RELATIONSHIP OF E- EXTENSION SERVICES ON FOOD SECURITY PROJECTS AMONG SMALLHOLDERS' FARMERS IN KARATU DITSRICT

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Abstract

Smallholder farmers require adequate access to knowledge, information, and other necessary services to improve food security, E- extension services serve as an important tool to transfer knowledge, advice and educate farmers about new technology and practices to stimulate desirable agricultural developments for improving food security. The study consisted of six predictors identified for testing towards food security projects as the dependent variable. The predictors include weather forecasting information, disease and pesticide outbreak, financial services, access to agro inputs, access to output market and advisory services on good agronomics practices. Explanatory design was used to foster information gathering process by means of relationship testing between study variables with the information for the study gathered using questionnaires. The collected results from the field were computed in SPSS data sheet version 23.0 to generate relevant statistics useful to present the results. Findings indicated that four predictors among six tested including weather forecasting information, financial services, disease and pesticide outbreak and access to agro inputs were positive with significant effect statistically on food security projects with $p<0.05$. However, access to output market and advisory services on good agronomics practices were found positive with insignificant effect on food security projects with $p>0.05$. This implies that food security projects in Tanzania through e-extension services among smallholder farmers is influenced with weather forecasting information, financial services, disease and pesticide outbreak and access to agro inputs.

KEY WORDS: E-Extension Services, Food Security, and Smallholder Farmers

1.0 Introduction

The rapid evolution and uptake of E- Extension services are hailed because the 'fourth industrial revolution, that is characterized by a fusion of technologies that's blurring the lines between the physical, digital, and biological spheres'(Baumüller, 2018). Many believe that these changes hold nice promise for developing country agriculture reference As a report by the globe Bank, the African Development Bank, and also the African Union note, 'The strategic application of ICT [information and communication technology] and mass communication to the agricultural industry, the most important economic sector in most African countries, offers the most effective chance for economic growth and poverty alleviation on the continent' (Tata & McNamara, 2018).

In developing countries, productivity growth in small-farm agriculture can function a vital driver of economic development and poverty reduction (Antwi-Agyei and Stringer, 2021). However, the effectiveness of ancient extension approaches have been restricted, both attributable to insufficient funding and so low outreach or information that's not sufficiently tailored to farmers' needs. Smallholder farmers generally face several challenges, similar to unpredictable weather conditions, market risks, and limited access to information, technologies, and financial services (Aker *et al.,* 2016). The constraints lead to low productivity and low rates of market participation.

Agricultural extension programs are one amongst the main conduits of addressing rural poverty associated food insecurity. Extension services have the means that to transfer technology, support rural adult learning, assist farmers in problem-solving and find farmers actively concerned within the agricultural knowledge and data system to improve food security (Rajkhowa and Qaim, 2021). The traditional agricultural extension is principally done by an extension officer visiting a farmer or farmer' field college (Demo Plots. Modern extension services use few extension officers to cover a bigger population because of the introduction of technology. Information and communication technologies (ICTs) can be incorporated into agricultural extension services system. (Baumüller, 2018) argued that E- extension provides a source of information on new technologies for farming communities that once adopted can improve production, incomes, and standards of living. Extension service suppliers make an innovation known to farm households.

Recently, United Republic of Tanzania has adopted the use of ICT in its extension services wherever E- extension services are practiced. This was attributed to the adoption of the ICT policy of 2003 (URT, 2021) E- Extension services have been spreading rapidly. The technology development advancement has generated high expectations in sub-Sahara Africa concerning the role of E- extension service delivery performance on food security. The E- extension services play a vital role in addressing these challenges facing small farmer holders and improving tiny farmers' food security.

A growing number of E- extensions are being developed or have recently been developed in Sub Sahara Africa, as well as tools specific for maize ('Maize-Variety-Selector', 'Maize-Seed-Area'), rice ('Rice Advice', 'Weed Manager'), for cassava ('Akilimo'), for cocoa ('CanOvaLator') and for crops generally ('Farmbook', 'Fertilizer Optimizer', Nuru Kilimo, esoko, Uliza, and M-Kilimo 'FAMEWS').(Naika *et al.,* 2021)

Despite the roles played by E- Extension services in the agricultural sector in Tanzania, Weak and unreliable information has been found to be one of the factors that hinder productivity (Da-uri, 2021). Moreover, food insecurity, lack of infrastructure, access to credit and services, information gaps, and ever-changing climate conditions have all been identified to be affecting smallholders' farmers. (M. Naika *et al.,* 2021) Therefore, the study is proposed to assess the role of E- Extension services in up smallholder farmer's food security within the Karatu district.

The reminder of this articles is organized as followers' section 2 describing the problem and overview of the inquiry. Section 3 describes the literature review consisting of the theoretical review, empirical reviews and the description of the variables through the conceptual framework. Section 4. describes the methodology the study used to accomplish the study. Section 5 described the findings and discussions of the results. The last section offers the conclusion and recommendations respectively.

Literature Review

Digital innovation theory

The study is guided with digital innovation theory which asserts the role of multiple agencies and distributed learning mechanisms in technological changes (Chang et al., 2013). It refers to the process of interacting with changes in people's behavior, the institutional and socioeconomic structures include the market, consumer preferences, policy goals, actors' skills, and knowledge) The theory articulate that it can help to better tailor different components of agriculture advices to farmers individuals in multiple ways, for example predictive analytics and machines learning algorithm can be used to combine on soil condition, weather forecast, market price , and other aspect to deliver the services on agricultural recommendation

The Digital innovation theory specifically on E- Extension can affect the farmers in different ways such as reduce information barriers by providing the personalized advices on which type of crop to grow in which season and appropriate inputs to use, moreover they can connect farmers to the new inputs market by providing the transparent information on local market price(Lambek, 2018) , it help to improve farmers bargaining power by providing transparent and additional supplier option as well as financial accessibility.

Digital Innovation can ease of use influence the farmers' attitude towards new technology, which affects the intention to adopt the technology(Marina Fischer, 2014). However, the digital innovation theory articulates that the interaction between a service system and its clients is at the heart of the service delivery process. Using this theory on the research will enhance the effective and performance of E- Extension service delivery as well as positively and significance associated with input intensity, production diversity, crop productivity and crop income. (Da-uri, 2021).

The other one is food security theory which describes food security comparatively demands an "integrated assessment" approach that considers the interaction of ecosystems and social systems

to account for food security (Chang et al., 2013) . An interdisciplinary and multiple theory approach to food security is best because numerous explanations for its prevalence exist (Egger et al., 2020), Techno-ecologists Lambek, (2018) take a more optimistic approach, arguing that ominous scenarios for the planet are oversimplified. They believe that technology and human ingenuity are the greatest resources available and are not being threatened with scarcity.

Thus, as has been the case in the past, future challenges confronting the world's carrying capacity will be met. Techno-ecological perspectives are linked most closely with food availability and the importance of adapting agricultural methods to produce enough food. This was the whole philosophy behind the "Green Revolution" and the spread of new technology to LDCs where food is needed most. Fertilizer use and the intensification of agriculture, for example, are associated with human adaptation (Egger et al., 2020) Using Techno – Ecology theory will enhance to analysis the components of food security which includes, Food Accessibility, Availability, and stability utilization by using the digital extension delivery services.

A Review of Empirical Evidence

Several studies have been undertaken in the area including Rajkhowa and Qaim, (2021) analyzed the use of the internet and smartphones in rural areas of developing countries, generally finding positive effects on household welfare. Various internet-based applications and technologies are being developed, which could have major implications for agricultural development through increasing food security. Cloud services, low-cost open-source software, and big data analytics contribute to the emergence of new, internet-based agricultural technology platforms (agri-tech platforms henceforth) that aggregate supply and demand by reducing the number of intermediaries and connecting farmers directly to agro-advisory services, input providers, retailers, or consumers.

Naika *et al.,* (2021) analyzed the effects of using training videos or call centers and interactive voice response services for farmers, with somewhat mixed results. However, in these examples, ICTs were used primarily to improve the delivery of generic extension information. We are aware of only two published studies that analyzed the effects of personalized advice (as opposed to standardized generic advice), and both these studies were carried out with farmers in Nigeria (Rajkhowa and Qaim, 2021); both studies showed that site-specific nutrient management recommendations provided through digital decision support tools help to increase crop yields. However, the study analyzing a little information on how E- Extension services in improving food security project. Unlike Antwi-Agyei and Stringer (2021) who focused on nutrient management advice only.

Antwi-Agyei and Stringer (2021) analysed E- Extension services can affect smallholder households through several mechanisms. First, they can reduce information barriers by providing personalized advice on which types of crops to grow in what season, the appropriate types and quantities of inputs to use, and the best timing for the different operations and input applications. Second, they can connect farmers to new input markets by providing transparent information on

local market prices and reputed brands and suppliers. Third, they can help improve farmers' bargaining power by providing transparency and additional supplier options. Fourth, improved access to personalized information and new technologies and inputs can increase the levels of commercialization. These mechanisms will likely change farmers' cropping patterns and increase their input intensities, crop yields, sales volumes, and incomes (Antwi-Agyei and Stringer, 2021). This is comprehended to deep dive on the role of E-extension service on improvement of food accessibility, availably and food stability on the community.

This study of E-extension service delivery involves a broader extension package, including advice for good agronomic practices, post-harvest management, weather forecast, marketing, how to obtain these inputs at good quality and prices that lead to informed decision (Higgins and Bryant, 2020). E-extension services is used in agriculture to make various decisions by knowing the weather forecast, which leads to making decisions to properly plan the calendar of the agricultural season. The weather forecast cannot be used in isolation unless the farmer employs good agronomic practices and makes an informed decision about whether to plant long-term or short-term seeds. Knowing the weather forecast will help you decide what kind of input to use during the farming season. (David 2021) Smallholder farmers will also be able to better organize themselves by learning how to control insects and diseases in agriculture and seeking advice from agricultural experts on cultivating good agriculture.

However, various digital platforms help farmers in obtaining crop price information and determining what price he can sell his crops for. Using a digital platform enables farmers to obtain capital and loans from financial institutions, allowing them to invest in agricultural activities. This will not only improve the farmer's certainty of food security but will also improve the livelihood of small-scale farmers.

Conceptual Framework

This is the model that describes the study variables and the way they influence each other in the process of knowledge. The model describes the predicting variables and the dependent variable which are shown in figure 1 below.

Figure 1 Conceptual Framework
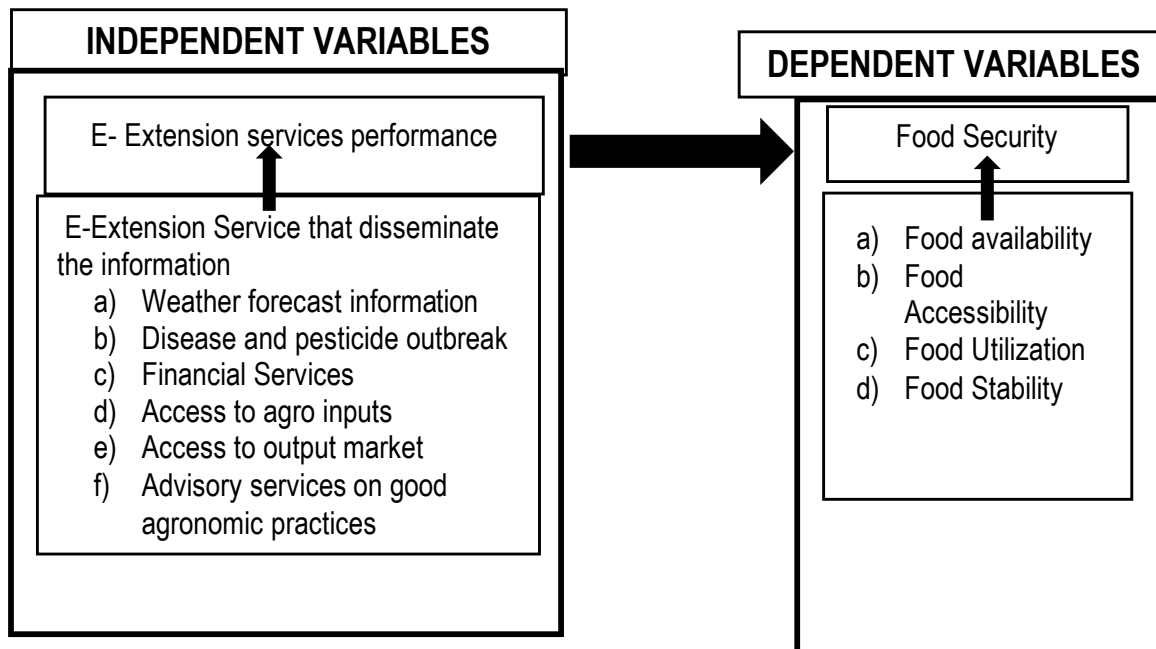
Source: Field Data (2022

Methodology

The study was conducted in Karatu District using causal relationship testing between study variables. The study comprised of six predicting variables namely weather forecasting information, disease and pesticide outbreak, financial services, access to agro inputs, access to output market and advisory services on good agronomics practices tested on food security projects as the dependent variable. The study was guided by the assumption that food security projects in Karatu Districts constitute positive influence through e-extension services. The study used primary data which were gathered from beneficiaries as farmers using structured questionnaires. Data were collected from the sample of 80 respondents who were randomly picked as respondents. The collected results were computed in the statistical software to generate relevant statistical tests to present the findings. Multiple regression analysis was used to describe the existing relationship between study variables. In that case, the description is further illustrated by the model that;

$$FSP = \beta o + \beta 1 WFI + \beta 2 DPO + \beta 3 FS + \beta 4 AAI + \beta 5 AOM + \beta 6 ASGAP + e$$

Where by

FSP = Food Security Projects

βo = Constant factor

$\beta 1 WFI$ = Weather Forecasting Information

$\beta 2 DPO$ = Disease and Pesticide Outbreak

$\beta 3 FS$ = Financial Services

$\beta 4 AAI$ = Access to Agro Inputs

$\beta 5 AOM$ = Access to Output Market

$\beta 6 ASGAP$ = Advisory Services on Good Agronomics Practices

e = Random variable

4.0 Findings and Discussions

The findings are illustrated to show the contribution of each predicting variable to the dependent variable as well as the descriptive analysis. Hence, table 1 describes the findings pertaining to the description analysis which are as follows.

Table 1 Variables Tests on relationship between the E- extension service performance and food security

Hyp.	Motive	Gender	N	Mean	SD	Results: Mann-Whitney U Test (P-value)
H1		Male	57	6.732	.1846	.002

	Weather Forecasting Information	Female	23			.025
H2	Disease and Pesticide Outbreak	Male	57	6.674	.1721	.019
		Female	23			.042
H3	Financial Services	Male	57	6.537	.1622	.102
		Female	23			
H4	Access to Agro Inputs	Male	57	6.163	.1264	.002
		Female	23			.025
H5	Access to Output Market	Male	57	6.261	.1376	.019
		Female	23			.042
H6	Advisory Services on Good Agronomics Practices	Male	57	6.372	.1408	.102
		Female	23			

Source: Field Data (2022)

The findings reveal the thorough pattern regarding the relationship between study variables that with mean the results showed that weather forecasting information as the predictor possess stronger influence than other predicting variables towards food security projects since it has higher mean value. The implication is that food security project in Karatu District in mostly influenced with weather forecasting information. This is the reality because small farmers depend on nature for production that weather information is very vital for planning and production process. Besides that, the standard deviation results reveal that variance between study variables are not high with the values of the test being less than 3. This signifies that respondents' opinion did not differ much.

Additionally, the relationship between study variables is further articulated using multiple regression described in table 2 below.

Table 2 Variables Relationships

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
(constant)	-10.427	6.163		-1.104	.000
Weather Forecasting Information	.218	.283	.091	12.762	.002
Disease and Pesticide Outbreak	.084	.267	.097	12.437	.025

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.
	B	Std. error	Beta		
Financial Services	.934	.295	.521	12.602	.019
Access to Agro Inputs	1.216	.219	.538	12.174	.042
Access to Output Market	.813	.286	.552	7.320	.102
Advisory Services on Good Agronomics Practices	1.058	.232	.515	9.683	.093

Source: Field Data (2022)

The study results show the multiple regression analysis on all study predicting variables to the dependent variable. With that, the results indicate that four predictors among six tested including weather forecasting information, financial services, disease and pesticide outbreak and access to agro inputs are positive with significant effect statistically on food security projects with $p<0.05$. However, access to output market and advisory services on good agronomics practices were found positive with insignificant effect on food security projects with $p>0.05$. This implies that food security projects in Tanzania through e-extension services among smallholder farmers is influenced with weather forecasting information, financial services, disease and pesticide outbreak and access to agro inputs.

The assertion is supported most with Aker *et al* (2016) that e-extension services in the agriculture sector are very important in fostering performance in the agriculture sector among farmers of different category in the jurisdiction. This is the case because they are useful in facilitating information access towards weather forecasting which are useful in planning and activity engagement especially in the developing countries like Tanzania where majority of producers are small scale farmers relying on nature in the production process. Despite that, Chowdhury *et al* (2014) suggest that the e-extension services are highly useful since they are instrumental in disseminating information to the farmers regarding avenues to access financial services useful to boost capital structure for the activity engagement respectively.

Additionally, Folitse *et al* (2018) suggest that the e-extension services play vital role in facilitating growth and prosperity in the agriculture sector among small farmers because information regarding diseases and pesticides are well disseminated and accessed for knowledge and necessary action in the production process. This automatically fosters food security projects because production is

likely to encounter boost than losses. Furthermore, Islam *et al* (2017) suggest that the e-extension are useful in facilitating access towards agro inputs information to the farmers and link with various stakeholders among small farmers and producers at large. This has implication on food security though the issues pertaining to the market for the produces in most required to be handled by farmers with less influence by the services since they comprise realities within the society and also best practices in the agronomics.

5.0 Conclusion

E-extension services are of vital relevance towards food security and the entire agriculture practices among smallholder farmers in Karatu District once are effectively utilized by farmers. This signifies the attainment of the means towards transforming agriculture among small farmers to a certain extent at least towards production boost. In that case, there initiatives constitute challenges which must be eradicated to assure sustainability and prosperity. Mostly is the ownership of the initiatives by the government for communities to benefit.

6.0 Recommendations

With e-extension services among smallholder farmers in attaining food security, the study recommend that it is important for the government to own and take control of the initiatives. This is important because most of the initiatives are donor funded projects which becomes difficult for attaining sustainability. This is something that needs to be considered in the practices to assure sustainability of the initiatives.

The study also recommends that it is essential for the government to collaborate with the non-state actors with most being non-governmental organizations (NGOs) to facilitate awareness to the smallholder farmers as the beneficiaries of the initiatives. This is necessary because the more the information spread and users increase in number the likely of performance in the sector is well attained.

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