farm inputs was cited as a challenge during adoption with 64% of the field officers and (75%) of OAF farmers agreeing with this challenge as shown in Figure 5. Field officers attributed high costs of farm input to high prices charged by seed companies on farm inputs which are then transferred to farmers with OAF acting as a middleman. This statement is supported by Mukhwana et al. (2005) who noted that to produce 100 kg bag of maize in Kenya, requires Kshs. 800/= compared to Kshs. 470/= and Kshs 390/= in Uganda and South Africa respectively. It is therefore evident that in Kenya, seed companies have a business-driven approach that is attractive to their clientele to make profits which results in costly farm inputs (FAO, 2011).

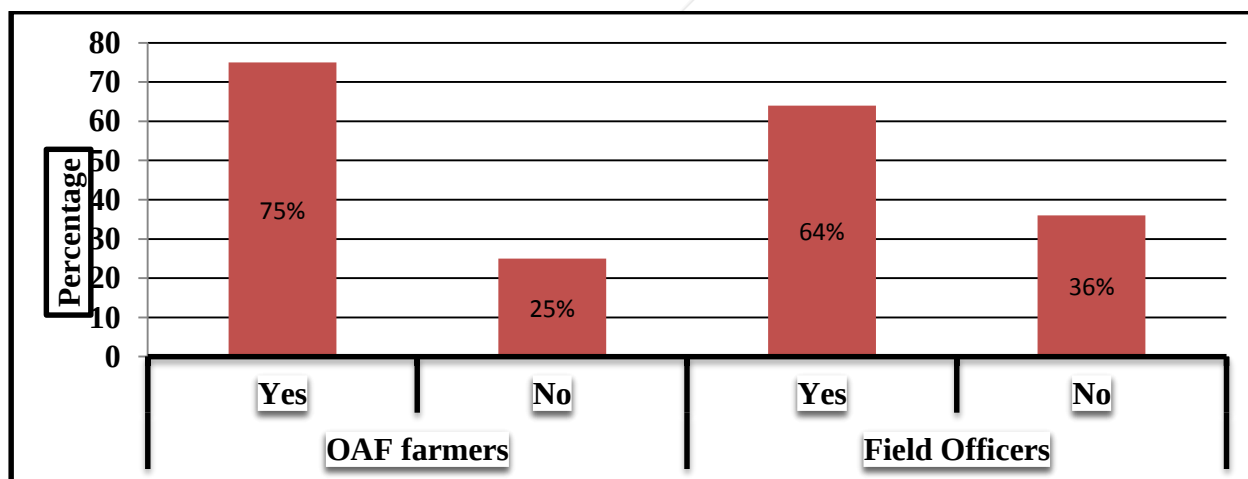


Figure 5: High cost of inputs

Source: Fieldwork (2019)

Low Prices and Low Produce

Study findings indicated that low prices of maize are caused by low market 14% which is attributed to flooding of the market by maize due to bumper harvest during harvest season making middlemen take advantage of the same. Besides low markets, nine per cent 9% of the respondents revealed that low prices also emanated from the fact that OAF management do not help farmers in marketing their produce nor cushion them from exploitation. This, therefore, forces farmers who

do not have alternative markets for their produce, to sell their maize at throw-away prices to exploitative middlemen, hence making losses.

Of the sampled respondents 13% noted pests such as weevils to be a challenge as they result in low quality of maize harvested making it uncompetitive on the market. Some respondents 8% said that the culture does allow farmers to work on their farms when bereaved up to a period of 40 days which is crucial as it stopped farming for a period exceeding one month leading to loss of agricultural production. This is supported by Wabwoba, (2018), who assert that bereavement contributed to low productivity in case it occurred during planting season. Respondents 8% that some maize was stolen while in the farms or stores, hence lowering the produce.

Lastly, a majority 51% of the respondents said to have been exploited by middlemen as shown in figure 6. Findings indicated that retailers, assemblers, bicyclists, posho-millers, wholesalers and dis-assemblers were some of the middle men who exploit farmers during the harvesting season as they flood in the region with very low prices.

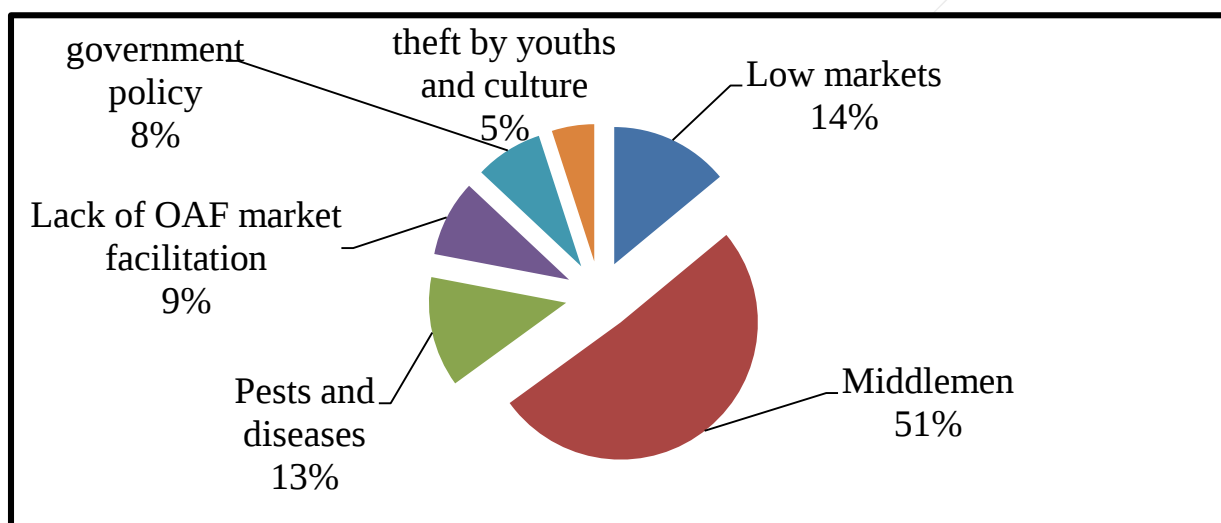


Figure 6: Low market prices and produce

Source: Field Data (December 2020)

Strategies for Enhanced Adoption of OAF Program

The proposed strategies to enhance adoption of the program were as shown below, Focused Group discussions were subjected to pairwise ranking method and the following are the results (figure 6).

Table 1: Evaluation of priority strategy for enhancing adoption

	RCFI	A	CI	RLRI	IUF	Tally
RCFI		RCFI	CI	RLRI	RCFI	4
A	RCFI		CI	RLRI	A	1
CI	CI	CI		RLRI	CI	6
RLRI	RLRI	RLRI	RLRI		RLRI	7
IUF	RCFI	IUF	CI	RLRI		1

Source: fieldwork, (2020)

<i>Code</i>	<i>Proposed strategy</i>
<i>RCFI</i>	<i>Reduced cost of farm inputs</i>
<i>A</i>	<i>Awareness on all existing innovations</i>
<i>CI</i>	<i>Crop insurance</i>
<i>RLRI</i>	<i>Reduced loan repayment interest</i>
<i>IUF</i>	<i>Increased used of fertilizers</i>

Therefore, the pairwise ranking method which involved ranking of the priority strategy that can enhance adoption of OAF agricultural innovation revealed that reduced loan repayment interest (7), crop insurance (6), reduced cost of farm inputs (4), increased use of fertilizers (1) and awareness on all existing innovations (1) were the priority strategy for scaling adoption in Bungoma county in the order shown in table 2.

Table 2: Rank for strategies that can enhance adoption of OAF program

Strategy	Code	rank
Reduced loan repayment interest	RLRI	7
Crop insurance	CI	6
Reduced cost of farm inputs	RCFI	4
Awareness on all existing innovations	A	1
Increased use of fertilizers	IUF	1

Source: Fieldwork (2020)

CONCLUSION

The study paid emphasis on the challenges that impede adoption of the OAF agricultural innovation program. The challenges identified during interviews were; lack of crop insurance, high registration fee, high cost of repaying the loan, presence of only one variety of maize, infertile and leached soils, climatic variations and small land sizes. Farmers who had not adopted the whole OAF package were limited by the aforementioned key challenges. The study concludes that there is need to reduce loan repayment interest in order to retain and also attract more smallholder farmers into the programs.

RECOMMENDATIONS

1. There is a need to increase the participation of youths in the OAF program through mentorship and education.
2. OAF management should scale up its program to accommodate even farmers with large farm sizes.

3. OAF management should also introduce a program that tailors towards crop diversification to offer a variety to farmers to make choice on which crop to adopt.

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Conflict of Interest

The author(s) declares no conflict of interest.

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