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Research Article

Are the AgriTech Technologies Available, Adaptable and Practical to Young Farmers? Lessons from Tomato farmers in Kirinyaga County, Kenya

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Abstract

Information and communication technologies (ICTs) in particular mobile phone applications and internet are transforming how agribusiness is carried out in some parts of developing countries including Kenya. The spread of information and communication technologies (ICTs), especially mobile phones, in developing countries has been both extensive and rapid creating a need to assess its efficiency and the rate of adoption. This study aimed at examining how farmers in the county integrate technological innovations in the production and marketing stage of tomato in the sampled area. The objective of the study was to examine how small scale farmers are integrating social media marketing platforms, digital credit, agricultural value addition and artificial intelligence in their production and marketing stages in the agricultural value chain. The results indicate statistically significant positive effects of AgriTech Technologies on farm income (t-prob 0.000< 0.05). The results notably indicate that using social media marketing platforms has the highest positive contribution to a unit change in farm income (β= 3.84). Smallholder farmer's ability to access knowledge, networks, and institutions essential for improving productivity, food security, and employment opportunities is a big challenge especially in rural areas where internet connectivity and poverty levels are alarming.

Keywords: *Social media platforms; Digital credit; Agricultural value addition; Artificial intelligence*

Introduction

In Africa, agricultural practices are more traditionally oriented as most farmers prefer to use processes that depend more on traditional equipment like hoes instead of introducing modern technology [1]. New modern technologies like mobile applications, open-source software and cloud computing are being introduced into farming as they are becoming more affordable and accessible. In Kenya a number of farmers especially the youth have infused ICTs into agribusiness by use of various mobile applications and other information systems available linking all the stakeholders and therefore increasing the outreach of their products to consumers [2]. The use of ICTs enable them make objective decisions on profitable enterprises, their niche markets, modern technology and model success stories [3].

With the increased access to mobile phones, wireless and internet industries, technology has made a great leap from the once costly, bulky, high energy consuming equipment used to analyze agricultural and scientific data. These can now be afforded by smallholder farms for their daily activities across the developing countries [4]. Information and technology has been seen to increase efficiency, productivity and sustainable agricultural sector through improved farm operations by accessing information easily [5].

The future of agribusiness requires great focus on sustainability and digital transformation juxtaposed by an industry that faces various challenges as well as new and exciting opportunities. New ICT technologies that connect the players in the industry bring opportunities for growth and innovation. Kenya has become more gradually visible as an ICT hub in East Africa by being the pacemaker in innovative ICT technology.

A number of ICT oriented youth in Kenya have therefore come up with various software applications and mobile based applications such as Mfarm, Kuza Doctor, icow among others to assist farmers to increase their agricultural yields and also their skills [6]. Mobile phones for short messages (SMS) and voice messages are also commonly used for accessing timely market information on prices reaching customers, sharing accurate information about financial transactions and production.

A number of social media innovations platforms in the country like Mkulima Young, Young Farmers Market, Digital Farmers Kenya and Mkulima Hub Kenya have been developed with the aim of enhancing agricultural productivity [7]. The study notes that the platforms are aimed at educating and informing farmers on agricultural related matters through sharing of information links and news articles as well as making inquiries and obtaining feedback. In addition to the platforms mentioned above, most agricultural institutions in Kenya have incorporated social media as part of their information systems.

Most successful agribusinesses rely on gaining understanding on how to manage complex value chains within the competitive global markets. Therefore, most of this agribusiness companies need more skills and training to ensure that the value of their products is of the highest standard and also to ensure that the company will be able to with stand any challenge it may face and also build the capacity to adapt to change in its environment.

The use of ICTs in agribusiness industry in Kenya has played a very important role with different types of ICTs having different advantages and disadvantages when applied. The use of ICTs improves the performance and profitability of agricultural activities, provides access to information and services essential for farmers and their organizations to link to integrated value chains and it also allows mitigation of inherent risks [8]. Farmers of different sectors can now employ ICT applications and tools to manage their farming activities, from crop selection to the monitoring of production. ICTs help in the efficient use of key farm inputs therefore help in reducing wastage of resources such as water, land and other farm inputs thus helping in increasing farm productivity [9].

Methodology

The study was carried out in Kirinyaga County in the highlands of former central province in Kenya. The study area was purposively selected due to extant literature on massive tomato farming and its proximity to major market centers in the country. The scope of the study focused on young farmers informed by the assumption that the marginal rate of technology adoption diminishes with age and vice versa. The study sampled 171 youthful farmers who were randomly selected. The required sample size was determined by proportionate to size sampling methodology [10].

$$n = \frac{pqZ^2}{E^2}$$

Where n = sample size, p = proportion of the population under tomato farming, q = 1-p, z = confidence level ($\alpha = 0.05$), E = acceptable/allowable error. Since the proportion of the population was not known, p=0.5, q = 1-0.5= 0.5, Z = 1.96 and E = 0.075. This resulted to a sample population of 171 youthful farmers. Questionnaires consisting of structured and non-structured questions were used to collect data from the youthful farmers in the county who were purposively selected based on age.

A multiple regression analysis to predict the influence of AgriTech technologies (independent variables) on farmers' income (dependent variable) was estimated as indicated below. :

$Y = \beta 0 + \beta 1SMMP + \beta 2DC + \beta 3AVA + \beta 4AI + \varepsilon$

Where;

Y= Farmer's agricultural income

β0 = Constant

βi = Coefficient for Xi = (i=1,2,3,4)

SMMP= Social media marketing platforms

DC = Digital credit

AVA=Agricultural value addition

AI = Artificial intelligence.

Results and Discussions

From figure 1 below, 11.1% of the sampled farmers indicated an income of ksh.200,000- ksh.300,000, 9.4% ksh.80,000- ksh.150,000, 8.2% ksh.50,000- ksh.100,000, 19.9% ksh.10,000- ksh.50,000 and 51.5% indicated an income of less than ksh.50,000 per hectare of tomato.

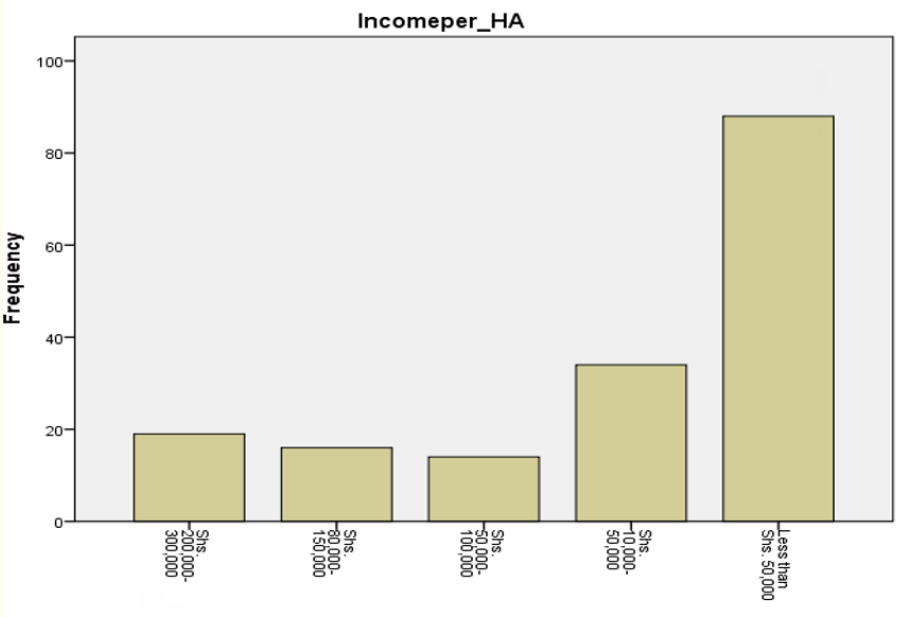

Figure 1

A correlation analysis to determine the relationship between selected agritech technologies and agricultural income from a hectare of tomato produce was performed. The results from table 1 below indicate a positive relationship between farm income and social media platforms, digital credit and agricultural value addition. The predictors were found to be significant at 1% confidence level. This concurs with the findings of [11] who argue that ICTs help in the efficient use of key farm inputs therefore reducing wastage of resources such as water, land and other farm inputs hence increasing farm productivity. However, no farmer applied artificial intelligence in both production and marketing of their produce.

Correlations						
		Incomeper_HA	**Socialmedia_Platforms**	**Digital_Credit**	**AVA**	**AI**
Incomeper_HA	Pearson Correlation	1	.838**	.632**	.550**	.b
	Sig. (2-tailed)		.000	.000	.000	.
	N	171	171	171	171	171
Socialmedia_ Platforms	Pearson Correlation	.838**	1	.740**	.664**	.b
	Sig. (2-tailed)	.000		.000	.000	.
	N	171	171	171	171	171
Digital_Credit	Pearson Correlation	.632**	.740**	1	.492**	.b
	Sig. (2-tailed)	.000	.000		.000	.
	N	171	171	171	171	171
AVA	Pearson Correlation	.550**	.664**	.492**	1	.b
	Sig. (2-tailed)	.000	.000	.000		.
	N	171	171	171	171	171
AI	Pearson Correlation	.b	.b	.b	.b	.b
	Sig. (2-tailed)	.	.	.	.	
	N	171	171	171	171	171
**: Correlation is significant at the 0.01 level (2-tailed).						
b: Cannot be computed because at least one of the variables is constant.						

Table 1: *Technology and Farm Income*

Autocorrelation test was performed to establish whether the error terms were serially interdependent using Durbin Watson statistics. Autocorrelation is present if the DW statistics is close to 0 and 4. A value of 0 shows evidence of perfect positive autocorrelation while 4 shows evidence of perfect negative autocorrelation. A Durbin Watson value between 2 and 2.5 indicates absence of autocorrelation. Absence of autocorrelation implies that the data is reliable and suitable for estimation.

Model Summary[b]										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.838[a]	.702	.697	.073	.702	131.438	3	167	.000	1.902
a: Predictors: (Constant), AVA, Digital_Credit, Socialmedia_Platforms										
b: Dependent Variable: Incomeper_HA										

Table 2: *Durbin Watson Test*

The Durbin Watson value in model 1 was 1.902 which implies weak positive autocorrelation. The existence of weak positive autocorrelation does not have significant effect on the model estimation and prediction.

A regression analysis Y = β0+ β1SMMP+ β2DC+ β3AVA +β4AI+ ε was performed using SPSS software to estimate the effects of selected agritech technologies on farm income (Y). The results in the table 3 below indicate that adoption of any agritech technology increases the amount of income that the farmers receive per hectare.

Coefficient[s]a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
B		Std. Error	Beta			
2	(Constant)	1.530	.072		2.824	.000
	Socialmedia_Platforms	3.839	.051	1.826	1.299	.000
	Digital_Credit	1.080	.187	0.527	4.429	.038
	AVA	2.056	.058	0.812	3.216	.011
a: Dependent Variable: Incomeper_HA						

Table 3: *Regression Analysis*

Model 2: Y = 1.53+ 3.84SMMP+ 1.08DC+ 2.06AVA +0AI.

The results indicate statistically significant positive effects of AgriTech Technologies on farm income (t-prob 0.000< 0.05). The results notably indicate that using social media marketing platforms has the highest positive contribution to a unit change in farm income (β= 3.84). This is in line with the findings of [12,13] who conclude that the use of social media in the field of agricultural marketing offers great opportunities for the buying, selling of agricultural commodities. This means that, ceteris paribus, a unit increase in social media platforms usage measured in terms of mobile phone apps used leads to appreciation of farm income by 384%. There was however no indication of application of any artificial intelligence proxy by computerized farming, controlled production and use of drones.

Conclusion and Recommendations

The formal Kenyan economy has been unable to create enough employment opportunities to absorb the constant supply of labour-seeking youth. Whatever the solution to this problem is, a great deal of coordination and skillful thinking will be required to attract

gadget-loving and efficiency-prone young people into the agricultural sector. However, youth participation in the agriculture sector in Kenya is low, largely because the sector is highly unattractive due to risks, costs, inefficiency and its labour intensive nature. As such, motivating the youth to view agriculture as a career opportunity will require a multi-level intervention. The flow of information on agricultural production and marketing to youth has been hampered by under-utilization of information and communication technologies. However, it is essential to digitize agricultural production and marketing information into web-based resources. This would enable wider outreach and use since the few available extension officers do not effectively reach the majority of the farmers at different locations. The youth could greatly contribute to the agricultural sector through actively participating in generating, posting, management and utilization of this information. Continuous initiatives to support youth in agricultural enterprises and widen the opportunities to showcase their successes in order to attract more young people are paramount. One of these should be the incorporation of information and communication technologies (ICTs) such as the internet, mobile phones, computers and Global Positioning Systems (GPS) associated or not with traditional communication technologies such as radio, television, written press and video. It's therefore imperative that the county governments and the national government provide up-to-date information centers where young farmers can use the information to plan for a successful agribusiness.

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