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Mobile technology, farmer education and performance of agricultural projects: A case of the digifarm sunflower project in Makueni County, Kenya.

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Abstract: Mobile technology in agriculture offers an effective and economical means of expanding knowledge sharing and exchange. The purpose of this study was, therefore, to establish the influence of mobile technology on the performance of agricultural projects in Makueni County, Kenya. Specifically, the study remit was mobile applications and mobile money transfers. This study adopted a mixed-methods approach to ensure a comprehensive assembly and triangulation of requisite data to respond to the survey objectives. The target population for this study was all sunflower farmers in Makueni County who subscribed to the DigiFarm platform. The sample size for this study was 208. The results were presented using descriptive statistics and correlations between the variables studied. Mobile applications presented weak positive correlations with the performance of agricultural projects, while Mobile money presented a strong positive correlation with agricultural projects.

Keywords: Mobile technology, mobile applications, digiFarm, agricultural outcomes

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INTRODUCTION

Globally, mobile technology has disrupted agricultural project planning, design, and implementation. The disruption of technology in agriculture, particularly mobile technology, has shifted how agricultural projects are planned, implemented, and managed. According to Jeehye et al. (2020), disruptive technologies can significantly speed the attainment of agricultural results and yield benefits for the smallholder community if they are widely adopted.

Research has indicated that user acceptance of new technologies has gained traction over the years (Park & Pobil, 2013). An increasing number of farmers use mobile phones, thus adopting mobile technology that helps improve productivity (Jeehye, 2020). Innovation adoption contributes to improved agricultural outputs and a constant food supply (Dong, 2021). Despite the progress made in food output, farmers and consumers need to use emerging technologies to solve common agricultural problems. With technological advancement and stiff competition, agricultural projects must keep up with market demands to gain a competitive advantage. An agricultural project is perceived to perform well when it achieves its set objectives within the assigned time and budget, satisfying client needs.

Factors such as the weather, demand, access to the market, pests, and available resources determine the performance of agricultural projects. Analysis of these factors contributes to the identification of measures that increase productivity. Weather plays a central role in determining agricultural yield and productivity. Unusual weather patterns can ruin crops and reduce productivity (Simiyu, 2018; Kogo et al., 2021). The fact that humans cannot control weather patterns makes it a significant challenge for farmers.

Adopting innovative farming techniques, such as mobile technology, contributes to incorporating innovative ideas, such as studying weather patterns over specific periods and planning effectively (Nyasimi et al., 2017; Baumüller, 2018; Ayoung & Abbott, 2021). Access to the market is essential in meeting set targets related to the performance of agricultural projects. Mobile technologies can potentially improve services for smallholder farmers, but it is unclear whether these benefits are fully realized (Baumüller, 2018; Park & Pobil, 2013). In Sub-Saharan Africa, mobile phone usage for improving productivity among farming communities is not widespread. Mobile technology technology is well-liked by traders, nevertheless. Most farmers use their mobile phones for regular contact, such as staying in touch with friends and family, compared to traders who use them to look up prices in various agri-food marketplaces (Nyasimi et al., 2017).

There is a significant positive relationship between technology preparedness and intent to use the system (Mutinda et al., 2019). Consequently, over the past years, there has been an increase in research and development efforts, better education and training of farmers, and quicker and cheaper means of disseminating, managing, and sharing information. Adopting new technology in agriculture leads to enhanced agricultural growth (Mottaleb, 2018). Ensuring that communities have strategic technology leads to easy access to information and eliminates marginalization. Lwoga, Ngulube, and Stilwell (2010) assert that regular research should be done, and local people should consider the design and development of agricultural technologies to increase the use and adoption rate. According to Krell et al. (2021), failure to recognize the psychological component of technology adoption is a barrier to adopting technology in agriculture. There is a need for the education process to take place on the farmer's land to showcase the real-time benefits of mobile technology. In addition, the educational process should recognize the importance of the psychological component, as the generation of knowledge is not equal to the diffusion and adoption of knowledge. Adoption requires recognizing cultural, social, personal, and institutional factors. Scientists and innovators should adopt a systematic adoption process from creating awareness, providing information and knowledge to farmers, evaluation, trial, and adoption.

Mobile technology has been used in agriculture with considerable success. Digital technology adoption and development have been linked to farmers' increased access to agricultural information in some African regions (Baumüller,2017; Annan et al., et al. 2016). Farmers must obtain detailed advice on optimal methods, input consumption, accurate local weather forecasts, and current market and price information because agriculture is a location-specific sector. By leveraging the growing use of the Internet and related digital devices like mobile phones, farmers can obtain the information they need and get around restrictions with traditional agricultural extension and consulting services. Revolutionary agricultural growth, including cooperative agricultural education and knowledge exchange, may be made possible by these technologies (Donner & Escobari, 2010; Aker & Mbiti 2010).

The use of mobile technologies in agriculture is challenging, especially in Sub-Saharan Africa. In Sub-Saharan Africa, low literacy levels and financial constraints will probably affect the use of agricultural technologies. Most low-income rural residents in Sub-Saharan Africa operate in highly uncertain environments without access to capital, crop insurance, or markets for inputs and outputs. Smallholder farmers are less able to buy "modern" technologies due to these limitations, especially those that require significant upfront costs. (AGRA 2016). The projected goals for increased agriculture investments by African governments have not yet been met (Jellason, 2021).

In Kenya, the government has made efforts in recent years to improve its information communication and technology policies. According to the World Bank report (2008), the lack of strategies and ICT policies in developing countries is one of the reasons for the slow development of ICT in Africa compared to other industrialized nations. In 2018, Bidco Africa partnered with the Makueni County Government and DigiFarm to launch the DigiFarm project, a mobile technology-oriented agricultural project targeting sunflower farmers in Makueni County. According to the Makueni County Department of Agriculture (2019), the DigiFarm project was piloted among 640 farmers and covered 941ha, harvesting 941 metric tons of sunflower seed valued at about 35 million Shillings. Bidco's role in the partnership has been to provide a ready market by buying sunflowers from the farmers to be used as raw material in their edible oil manufacturing business. Out of the 10,000 metric tons of sunflower seeds demanded by Bidco annually, Makueni County allocated a 2,000 quota by the company, which presents an incredible opportunity for farmers to increase their production and consequently improve their earnings.

METHODS

The present investigation opted for a descriptive survey design, using a mixed methods approach to guarantee data triangulation to address the survey objectives. The mixed methods technique combines quantitative and qualitative methods into a single study to provide a complete knowledge of the inquiry. Thus, the pragmatism paradigm—which applies to mixed methods, was selected for this work (Gatotoh, Gakuu, and Keiyoro, 2018). Two hundred eight farmers, five (5) key informants selected from the county government, and DigiFarm specialists made up the study's sample size.

RESULTS

The results of the study are organized in two main sections, The first deals with the influence of mobile money on agricultural outcomes while the second presents findings on the influence utilization of mobile applications on agricultural outcomes.

Mobile Money and improved agricultural outcomes

The further sought to establish the degree to which mobile money transfer effects the performance of agricultural projects in Kenya using the Pearson Correlation Coefficient. This helped in establishing the strength and magnitude of the affiliation between mobile money transfer and the performance of agricultural projects in Kenya. The correlation outcomes are displayed in Table 1.

TABLE 1. *Correlation Analysis between Mobile Money Transfers and agricultural outcomes*

Variable		Mobile Money Transfers	Performance of Agricultural Projects
Mobile Money Transfers	Pearson Correlation Sig. (2-Tailed) n	1 192	0.624** 0.000 192
Performance of Agricultural Projects	Pearson Correlation Sig. (2-Tailed) n	0.624** 0.000 192	1 192

***. Correlation is significant at the 0.05 level (2-tailed)*

The results displayed in Table 1 reveal that there is a moderate positive correlation of 0.624 between mobile money transfer and performance of agricultural projects, indicating a noteworthy association with a p-value of 0.000 that is lower than the test level of an implication of 0.05. This shows that mobile money transfer effects the performance of agricultural projects.

A further regression analysis was conducted using a simple linear regression model using the as shown;

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.624[a]	0.389	0.381	4.20044

ANOVA

Factor	Sum of Squares	d.f	Average Square	F	Sig.
Regression	581.666	1	581.666	105.564	0.000[b]
Residual	1046.912	190	5.510		
Total	**1628.578**	**191**			

Coefficients

	Un-	Standar	t	Si

	standardized Coefficients		**dized Coefficients**		**g.**
Variables	**B**	**Std. Error**	**Beta**		
(Constant)	11.223	5.816		1.929	0.000
Mobile Money Transfers	0.467	0.143	0.624	3.266	0.000

a. Dependent Variable: Performance of Agricultural Projects

The research outcomes revealed the level to which mobile money transfer as an explanatory variable and explains the general variance of the model. The $R^2$is 0.389 demonstrating that mobile money transfer contributes to 38.9% of the variations in the performance of agricultural projects. This shows that additional issues which were not taken into account in this model explained for 61.1%. The research resolved that there was a noteworthy effect linking mobile money transfer and the performance of agricultural projects. ANOVA was utilized to determine the soundness of fit of the regression model. It was noted that the F-significance value of 0.000 was lower contrasted to 0.05 ($p<0.05$). The F-ratio, $F(1, 190) = 105.564$ was considerably bigger than the critical value of $F=4.03$. This demonstrates that the model was substantial. The results further showed a standardized beta value of 0.624 indicating that a unit increase in mobile money transfer contributes to a 62.4% upsurge in the variations of the performance of agricultural projects. The overall model was sound to forecast the performance of agricultural projects given mobile money transfer at $p<0.05$. The regression model $y= \beta 0 +\beta 2X2+e$ would be represented as; Performance of agricultural projects = 11.223+0.624 (Mobile Money Transfer) + e; $t = 3.266$; $p<0.05$.

Thus, the null proposition was rejected and the alternative accepted, concluding that there was a noteworthy affiliation between mobile money transfer and the performance of agricultural projects in Makueni County.

The research further gathered qualitative data regarding mobile money transfer and the performance of agricultural projects among farmers in Makueni County. Results generated from the consultations with the DigiFarm experts were taken. The informants were asked to state whether the use of mobile technology had any social and economic benefits. A respondent shared the following sentiments;

"The farmers have benefitted through the exchange of information on farming techniques. The age of mobile phones and the easy access to information has transformed agriculture for many, from being a subsistence-based activity to being an income-generating business. So definitely there has been social benefits, especially for women and the youth who are taking advantage of the information age to diversify agriculture and maximize yields, thereby improving their livelihoods and by extension, that of their communities."

When asked whether farmers achieved high returns from the use of mobile technology, a farmer interviewed gave the following opinion;

"The presence of digital lending companies has enabled farmers to take up small loans to advance their farming practices. The digital lending companies for has enabled farmers to access credit at very affordable interest rates. However, most farmers are afraid of falling into debt".

The findings from the qualitative and quantitative data linking mobile money transfer and information sharing using mobile devices and improved agricultural outcomes among farmers.

Mobile Money applications and agricultural outcomes

Further, the study sough to determine the degree to which mobile applications impact the performance of agricultural projects. A Correlational analysis on the relationship between mobile applications and performance of agricultural projects was conducted using the Pearson Correlation Coefficient. This was critical in establishing the strength and magnitude of the association linking mobile applications and the performance of agricultural projects. The correlation outcomes are displayed in Table 2.

TABLE 1: *Correlation Analysis between Mobile Applications and Performance of Agricultural Projects*

Variable		Mobile Applications	Performance of Agricultural Projects
Mobile Applications	Pearson Correlation	1	0.294**
	Sig. (2-Tailed)		0.000
	n	192	192
Performance of Agricultural Projects	Pearson Correlation	0.294**	1
	Sig. (2-Tailed)	0.000	
	n	192	192

**. Correlation is significant at the 0.05 level (2-tailed)

The study established a weak positive correlation of 0.294 between mobile applications and performance of agricultural projects indicating a substantial affiliation with a p-value of 0.000. The value was lower than the test statistic of 0.05. This showed that those mobile applications effect the performance of agricultural projects.

Further a regression analysis was conducted using a simple linear regression model using the following model; $y= \beta 0 + \beta 1X1+e$ where y= performance of agricultural projects; β0= constant; β1= beta coefficient, X1= Mobile Applications; e= error term as shown.

Model Summary

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	0.294[a]	0.087	0.082	2.798

ANOVA

Factor	**Sum of Squares**	**d.f**	**Mean Square**	**F**	**Sig.**
Regression	141.055	1	141.055	18.017	0.000[b]
Residual	1487.523	190	7.175		
Total	**1628.578**	**191**			

Coefficients					
	Un-standardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**
Variables	**B**	**Std. Error**	**Beta**		
(Constant)	15.675	1.983		7.906	0.000
Mobile Applications	0.300	0.071	0.294	4.245	0.000

a. Dependent Variable: Performance of Agricultural Projects

[R=0.294, R^2=0.087, β=15.675, t= 4.245, $F(1,190)$ = 18.017, $p<0.05$]

The model summary explains the level to which mobile applications as the explanatory variable explains the general variance of the model. The R^2 is given as 0.087 indicating that mobile applications contribute 8.7% of the dissimilarity of the response variable; the performance of agricultural projects. The outcomes specify that there could be other factors that the research did not consider in the model that accounted for 91.3%. The conclusion was that there was a substantial association between mobile applications and the performance of agricultural projects.

The Analysis of variance (ANOVA) outcomes that explain the power of the regression model and the goodness of acceptability of the regression model. The research established the F-significance rate at 0.000 was lower than 0.05 (0.000<0.05). The F-calculated (18.017) was substantially bigger than the F-critical value at $F(1, 190)$ = 4.03, thus the model was deemed significant.

The output further displayed a standardized beta value of 0.294 indicating that a unit increase in mobile applications contributed to a 29.4% increase in the dissimilarity of performance of agricultural projects. The research observed that the overall model was sound to forecast the performance of agricultural projects given mobile applications at $p<0.05$. The regression model in the form $y= \beta 0+\beta 1X1+e$ would be; Performance of agricultural projects = 15.675+0.294 (Mobile applications) + e; t = 4.245; $p<0.05$. From the findings, the research observed that the null proposition was rejected and the alternative proposition accepted. The qualitative responses showed that farther benefited from mobile applications. When asked about the accessibility and utilization of mobile applications, one of the sunflower project members narrated the following;

"We have different groups of participants who are engaged in farming in this area. Smallholder farmers, county agriculture extension workers, non-governmental organizations that advocate for food and environmental issues, and county administrators in charge of agriculture. These groups consult using mobile communication on techniques to improve farming in the arid areas of Kisau-Kiteta, Mbooni, Kaiti, and Kithungo Kitundu in the larger Makueni County."

The outcome from the qualitative and quantitative response shows that although the use of mobile applications is not widespread it had an impact on the agricultural outcomes.

Barrers to optimized adoption of mobile device technologies in agriculture

The research endeavored the informants' opinions on whether there existed barriers or challenges facing the acceptance and usage of mobile technology in agriculture in Kenya and how the barriers could be overcome. One of the informants had this to say in an interview;

"Yes, there are challenges. Lack of internet connection in remote areas, lack of electricity, and lack of awareness among most farmers who still engage in small-scale and traditional agriculture, like relying on rain and being uneducated on disease control. This should change by engaging community-based organizations to mobilize farmers and build the capacity of farmers through training and extension services."

Opinion was also sought from farmers on any recommendations they could give to the government in improving the use of mobile technology in agriculture. A respondent had this to say;

"The government should enhance network and power connectivity in remote areas. Mobile technology practitioners should carry out massive sensitization on the importance of adopting mobile technology in agriculture".

The outcomes from the qualitative along with the quantitative data show that there was an affiliation between the mobile information sharing platform and the performance of agricultural projects in Makueni County, Kenya. The adoption of a mixed-method approach justified the need for data triangulation in the research.

DISCUSSIONS

The findings of this study showed that though farmers benefit from mobile applications, the benefits are limited, and the influence of mobile applications is limited. These findings are consistent with Mendes, Pinho, Neves et al. (2020), who argue that the great potential offered by smartphone applications is still yet to be fully realized. These findings are also consistent with Michels, Fecke, Feil, et al. (2020), who find that smart farm adoption depends on many factors, including farmers' age, education, and farm size. This study is also consistent with Yu, Dananjayan, Chaojun et al. (2021), who argue that smart farming requires high investment costs, better coverage and connectivity and higher bandwidth which is not widespread.

CONCLUSION

The study concludes that mobile applications play a significant role in improving agricultural outcomes. Farmers can learn from the apps and well as share the information. The full potential of mobile apps is, however, yet to be realized. Thus, there is a need for more investment in improving customized mobile applications, awareness creation, digital literacy for farmers and investment in improving affordability and accessibility of connectivity, mobile devices and agricultural applications.

RECOMMENDATIONS

The study makes the following recommendation;

- The Kenyan government should consider partnerships with mobile technology practitioners, farmers, and agriculture experts to adopt a robust agricultural mobile technology policy that is all-encompassing. The government can achieve much more and reach more farmers by incorporating mobile technology to fast-track other policies, such as the agricultural extension policy to offer information to farmers on financing, soil health, pests and diseases, farm inputs, harvesting, and market access.

- There is a need for stakeholders in agriculture to conduct capacity-building for farmers through continuous training on emerging technologies in agriculture, both at the micro and macro levels.

REFERENCES

Aker, J.C.; Mbiti, I.S. Mobile phones and economic development in Africa. J. Econ. Perspect. 2010, 24, 207–232.

Alliance for a Green Revolution in Africa (AGRA) (2016) Progress Towards Agricultural Transformation; Alliance for a Green Revolution in Africa (AGRA): Nairobi, Kenya, 2016; pp. 105–124. [Google Scholar]

Annan, K.; Dryden, S.; Conway, G. (2016) Digital Thinking to Transform Africa's Food System: Overcoming Isolation, Speeding Up Change, and Taking Success to Scale.; Available online: https://www.digitalgreen.org/wp-content/uploads/2017/06/african_farmers_in_the_digital_age.pdf (accessed on 30 May 2018).

Ayoung, D. A., & Abbott, P. (2021). Minding the design reality gap: an empirical evaluation of telecentre initiatives in rural Ghana. The International Journal of Information, Diversity, & Inclusion (IJIDI), 5(3), 64-97.

Baumüller, H. (2017) Towards smart farming? Mobile technology trends and their potential for developing country agriculture. In Handbook on ICT in Developing Countries: 5 G Perspective; Skouby, K.E., Williams, I., Eds.; River Publishers: Delft, The Netherlands, [Google Scholar]

Baumüller, H. (2018). The little we know: an exploratory literature review on the utility of mobile phone-enabled services for smallholder farmers. Journal of International Development, 30(1), 134-154.

Dong, L. (2021). Toward resilient agriculture value chains: challenges and opportunities. Production and Operations Management, 30(3), 666-675.

Donner, J.; Escobari, M.X. (2010) A review of evidence on mobile use by micro and small enterprises in developing countries. J. Int. Dev. , 22, 641–658. [Google Scholar] [CrossRef]

Doswell, Willa; Braxter, Betty; Cha, EunSeok; Kim, Kevin (2011). "Testing the Theory of Reasoned Action in Explaining Sexual Behavior among African American Young Teen Girls". Journal of Pediatric Nursing.

Gatotoh A.M, Gakuu C, M., Keiyoro, P, N, (2017) Learner Attitude and mLearning Adoption among Community Health Care Trainees, Kenya. International Journal of Current Research, Vol. 9, Issue,11, pp.60834- 60838, November 2017

Gatotoh A.M, Gakuu C, M., Keiyoro, P, N, (2018) Learner self-efficacy and mobile learning adoption among community health trainees, Kenya. International Journal of Science Arts and Commerce, Vol. 3 No. 2, February-2018 2

Jeehye, Kim, Shah, P., Gaskell, J. C., & Prasann, A. (2020). Scaling up disruptive agricultural technologies in Africa. World Bank Publications

Jellason, N. P., Robinson, E. J., Chapman, A. S., Neina, D., Devenish, A. J., Po, J. Y., & Adolph, B. (2021). A systematic review of drivers and constraints on agricultural expansion in Sub-Saharan Africa. Land, 10(3), 332.

Kogo, B. K., Kumar, L., & Koech, R. (2021). Climate change and variability in Kenya: a review of impacts on agriculture and food security. Environment, Development, and Sustainability, 23(1), 23-43

Krell, N. T., Giroux, S. A., Guido, Z., Hannah, C., Lopus, S. E., Caylor, K. K., & Evans, T. P. (2021). Smallholder farmers' use of mobile phone services in central Kenya. Climate and Development, 13(3), 215-227.

Lwoga, E. T., Ngulube, P., & Stilwell, C. (2010, April). The management of indigenous knowledge with other knowledge systems for agricultural development: challenges and opportunities for developing countries. In Scientific and Technical Information and Rural Development–IAALD XIIIth World Congress (pp. 26-29).

Makueni County Department of Agriculture (March 28, 2019) Makueni farmers to reap millions from Sunflower growing Retrieved from https://www.makueni.go.ke/departments/agriculture/makueni-farmers-to-reap-millions-from-sunflower-growing/

Mendes, J., Pinho, T. M., Neves dos Santos, F., Sousa, J. J., Peres, E., Boaventura-Cunha, J., Cunha, M., et al. (2020). Smartphone Applications Targeting Precision Agriculture Practices—A Systematic Review. Agronomy, 10(6), 855. MDPI AG. Retrieved from http://dx.doi.org/10.3390/agronomy10060855

Michels, M., Fecke, W., Feil, JH. et al. (2020) Smartphone adoption and use in agriculture: empirical evidence from Germany. Precision Agric 21, 403–425 (2020). https://doi.org/10.1007/s11119-019-09675-5

Mottaleb, K. A. (2018). Perception and adoption of new agricultural technology: Evidence from a developing country. Technology in society, 55, 126-135.

Mutinda, Celestine Mutheu, Gatotoh, Augustine Mwangi, Keiyoro, Peter Njenga, (2019). "Attitudinal and Technological Determinants of iTax system acceptance: The case of Kenya Revenue Authority", International Journal of Current Research, 11, (03), 2259-2262

Nyasimi, M., Kimeli, P., Sayula, G., Radeny, M., Kinyangi, J., & Mungai, C. (2017). Adoption and dissemination pathways for climate-smart agriculture technologies and practices for climate-resilient livelihoods in Lushoto, Northeast Tanzania. Climate, 5(3), 63.

Park, E., & Pobil, A.P. (2013). Technology Acceptance Model for the Use of Tablet PCs. Wireless Personal Communications, 73, 1561-1572.

Simiyu, N. R. (2018). Project management practices and performance of agricultural projects by community-based organizations in Bungoma county, Kenya (Doctoral dissertation, Doctoral dissertation, Kenyatta University).

World Bank (2008). Agricultural Innovation Systems; From Diagnostics towards Operational Practices. Agriculture and Rural Development Discussion Paper No. 38.