The Role of Technological Interventions in Enhancing Food Security in Kajiado County, Kenya

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ABSTRACT

Despite the many attempts to enhance food security in Kenya, insufficiency of food and food items remain a challenge in many parts of the country. Many interventions have been instituted in the past with limited results despite heavy investments and government spending both at policy and implementation levels. The study objective was to determine how technology application intervention has enhanced food security in Kajiado County. Diffusion of innovation theory informed the study. Pragmatic research philosophy was used to establish the effectiveness of technology interventions in achieving food security in Kajiado County, Kenya. This research used a mixed research design with descriptive and explanatory being employed. The target population comprised of the registered famers, the agricultural extension officers, and County government officers. A total population of this study was 29,572 respondents which comprised of 29,514 registered famers, 47 agricultural extension officers and 11county government officials. The study used a sample size of 411 respondents comprising of 356 registered famers and a census of all 47 agricultural officers and 11 County government officers. The researcher utilized semi structured questionnaires for registered famers and agricultural extension officers and interviewed the County government officials to collect quantitative and qualitative facts. The questionnaire was administered physically with a help of a research assistant who was able to understand the local dialect of the community around the county and helped fill the information in google forms. In addition to these, the study used 10 interview schedule questions to collect qualitative data from County government officials. The internal consistency was measured using Cronbach's alpha, where an alpha value of $0.7 \leq \alpha < 0.9$. Data was analyzed descriptively and the Content analysis was used to analyze qualitative data involving outlining the useful responses and presenting them in themes in prose form. The findings indicated that technology significantly influenced food security in Kajiado County. This study contributes largely to policy, theory and the practices in the body of knowledge.

Keywords: Technological interventions, Food security, County government

BACKGROUND TO THE STUDY

Globally, food is considered as a fundamental right. It is contained in the International Covenant on Economic, Social and Cultural Rights (ICESCR). Article11 of the ICESCR (1976) acknowledges that food accessibility is a universal human right thus requiring countries to enhance food practices, preservation as well as circulation. It therefore indisputably acknowledges that having food is a fundamental right. According to the World Health Organization, the population of people in the world is estimated to grow to 8.5 billion in the year 2030 growing from 7.7 billion in 2021, it is essential to understand the effectiveness of interventions put in place to ensure that food security go hand in hand with population. Despite the global efforts pinpointing and employing suitable policy interventions like enhancing agriculture and distribution of food, food security has remained a great challenge (FAO, 2019). Globally, constant chronic and acute food crisis, show that more and more people are becoming vulnerable to different shocks either economically, politically or even climatically endangering food security (FAO, 2019). The world's biggest challenge is to feed the ever-growing number of people by increasing production of food with minimal energy and water with limited resources, little fertilizers and pesticides by 2030 (Shukla & Shankar, 2015). Utilizing the existing technology and discoveries of new technologies led to such arrangements. Technology has been used globally to enhance food production. Since mid1990s, Biotechnology has been used to produce genetically modified organisms (GMOs) (Oloo et al., 2020).

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India is among the worst hit food insecure countries. Its escalating population has exerted pressure on the financial systems. Its government is utilizing biotechnology to achieve desired characteristics in plants and animals to try and boost its food production however; it has not effectively mitigated hunger. The government of India is also focusing on research to enhance food production. Its target is to reinstate 26 million ha of destroyed state, by 2030 to increase food production (Kumar & Sharma, 2020). Different States universities have been engaged to come up with different strategies and new technologies towards the same. The research has had great achievements especially on understanding salinity and water dynamics (Mashal et al., 2021). This means that such research interventions should be emulated by other countries facing various challenges leading to food insecurity.

Bangladesh is a developing country dealing with food insecurity too. Its government has invested in technology which has helped famers increase their production and income. Digital Geppetto advisory platform has been effective in helping farmers to receive instant SMS messages informing them when favorable climatic conditions are expected, and how to control pests and diseases. (Singha, 2019). Bangladesh is a small country but it is now among the highest world's potato producer. Further using agricultural extensions, the government is trying to provide drought resistant crops which could be planted in the areas that receive unpredictable rainfall with prolonged drought period. This has enhanced food security and reduced drought impact especially to the smallholder famers (Saha et al., 2019).

Ethiopia was among the worst hit with famine worldwide at the end of the year 2022 (WFP, 2022). By December 2022 approximately 22.6 Ethiopians (18% of the total population) were suffering from food insecurity across Ethiopia. Interventions on technologies in water harvesting have been minimal in ASALs though some irrigation was done (Gebru et al., 2021) However, there was a constraint of applying the technology in many areas. Ethiopian government gave incentives in areas that agriculture was doing better to encourage famers to shift from subsistence to commercial agriculture through various means including boosting agricultural, orientation of certain crops for markets and promoting coffee production (Manolas et al., 2019. Ethiopian government is working together with Technologies for African Agricultural Transformation (TAAT) and seed companies to produce varieties of wheat seeds that are heat tolerant which has been availed to lowland famers. This intervention has been successful. The land in which the wheat was irrigated increased rapidly. In 2018/19 not more than 5,000 ha were cultivated which increased in the year 2020/21 to 187,240 ha, and to 650,000 ha in 2021/22. The wheat production increased from approximately 2.0 t/ha to 4 t/ha (Tadese, 2022)

Kemboi et al (2021) sought to establish Socioeconomic Impacts of drought among Pastoral Community in Kajiado County and their coping mechanisms and adaptation methods. They reported measures like water pans, self-help groups raised capital, Tourism the motor cycle (boda boda) transport businesses, milk marketing cooperative and borehole drilling for water adaptive mechanisms. Veterinary services provision and education were the reported drought mitigation measures. Their recommendation included adequate funding to ease drought mitigation, integrated natural resources management to improve coping abilities to drought, and the establishment of vocational and technical trainings to enhance different types of livelihoods rather than pastoralism.

Statement of the Problem

In spite of the many attempts to improve food security in Kenya, food insufficiency remains a challenge in many parts of the country. Many interventions have been instituted in the past with limited results despite heavy investments and government spending both at policy and implementation levels. Agriculture being a devolved function has made county governments largely responsible in the implementation of food security intervention strategies at their jurisdictions. Despite these interventions, many famers continue to bear the brunt of adverse climatic conditions, limited access to credit facilities, poor livestock breeds and seeds, limited research interventions as well as erratic extension services. Technology application remains a mirage for many farmers though cooperative societies have stepped up their support for the farmers.

Technology has been used globally to utilize food resources and minimize waste. It has been used in genetically modifying crops, managing soil and water, pest control, and post-harvest processing. Agricultural extensions are important in enhancing food security they equip farmers with major information, like market information, new

crops varieties and animal breeds, crop prices and other management practices. The purpose of disclosure of such information is to increase farmers' capacity to maximize the use of their resources.

EMPIRICAL REVIEW

Food Security

World Food Summit (1996) defined food security as availability of adequate, safe and nutritious food every time with economic and physical accessibility which must fulfil dietary needs and food preferences for a functional and healthy life (Grote et, al., 2021) Food security has been devised to rest on three dimensions that is availability, access, and utilization (Garcia-Diez et al., 2021) These notion are seen as inherently hierarchical, whereby food availability does not necessarily mean it is adequate or accessible neither does it mean it is effectively utilized. Accessibility is related to the individual or household well-being such as the range of food choices, household income and the prevailing prices, safety nets through which food can be accessed (Andam 2020).

Pawlak and Kołodziejczak (2020) in their study on developing countries agriculture and its relation to food security found out that, households' purchasing power, is key in ensuring food availability and accessibility. The two authors argue that countries' technology transfer and productivity enhance high-yielding varieties ensuring food availability. However, the study was done outside Africa and the study filled the gap by studying the effectiveness of government interventions in Kajiado which is one of the ASAL counties in Kenya.

Food availability is all about adequacy of food to all members of the society. It is attained through production, imports, storage, and food aids. Grote et, al. (2021) revealed that agriculture plays a strategic role in enhancing food availability. Water is also a key resource required for food production. Population growth has put exceeding pressure on existing natural resources. Land degradation has resulted due to climate change degrades land and lack of farming water led to losses of livelihoods (Lin et al., 2022).

Food accessibility is more on having the purchasing power to access the food physically. Food availability does not give assurance of individuals' food security. Concerns about food inaccessibility have made the policymakers focus on how to increase people's incomes and reduction of prices in achieving food security goal (Seligman & Berkowitz 2019). Food accessibility focuses on the peoples' purchasing power to obtain sufficient quantity and quality of nutritious diet. O'Hara and Toussaint (2021) on their study titled food access in crisis reported that food access depends normally on the food prices, available income and access to market. Food Utilization is conceptualized to be how the nutrients get to the body and are used. Niu et al., (2022) on their study on food waste and its embedded resources reported that the nutritional status is determined by how the food was utilized. They indicate that despite the accessibility and availability of nutritious food the household decides what to purchase and how to prepare it. Mission and Koutsoumanis (2022) on their study on food safety and spoilage as a result of climate change addressed an overlooked aspect of climate change; the duo addresses the post-harvest handling of food to ensure it's safe for consumption. However, the current study addressed the effectiveness of interventions to enhance food security.

Food stability ensures food is accessible by individuals at all times. Even if an individual has sufficient food currently, does not guarantee food security in some periods if it's not available. Diez et al., (2021) on their study on how food security is determined by food stability reported that, human and technical resources are paramount in achieving food security. They argue that food stability assurance depends on crop and livestock production and use of their fresh or processed products which provides the population with sufficient food for a healthy life. The current study looked into the effectiveness of interventions put place in Kajiado County to enhance food availability and accessibility and well utilization and hence food stability.

Technology Application Interventions and Food Security

The information and communication technology (ICT) revolution has had unstoppable effect, cell phones are owned by most farmers where they access advises in agriculture and other agricultural services at low-cost within no time (Norton & Alwang, 2020). ICT is a vehicle which offers farmers information on better input

management, improved technologies and better farming techniques. Famers get knowledge on better markets, higher sales opportunities for their products and thus more efficiency on agricultural markets and thus food availability (Hudson et. al, 2017). The growing use of cellular phone technology in both developed and developing countries has provided a significant development opportunity worldwide. Nakasone and Torero (2016) on their study on enhanced food security through ICTs in developing countries pointed out that farm management practices were improved through ICTs leading to the growth of agricultural extension services. They also found out that through technology famers were acknowledged on prevailing market prices and made informed decisions on when to sell their products.

Shafiee and Cai (2016) investigated the use of technology in minimizing food waste and enhancing food security in America. The researcher established effectiveness of technology in enhancing food security in Kajiado County Kenya which is food insecure. Since mid-1900s, biotechnology has been around in terms of genetically modified organisms (GMOs) and Genetic Engineering (GE) technology. Oloo et.al (2020) on their study on advancing adoption of GMOs in Africa found many restriction factors in Africa specifically Kenya including unfounded fears regarding effect of GMO. According to Hallerman and Grabau (2016) on their study on crop biotechnology reported why societies resist new technology. The duo reported that U.S, saved hundred thousand tons of soils though the adoption of GMO technology, no-tillage agriculture and herbicide tolerant crops. It has also resulted in the development of seeds that are resistant to pests, diseases, and environmental stressors.

Sinyolo (2020) on the study in South Africa among rural households investigated how small-scale maize producers in South Africa used technology to enhance food security. Eighty one percent (81%) of the sampled 513 farmers reported increased harvest during the time of the study. However, the study did not focus on effectiveness on technology in enhancing food security. The current study examined the effectiveness of technology application enhancing food security in Kajiado County.

Kumar et al., (2020) studied solar powered irrigation systems and found out that high-cost electricity and fuel restrict supply of water for irrigation requirements and converting sun rays to energy play a key role in solving the problem. The solar powered water pumping system increase the sprinklers and water bikes' and make them rotate to its maximum speed and hence spray to a larger area. It also helps in storage of water in tanks for later use. The current study focused on the effectiveness of the technology intervention on supporting irrigation systems to enhance food security in Kajiado County.

Theoretical Framework

Diffusion of Innovation Theory

The study also adopted the Diffusion of Innovation (DOI) to theory explain how technology interventions effectiveness helps in enhancing food security. E.M. Rodgers came up with DOI theory in 1962.

It reveals how technologies, products or new ideas spread through a society or social system. This theory was chosen because it can be applied to food security to help understand how new ideas, technologies, and practices can be adopted to improve food production, distribution, and access. It showed how innovations in agricultural practices, food processing, storage, and distribution can be adopted to enhance food security and help identify the barriers that prevent innovations from being adopted and develop targeted interventions to address these barriers. The role of early adopters is one of the most important aspects of the diffusion of innovation theory who are often influential in promoting the adoption of new ideas or technologies. Early adopters may include farmers who are willing to try new agricultural practices or technologies, as well as businesses or organizations that are willing to invest in new food processing or distribution systems.

The importance of communication and information-sharing is also considered an important aspect of the theory. Effective communication and information-sharing are essential for promoting the adoption of new ideas and technologies, and for building trust and credibility among potential adopters. It has helped identify the different stages of adoption, including awareness, interest, evaluation, trial, and adoption. This can help policymakers and practitioners develop targeted interventions to support the implementation of new technologies and ideas. The theory can help identify the inhibiting factors towards use of new technologies. These factors may include

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shortage of credit, inadequate infrastructure, limited education or training, and cultural or social barriers.

This theory has its limitation, it has been criticized because it tends to focus too heavily on technology and overlooks the social issues that can affect the adoption of new ideas and practices. It also does not pay enough attention to power dynamics within social systems, such as the influence of elites or dominant groups on the adoption of new ideas or practices. The theory has also been criticized due to its simplistic view of the adoption process, and may show the complexity of social change and the multiple factors that can influence the adoption of new ideas and practices yet it does not give enough attention to the contextual factors that can affect the use of new ideas such as political, economic, and cultural factors. It also does not pay enough attention to equity concerns, such as ensuring that new innovations are accessible and beneficial to those in ASAL

RESEARCH METHODOLOGY

The study adopted pragmatism philosophy since it allowed use of integrated multiple and mixed research designs, data collection methods, data analyses approaches and multiple modelling approaches. The philosophy also allowed the combination of both quantitative and qualitative methodological paradigms (Kaushik & Walsh, 2019). Creswell (2014) argues that pragmatism is all about "what works". The study used this philosophy as it seeks to establish what would work best for Kajiado County as it implements various food security interventions. The philosophy also allowed the application of both deductive and inductive reasoning. Creswell and Hall (2014) argue that pragmatism is oriented towards diversity of methods in resolution of real-world problems rather than pure assumptions about knowledge as it focuses on extent of experience unlike other philosophies that stress the nature of reality.

The study applied mixed research designs with descriptive and explanatory being employed. The design enhanced the establishment of correlation between the study variables, putting emphasis on studying a problem and analyzing variables relationship (Saunder, Lewis & Adrian, 2009). Descriptive also helps in determining "what exists" and thus analyzing the situation rather deeply with a view of generalizing about a wider population. Baran (2022) explains that explanatory design is helpful in the analysis of the qualitative data generated from the interviews. The study was conducted in Kajiado County with an area of 21,292.7km2, focusing on the registered famers in the county. The county has uncertain rainfall patterns, dry spells and droughts with majority of the residents being small scale subsistence farmers and/or livestock keepers whose livelihood primarily depends on rainfall. The county has 1,117,840 citizens in 316,179 households (KNBS, 2019) in 5 sub-counties and 25 Wards.

The study targeted 29,572 respondents including 29,514 registered famers (Kenya Integrated, Agricultural Management Information systems (KIAMIS report, 2023), 47 agricultural extension officers and 11 County government officers in Kajiado County. Sampling was done using disproportionate stratified random sampling techniques due to the extensive population. Nassiuma (2000) formula was employed to determine the sample size.

$$n = \frac{NC^2}{C^2 + (N-1)e^2}$$

Where:

n represents sample size,
N is the population size,
C is the coefficient of variation at (95%) confidence limit,
e is the standard error of 5%.

$$= \frac{29514\ (0.95*0.95)}{(0.95*0.95)+(29514-1)(0.05*0.05)}$$

= 356 farmers

Additionally, the study used purposive sampling in identifying the 356 farmers from across the County while the census of all County officials and the agricultural extension officers was studied and thus a total sample of 414.

Both semi-structured questionnaires and interviews were used to collect the primary data. The instruments were tested for reliability and validity in Machakos County, because of its similarity and proximity to the study area (Nyariki & Amwata 2019). Descriptive statistics analyzed quantitative data by using mean and the standard deviation while inferential statistics was done using regression model, correlation, ANOVA, F test and t-test. Qualitative data was analyzed using content analysis by outlining the important responses and dispensing them in themes in prose form.

RESULTS AND FINDINGS

The study achieved a 64% response rate (265 out of 414). The rate was adequate for analysis since Mugenda and Mugenda (2003) and Saunders et al (2016) argued that a response rate of 50% is adequate, 60% is good and 70% is excellent hence a response rate of 64% is good enough to represent the opinion of the respondents to represent the population that was targeted making it acceptable for further analysis of the study.

Descriptive Analysis

Food security is the dependent variable in the study. The study sought to determine the level of food security elements in Kajiado County. The food security composite measure was arrived at by adding the dimensions of food security (Food availability+ food accessibility+ Food stability +food utilization).

The results indicated that 42.5% of the respondents agreed that food availability is high in Kajiado County and 40.3% disagreed .13% were neutral, 3.2% strongly disagreed and 0.5% of the respondents strongly agreed with the statement. With the mean of 3.03 the respondents were neutral in this regard though the variation was fairly wide (standard deviation = 0.99). The results implied that the agreements and disagreements were approximately equal on availability of food. These findings agreed with the perspectives of Bobrick (2022) on the study on entitlement and food availability decline. The study established that food availability is the physical presence of food within an area and depends on factors such as agricultural productivity, food imports, and food reserves.

On food accessibility 67% of the respondents disagreed with that food accessibility is high, while 17.7% agreed that it is.3.6% strongly disagreed while 11.3 were neutral on it. With the mean of 3.57 the respondents were neutral on this regard though the variation was not so wide (standard deviation = 0.82). These results imply that access to food was a challenge to the majority of the respondents may be because they did not have the financial ability to buy it or did not have a physical access to the market where it was sold. Jafari and Jafari (2020) on the study climate change and food security reiterates that the ability to obtain sufficient food is determined by factors such as income levels, food prices, distribution channels, and transportation infrastructure. Availability of food does not give assurance of food security especially if there is no purchasing power to obtain it for everyone.

On food stability majority of respondents at 54.8% disagreed with the statement that food stability is high while 24.9% strongly disagreed on it.7.7% agreed and 1.4% strongly agreed while 11.3% did not take any side. The mean of 3.94 showed neutrality of the respondents with not very wide deviation of 0.89. The results implied that majority of the respondents were not confident that they would have food in future even if they had food at the time of the survey. It means that they lack food time to time. Savary et al (2020) study on food systems, resilience mechanisms and mapping disruptions establishes that reliability and predictability of access to food over time considers factors such as market volatility or fluctuations in food prices, environmental disasters and political stability which influence the food distribution and access.

More than half of the respondents (63.8%) disagreed that food utilization is high in Kajiado County, 5.9% strongly agreed with the statement, 11.8% agreed and 7.7% strongly agreed 10.9% were neutral. With the mean of 3.48 it showed neutrality of the respondents in this regard with a fairly wide deviation (standard deviation = 1.03) These results implied that the respondents were not keen on taking balanced diet and could just feed on what is available not taking into consideration of the nutritional value. The findings agree with the works of

Clapp (2022) on the study of the framework of six-dimensional food security that focuses on the quality and nutritional value of food consumed. The study considered factors such as consumption of a variety of foods, Protection against foodborne illnesses, adequacy of dietary intake, clean water access and hygiene practices. The respondents were asked whether Kajiado County is food secure or not. Majority of the respondents (84.6%) opined that Kajiado County was not food secure and only 15.4% of the respondents were of the opinion that Kajiado County was food secure. The findings imply that majority of the respondents felt that more efforts were needed to enhance food security in Kajiado County. With the mean of 3.48 it showed neutrality of the respondents in this regard, however it had a fairly wide deviation (standard deviation =1.03).

The perspectives of Ingutia and Sumelius (2022) on their study on food security determinants by women farmers in rural Kenya agree with the study findings. The study establishes that Kenya has made strides towards food security but challenges remain equitable access to nutritious food for all its citizens. The study noted that improving agricultural productivity, strengthening food distribution systems, and addressing nutritional needs are ongoing priorities for the government and various stakeholders.

Technological Interventions

Technology intervention was one of the independent variables of the study. The study sought to determine the effectiveness of technological interventions on enhancing food security in Kajiado County. The results are as analyzed in tables 4.8 and 4.9

Type of Technology

The study aimed to establish the specific type of technology that was used to enhance food security among Mobile Apps, Automated feeding, High-tech Irrigation or none. The result shows that the type of technology that the respondents used, majority of farmers at 49.3% of the respondents used mobile apps, 28.5% used high tech irrigation, 3.2% used automated feeding and 19% did not use technology. These results imply that majority of the respondents used mobile apps that helped them increase their production. Those who used high tech irrigation for their farming followed. The results further imply that the respondent would wish that the county increase their access to various types of technology to help them more in enhancing food security. Majority of the extension officers too used mobile phones in providing information to farmers. The study done by Mandi and Patnaik (2019) on the study titled mobile apps in agriculture and allied was in agreement with the findings. It established that mobile apps empower farmers by providing tools and information that improve productivity, profitability, and sustainability in agriculture. Mobile apps provided quick access to weather forecasts, agricultural techniques, and government policies, which are crucial for making informed decisions. It also helped farmers track crop health, pest outbreaks, soil conditions, and irrigation schedules, optimizing yields and reducing costs. It streamlined administrative tasks such as record-keeping, order management, and logistics, saving time and effort

The 19% of the respondents that did not use technology cannot be ignored and this is a challenge to the county that training and empowerment is much required if technology was to be effective in enhancing food security. These results were affirmed by the opinion of respondent R4 who said that:

“Technology in Kenya has evolved rapidly, and the country is at forefront of technology innovation and it would benefit the country and Kajiado county too if everyone could be empowered to use technology, this would lead to enhanced food security and that would make the world a better place to live in”

Descriptive statistics for Technology Interventions

The study sought to determine the effectiveness of technology application in enhancing food security in Kajiado County. The results showed that majority of the respondents agreed that technology has positively impacted their food production, 67.4% agreed, 14.5% strongly agreed, 4.5% disagreed and 1.8% strongly disagreed while 11.8% were undecided. These results imply that majority of the respondents had realized the importance of technology in their farming and as a result had noted the increase of their production. This was also revealed by mean 2.12 which showed that majority of the respondents had indicated realizing positive impact of technology,

however it had a slightly wide deviation (standard deviation = 0.77). The assertions of Sinyolo (2020) were in consistent with the findings, the study established that technology enhanced food security in South Africa and that the farmers need to be strengthened and empowered on technology application in order to enhance food security.

Majority of respondents at 67.9% agreed that Mobile phones have helped them to get information on county provision of inputs/ subsidies like fertilizers while 12.7% strongly agreed with the statement the statement.11.3% disagreed while 2.7% strongly disagreed and 5.4% were neutral on the same. With a mean of 2.24, the respondents on average, agreed that mobile phones have helped them to get information on county provision of inputs and or subsidies though the standard deviation of 0.91 was not so narrow. These results imply that majority of the respondents got information from the county very easily via their mobile phones. Any time that the county wanted to distribute any farm inputs or any services like vaccinations to the farmers it would be done instantly using mobile phones. These results were affirmed by the opinion of respondent R7 who stated that:

Communication has never been so easy like today, whenever as the county we have any information, we want to disseminate to the farmers it is just done by tapping a mobile phone, the information is spread within no time. Sometimes for example if there is a disease outbreak and we need to control it, together with announcements through the chiefs, churches and schools an instant message is first sent to the farmers. This has made communication easier than before since if one gets the information, they tell the others around them.

The results were consistent with assertions of Sullivann (2017) that technology provided information to smallholder farmers on innovative agricultural practices to increase production and thus enhanced food security.

On whether access to internet has helped in the management of crops/animals, 62% agreed while 12.2% strongly agreed.1.6% disagreed with the statement and 2.7 strongly disagreed. 6.3% of the respondents were undecided. These results implied that majority of the farmers in the county owned smart phones and could access internet. The findings further imply that some of the questions which would only be answered by rarely seen experts in the county could instantly be answered through internet and the farmers took this to their advantage in crops and animals management. The results were affirmed by the opinions of respondent R1 who stated that:

“Majority of residents in Kajiado County are Maasais in tribe, many stereotype this community to be uneducated and marginalized, this is not true since majority of them own smartphones and access internet anytime. You will confirm the truth of the matter with how fast they answer the questions.”

More than sixty three percent (63.7%) of the respondents disagreed that mobile phones have helped the farmers to get market information for their products.6.8% strongly disagreed with the statement,11.8% strongly agreed,12.2% agreed that mobile phones have helped them to get information on market, however 5.9% were un decided. These results imply that majority of the respondents did not have market information for their products; they did not have market prices too so as to decide in which market to sell or buy from. It further implies that the few that that agreed with the statement may have an app whereby they could get market information from various markets. These results were affirmed by respondent R9 who stated that:

As Kajiado County we have revenue officers especially in livestock markets in the county, these officers collect revenue from the traders every day, unfortunately there is no way to account for it, it is difficult for the county to know how many animals were sold at what price and how much was collected. There is no platform for farmers to be availed with such information, and mostly the brokers buy animals from the farmers very cheaply with unfavorable prices because they don’t know how much to sell and where to sell.

Majority of the respondents at 43.9% disagreed that technology has helped them to optimize resources utilization like water and land while 35.8% agreed with the statement, 5.9% strongly agreed, 2.7% strongly disagreed while 11.8 were neutral. The aggregate scores indicated that on average the respondents had a neutral response; the mean was 3.02 with a slightly wide deviation (standard deviation =1.12).

From qualitative analysis while responding to use of technology for optimization of resource utilization, R9 said:

“As a county we are very far on using technology for resources optimization, in developed countries, they are

using AI for powered crop monitoring, use GPS technology and automation. However just very few farmers use drones here. We have a long way to go on the matter"

On the difficulties encountered in accessing technology to enhance food security, 66.5% of respondents disagreed with the statement that they did not encounter difficulties and 14.01% strongly disagreed, 9.1% disagreed and 2.3% strongly agreed, however 8.1% of the respondents were undecided. With the mean of 3.81 and standard deviation of 0.87, majority of the respondents were neutral on the difficulties they experienced in accessing technology.

Majority of the respondents disagreed on that they experienced minimal financial implications when adopting technology at 59.3% and 17.2% strongly disagreed. 9.1 % agreed with the statement and 4.1% strongly agreed that the financial implications were minimal. With the mean of 3.76 findings indicate that majority of the respondents are neutral on the same though with a slightly wide deviation (standard deviation= 0.98)

Technology Interventions and Food Security

The results showed that technological intervention was significantly influencing food security in Kajiado county at P- value= 0.003 <0.05. Further, a (β=.205 means that 1% improvement in technological intervention led to a 20.5% increase in food security in Kajiado county in the presence of agricultural extension interventions, credit availability interventions and research interventions. The null hypothesis H01 that technology application interventions by county government are not significantly effective in enhancing food security in Kajiado County was therefore rejected. These results are in agreement with the assertions of Mok and Tan (2020) on innovations for food security in Singapore which established that technological innovations is urgently needed for maximization of food security despite the land and other natural resources diminishing around the world to produce adequate food. Singapore lacks both natural resources and space, yet it is an example of how to balance between resources and food supply. More technological innovations are therefore needed to ensure the natural resources are utilized maximally to produce sufficient, safe and nutritious food for the population.

The results also agree with the work of Sinyolo (2020) whose study established that having large pieces of land which are highly potential does not guarantee high production, the production may still be low if modern agricultural technologies such as precision farming, genetic improvements, or digital tools are not adopted or not effectively utilized.

CONCLUSION

From the study findings it was concluded that Technological interventions was statistically significant in enhancing food security in Kajiado County. The qualitative analysis highlighted how the county government interventions influenced food security. This has helped the Kajiado County farmers in their efforts of food production and distribution for the society.

The main objective of the study was to determine effectiveness of technology application in enhancing food security in Kajiado County. Based on the study findings the conclusions were made. Technology had positively impacted crops and animals' production in Kajiado County, it had also been used to optimize resources such as water and energy. However, there were challenges in adoption of technology due to the financial implications that accompany it, and the empowerment that is needed in terms of knowledge and skills to effectively use it. The correlation analysis results indicated a positive and significant association between technology and food security. This study therefore concluded that technology adoption is an important intervention towards enhancing food security in Kajiado County. It further concluded that empowerment in terms of finances and knowledge to effectively adopt technology is very important.

Contribution of the Study to the Body of Knowledge

Technological interventions influenced food security in Kajiado County. The findings of this study will be beneficial to the farmers and policymakers in enhancing food security. The study adds to the existing body of knowledge on food security issues. It improves to the researchers' conversation on enhancing food security and

extends conceptualization by integrating various interventions beyond the prior mitigation aspects to establishing a conceptual framework towards enhancing food security.

Theoretically, this study provided evidence of how diffusion of innovation establishes importance of theories and how they sharpen understanding in any field. Major gaps on research variables, methodology and modelling were conceptualized in this study. The study enhanced the empirical literature by highlighting how various interventions enhance food security. It also paved the way for further research on enhancing food security.

Recommendations for Policy Application

Based on the findings, the county governments, farmers and other stakeholders can draw policy implications. In this study, the technological interventions influenced food security in Kajiado County. In this context, the county government should focus on implementing the policies that enhance technology improvement instead of only making them

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