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Factors Influencing the Use of Digital Marketing Technologies in the Marketing of Green Leafy Vegetables Among Smallholder Farmers in Lari Sub-County, Kenya

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Abstract
Smallholder farmers in emerging economies have long faced information asymmetry difficulties which limits their access to lucrative markets. Farmers therefore, decide to sell their produce through middlemen at relatively low prices, resulting in insufficient profits. Numerous studies have shown that digital marketing technologies in agriculture are an important tool for farmers to be active participants in profitable markets by improving their access to timely and relevant market information. Despite the rapid expansion of digital marketing technology in emerging nations' agricultural sectors, adoption of such technologies in rural areas remains low. The purpose of this study was to identify the characteristics that influence smallholder farmers' usage of digital marketing technology in the selling of green leafy vegetables in Lari sub-County, Kenya. The study specifically attempted to determine the socioeconomic, institutional, and technological factors that influence smallholder farmers' usage of digital technology. A descriptive survey research design was used. A multistage sampling procedure was used to select 374 green leafy vegetable farmers. The semi-structured questionnaire was employed to collect data. A multivariate probit model was used to analyze the data. The results show that education level, access to extension services, electricity installation positively influenced the use of mobile phone, social media, and internet search engines in marketing of green leafy vegetables. The adoption of digital marketing technologies in the marketing of vegetables can be influenced by several factors. Therefore, the study recommends the County Government to implement targeted educational initiatives that focus on digital literacy for smallholder farmers.
Keywords: marketing; vegetables; mobile phone; social-media; middlemen; socioeconomic
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1. Introduction

The agricultural sector remains important for poverty reduction and contributes significantly to the majority of developing countries' economic growth (Eskia, 2019). This sector, which comprises countless small-scale farmers who generate over 80% of the food consumed in developing countries, also provides most rural households with either permanent or temporary employment. According to FAO (2022), Kenya's agriculture industry contributes around 33% of the country's GDP directly and another 27% indirectly through linkages with various other sectors. The subsector that exports the most is horticulture, and its growth continues to be key to the nation's economy. Cut flowers account for 70.3%, vegetables 18.1%, and fruits 11.7% of the total horticulture export earnings in Kenya, making it the fastest-growing subsector of the country's economy (KNBS, 2022).

Kiambu County is one of the counties where horticulture farming is developing as a viable commercial enterprise. The sub-sector is crucial to the county's economic development (Kiambu-County-ADP, 2016) as vegetables are considered high-value crops because of their health benefits. The growth of the subsector is being driven by the increased nutritional value and health consciousness of consumers, notably for fruits and vegetables. French beans, snow peas, kale, cabbage, garden peas, tomatoes, spinach, and carrots are just a few of the popular vegetables grown in Kiambu. In 2022, exotic vegetables contributed 42.4 percent to the domestic value of horticulture in Kiambu. The area, production, and value were 158,567 Ha, 3.1 million tons valued at KES 72.65 billion respectively (AFA, 2022).

Spinach, kale, and cabbage are among the exotic vegetables that the majority of smallholder farmers in Lari Sub-County produce and market. The year-round rainfall and consistent low temperatures are favorable for vegetable growing. Vegetables, however, are prone to spoilage (Pokhrel, 2021). It is risky to handle large quantities of vegetables at the outdoor market, especially if growers lack refrigeration to keep excess produce. Consequently, they are unable to market their farm produce directly even though there is a ready urban market in Kiambu, Nakuru, Nairobi, and Mombasa (Kiambu-County ADP, 2016). Therefore, farmers are dependent on market

intermediaries who buy their goods for less than market value. Inaccurate second-hand pricing information and a lack of market knowledge have major consequences for agricultural producers Deichman *et al.* (2016). Farmers risk having their produce wither away, being delivered insufficiently or excessively, or underselling their goods.

Market information asymmetry leads to substantial losses in profits (Zodidi, 2022). The use of digital marketing technology would thus go a long way in bridging the market information gap between farmers and consumers (Jerome, 2017). According to Nwafor *et al.* (2020) and Okello *et al.* (2020), digital technologies are thought to have a significant impact on closing the information gap between farmers and markets. In Sub-Saharan Africa, Kenya has become a leader in information and communication technologies (ICT) (Baumüller, 2016). Kenyan farmers may get market and agricultural information on social media platforms including Mkulima Hub Kenya, Digital Farmers Kenya, and Mkulima Young (Kipkurgat *et al.,* 2016). Through social media platforms, farmers may exchange information and communicate with one another (Akashraj & Pushpa, 2014). Social media sites include Facebook, LinkedIn, Twitter, Instagram, and WhatsApp, to name a few.

ICT, such as the Internet for marketing, internet for information awareness, mobile application services, telephone communication, SMS services, radio broadcasting, and TV broadcasting are available in Kiambu County (Warwimbo, 2017). Despite this, most farmers have not fully embraced these new technologies hence they continue to lack full access to market information, impacting negatively their agribusinesses. It is however not clear why the uptake of these technologies remains low. This study therefore seeks to investigate factors that affect the use of mobile phones, social media, and the internet in the marketing of green leafy vegetables among smallholder farmers in Lari sub-County.

2. Literature Review

There are a variety of factors that can influence the use digital technologies by smallholder farmers (Jha *et al.*, 2019). These factors can be classified into categories, (i) farmers' characteristics; (ii) farm characteristics; (iii) technology characteristics; (iv) institutional factors; and (v) finance. They have direct and indirect relationships and influence the use of digital technologies either positively or negatively. Age, gender, and family income are just a few examples of the socioeconomic factors of smallholder farmers that have influenced how they utilize ICT, (Bryan & El Didi, 2019).

However, Kante *et al.* (2016) pointed out that ICT's relative benefit, simplicity, compatibility, and observability also have an impact on smallholders' employment of the technology. According to Titilope (2020), smallholder farmers' slow adoption of ICTs may be caused by a variety of factors, including their poor income (or lack thereof), a lack of ICT infrastructure, their state of health, cultural differences, and other factors. Eskia (2019) and Nwafor (2020) claim that the poor adoption of ICTs among smallholder farmers is also a result of a lack of ICT awareness. According to Abebe and Mammo-Cherinet (2019), the key issues influencing smallholder usage of ICTs include limited energy supply, literacy, knowledge, and skills for running ICT applications.

The study conducted by Anthony revealed that the age of the household had a negative influence on the use of income. The implication is that relative to younger household heads, the older ones were less likely to use the internet. Ma *et al.* (2018) also pointed out that the authors argued that young people preferred to possess smartphones compared to older people. Okello (2017) stated that young farmers tend to be innovative and risk-takers and thus would try technologies more than older household heads. Older adopters of technology are usually slower at learning particularly if technology is relatively new.

Murage *et al.* (2015) found that male farmers adopt technology faster than female farmers. Therefore, men have more and easier access to ICT and more readily adopt technology. gender is an important variable in the adoption of innovations. When it comes to choosing which technology to use, the preferences of men and women differ. On the other hand, A big household size was often linked to a favorable effect on ICT use than a smaller household size, according to a study done by Sabuhoro *et al*. (2003) on factors that influence the use of computers by agribusiness owners in South Africa.

According to the reviewed publications, the education level of African smallholder farmers had a beneficial effect on their rate of technology adoption (Oyinbo et al., 2019). Smallholder farmers with some type of formal or informal education embrace new technology faster than illiterate smallholder farmers (Chirwa, 2005; Kassie *et al.,* 2015). Anthony *et al.* (2020) discovered that the off-farm job coefficient was positive and significant, indicating that families with an off-farm income used the Internet more than their counterparts. Off-farm income enabled farmers to acquire new technology like cell phones, which may improve their internet use.

Numerous studies have been undertaken on the usage, effect, adoption, and dissemination of digital technology by smallholder farmers, according to a review of the literature that is currently available. Researchers have attempted to determine the factors that affect smallholder farmers' usage of digital technology. The use of digital technology by smallholder farmers is still lower than anticipated, according to several prior researches. The poor uptake of digital technologies by smallholder farmers has been attributed to a number of challenges, including a lack of awareness about digital technology, a lack of assistance from the government, a lack of digital infrastructure, a lack of help from banks, and problems with management. However, research on the use of digital marketing technology by rural smallholder farmers in developing countries has been extremely limited. The preceding literature also reveals that there has been no major research on the use of digital marketing technology by smallholder farmers of green leafy vegetables in Lari sub-County, even though such farmers are regarded as a productive basis of the Lari sub-County economy. As a result, this study has been conducted to bridge the gap.

3. Materials and methods

The study was conducted in Lari Sub-county, Kiambu County. Kiambu County borders Nairobi and Kajiado Counties to the South, Machakos to the East, Murang'a to the North and North East, Nyandarua to the North West, and Nakuru to the West and has a population of 2,417,735. The county is divided into four broad topographical zones; Upper Highland, Lower Highland, Upper Midland and Lower Midland Zone. The Upper Highland Zone is found in Lari sub-county and it is an extension of the Aberdare ranges that lies at an altitude of 1,800-2,550 meters above sea level. It is dominated by highly dissected ranges and it is very wet, steep and important as a water catchment area (Kiambu County CIDP, 2016). Lari sub-county is one of the twelve sub-counties in Kiambu County. The sub-county has five wards namely Lari/Kirenga, Kinale, Kijabe, Kamburu and Nyanduma Ward. It covers an area of 439.20 square kilometers. The constituency borders several other constituencies which include Githunguri Latitude and longitude.

The sub-county was purposively selected because majority of farmers practice agriculture as the main source of livelihood. Crops grown for sale in Lari include vegetables such as cabbage, coriander, spinach, and kale. Additionally, vegetable farming in the sub-county is largely favored by large amounts of rainfall received throughout the year and the continuous cold seasons. The area is relatively cold because of its location on the windward side of Aberdare Range. It receives a considerable amount of rainfall in a year. The majority of farmers in Lari own and use digital marketing technologies like mobile phones. Some farmers have access to different social media platforms, and the internet search engines.

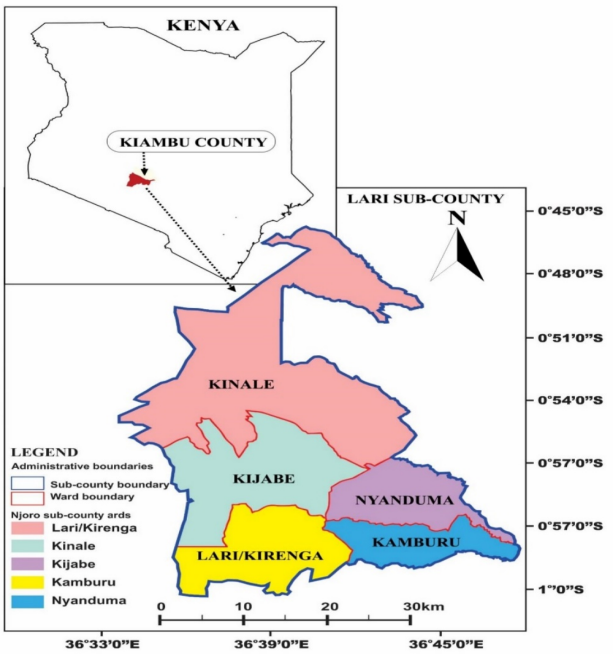

Figure 1. Map of Lari Sub-County, **Source:** IEBC (2022)

This study used descriptive survey design, since it enables both collection of qualitative and quantitative data without influencing the environment of the study, it also entails the descriptions of the attributes the target population exhibits, and hence its application is justifiable. A sampling frame was a list of 376 smallholder green leafy vegetable farmers. Ragab and Arisha (2018) define the sampling frame as the final list that represents the population which the researcher intends to select the sample from. The sampling frame of this study was obtained from Lari Sub-county agricultural extension officer**.**

A multistage sampling procedure was employed to select the respondents. Kiambu County was purposively selected for it is well known for its potential in agriculture, specifically the horticulture sector. The county is an important agricultural center, and it is under major seven vegetable-producing counties of Central Province. It is among the counties that have embraced the use of digital technology, more especially the use of mobile phones and social media in agriculture. In the second stage, Lari sub-county was selected purposively because it is dominated by smallholder farmers who grow vegetables like cabbage, spinach, and kale for sale. On the other hand, the majority of farmers in the sub-county own mobile phones, they have internet access, and social media platforms. Lastly, systematic sampling was employed to select the respondents from the five wards (Lari/Kirenga, Kinale, Kijabe, Kamburu, and Nyanduma) in the sub-county.

Determination of the sample size followed a proportionate-to-size sampling methodology as specified by Kothari (2004) using Cochran (1963) formula and was calculated as;

$$n = \frac{Z^2 pq}{e^2} \quad (1)$$

$$n = \frac{1.96 \times 1.96 \times 0.5 \times 0.5}{0.05 \times 0.05} = 384$$

where: n= Sample size; Z= Standard variation given confidence level of α= 0.05; p= Proportion of the population containing the major interest; q= 1- p and e = acceptable error or precision of 5%. Since the proportion of the population is unknown, p= 0.5, q= 1- 0.5= 0.5, Z= 1.96 and e= 0.05 (acceptable error term). This resulted in a sample of 384 respondents. The formula above is justified because the total number of smallholder green leafy vegetable farmers in Lari Sub-county is not known. Because of this, the assumption of the formula will be that 50% of the subject interest (farmers) possesses major attributes of interest for the study. The acceptable precision of 5% was chosen because of the smaller sample size and hence higher confidence level.

Table 1: Sample size distribution

Lari sub-county wards	Total Population	Proportion sample (%)	Sample
Kinale	26,007	21	81
Kijabe	27,627	22	84
Nyanduma	23,454	19	73
Kamburu	18,951	15	58
Lari/Kirenga	27,871	23	88
Total	**123,965**	**100**	**384**

Data was collected using a structured questionnaire. Data was organized into various categories, which are distinct from each other through coding, the data was then analyzed using SPPS version 29 and STATA version 17.

The objective of the study was to provide empirical evidence on the factors that influence the use digital marketing technologies on the marketing of green leafy vegetables among smallholder farmers in Lari sub-

County. The empirical specification of choice decision over the three digital marketing tools can be modeled by either multinomial or multivariate regression analysis. However, the choices among the digital marketing tools are not mutually exclusive as farmers are accessing information and use more than one digital marketing tool at the same time and therefore the random error components of the information sources may be correlated. MVP was thus used to analyze the data. This model simultaneously models the influence of socio-economic, institutional and technology-related factors on each of the different digital tools while allowing the unobserved and unmeasured factors to be correlated (Lin *et al.,* 2005). This model would allow possible contemporaneous correlation in the choice to use the three digital tools simultaneously.
Empirically the model can be specified as follows

$$Y_{i1} = X_{ij1}\beta_1 + \varepsilon_{i1}$$

$$Y_{i2} = X_{ij2}\beta_2 + \varepsilon_{i2}$$

$$Y_{i3} - X_{ij3}\beta_3 + \varepsilon_{i3} \quad (2)$$

where, i = farmer identification, Y_{i1} = 1, if a farmer uses mobile phone to access agricultural information (0 = otherwise), Y_{i2} = 1, if farmer uses social media to market their vegetables (0 = otherwise), Y_{i3} = 1, if farmer uses the internet search engines to market the vegetables, (0 = otherwise), X_i = Vector of factors affecting use of digital marketing technology tools, β_j = Vector of unknown parameters (j = 1, 2, 3), and ε = the error term. Factors influencing the use of digital marketing technologies can be tested by running three different independent binary probit or logit models by assuming that error terms are mutually exclusive. However, the decision to use different digital marketing technologies may be correlated, thus the elements of error terms might experience stochastic dependence. In this situation, a multivariate probit model of the following form is used to test the hypothesis.

$$Y_{ij} = X_{ij1}\beta_1 + \varepsilon_{ij} \quad (3)$$

where Y_{ij} (j =1….,3) represents the three different digital marketing technologies faced by the ith farmers (i = 1.…384), X_{ij1} is a 1 × k vector of observed variables that affect the choice decision of farmers, β_j is a k × 1 vector of unknown parameters (to be estimated), and ε_{ij} is the unobserved error term. Assuming the error terms (across j = 1… m alternatives) are multivariate and are normally distributed with a mean vector equal to zero, the unknown parameters in the above equation are estimated using simulated maximum likelihood. The method used Geweke Hajivassiliour-Keane smooth recursive conditioning simulator procedure to evaluate the multivariate normal distribution.

Table 2: Description and expected signs of the variables of hypothesized dependent and independent variables in the usage of digital marketing technologies

List of variables	Description	Measurement	Expected signs
Dependent			
Usage of digital tool	Usage of digital tools to market	0 = Use mobile phone, 1 = Use social media, 2= Use the internet,	
Independent			
Age	Age of respondent	Continuous	+/-
Gender	Gender of respondent	Dummy 1=male, 0=female	+/-
Education	Education level	Continuous	+
Experience	Level of experience	Continuous	+
Household size	Household members	Continuous	+/-
Farm size	Size of the land	Continuous	+/-
Off-farm	Total off-farm income	Continuous	+
Access to Extension	Access to extension services	Dummy 1=yes, 0=no	+
Access to credit	Access to credit	Dummy 1=yes, 0=no	+
Distance	Distance to output Market (km)	Continuous	+/-
Access to electricity	Access to electricity	Dummy 1=yes, 0=no	+
Digital training	Training on digital technologies	Dummy 1=yes. 0=no	+
Relevance	Relevance of digital tool	Likert 1 = SD, 2 = D, 3 = N, 4 = A, 5 = SA	+/-
Accessibility	Accessibility of digital tool	Likert 1 = SD, 2 = D, 3 = N, 4 = A, 5 = SA	+/-
Affordability	Affordability of digital tool	Likert 1 = SD, 2 = D, 3 = N, 4 = A, 5 = SA	+/-

SD =strongly disagree: D = disagree: N= neutral: A =agree: SA =strongly agree

4. Results and Discussions

4.1 Introduction

This chapter presents the results and discussions of the findings on the factors that influence the usage of digital marketing technologies on the marketing of green leafy vegetable among smallholder farmers in Lari sub-county. The digital marketing technologies considered were social media, mobile phone, and the internet search engines.

4.2 Questionnaire return rate

The researcher administered a total of 384 questionnaires to the respondents in Kinale, Kijabe, Kirenga, Nyanduma, and Kaburu wards in Lari sub-county. Out of 384 questionnaires, 374 of them were filled and returned. The response rate is considered very good for making the study conclusions. According to Mugenda and Mugenda (2003), a response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of 70% and over is excellent. The excellent response rate was due to the pre-notification of the key informants about the intended survey.

4.3 Factors Influencing the Use of Digital Technologies in The Marketing of Green Leafy Vegetables

4.3.1 Pre-estimation tests

Multicollinearity test

Table 3: Variance inflation factor

	VIF	1/VIF
Training	2.45	.408
Off-farm income	2.128	.47
Relevance	1.891	.529
Accessibility	1.714	.583
Affordability	1.705	.587
Extension access	1.492	.67
Education	1.397	.716
Electricity	1.304	.767
Credit access	1.154	.866
Distance	1.127	.888
Age	1.069	.935
Household size	1.06	.944
Land size	1.043	.959
Experience	1.019	.982
Gender	1.013	.987
Mean VIF	1.438	.

The Variance inflation factor was used to assess multicollinearity. The VIF values ranged between 1.013 to 2.445 which are below the acceptable threshold of 5, indicating that multicollinearity was not a problem.

Breusch pagan test for heteroscedasticity

The Breusch pagan test was used to test if the if the errors are homoscedastic. The p-value was below 0.05. We reject the null hypothesis that heteroscedasticity is a problem. The study applied a robust standard error to account for this problem.

Pairwise correlation test for categorical variables

Table 4: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)
(1) Gender	1.000				
(2) Extension access	-0.037	1.000			
(3) Training	0.036	0.374	1.000		
(4) Credit access	0.055	0.142	0.130	1.000	
(5) Electricity	-0.030	0.257	0.182	0.224	1.000

Pairwise correlation test was used to test whether categorical variables were correlated with each other. The pairwise correlation values were below 0.5 which is regarded acceptable.

Normality test

Shapiro Wilkes test was used to test for normality assumption. The p-value was above 0.01 indicating that the errors are normally distributed.

Table 5: Multivariate probit results for factors influencing the use of digital technologies in the marketing of green leafy vegetables

	Mobile phone		Social media		Internet	
	Coeff	Std. Err	Coeff	Std. Err	Coeff.	Std. Err
Age	-0.001	0.003	-0.001	0.003	-0.009***	0.003
Gender	-0.716***	0.188	-0.302*	0.174	-0.336**	0.165
Education	0.126***	0.041	0.187***	0.048	0.188***	0.050
Household size	0.105**	0.046	0.104***	0.038	0.107***	0.039
Farm size	0.106	0.099	-0.114	0.075	-0.080	0.054
Off-farm income	-0.000	0.000	-0.000	0.000	-0.000	0.000
Experience	-0.000	0.002	0.000	0.002	-0.003*	0.002
Extension access	0.897***	0.214	0.560***	0.204	0.622***	0.198
Training	0.026	0.055	0.001	0.060	0.063	0.061
Electricity access	0.794***	0.211	0.511**	0.202	0.285	0.192
Credit access	0.641***	0.191	0.799***	0.194	0.824***	0.193
Affordability	1.204***	0.249	1.319***	0.234	1.055***	0.231
Relevance	-0.108	0.109	-0.184*	0.105	-0.233**	0.115
Distance	0.015	0.024	-0.009	0.018	-0.008	0.020
Accessibility	-1.037***	0.298	-1.007***	0.256	-0.776***	0.240
_cons	-3.867***	0.718	-5.777***	0.662	-4.889***	0.637
Number of Observations 374						
L. R. test of rho21 = rho31 = rho32 = 0: 0 $\chi2(3) = 59.7641$ Prob > $\chi2$=0.0000						
Wald χ^2 (3) = 368.28 Prob > $\chi2$ = 0.0000						

Age of the household head had a negative effect on the usage of internet search engines with additional year reducing the usage by 0.9%. These findings indicate that adding a year to the age of the household head is connected with a decreased likelihood of that household head using the internet search engines as a source of marketing and accessing marketing information. Older household heads may be less likely to adopt new digital tools such as internet search engines since they may have had less exposure to technology during their formative years and may be less familiar with their use. Again, older farmers may be more resistant to change, prefer traditional marketing strategies. The findings are consistent with those of Katunyo *et al.* (2018) and Mdoda & Mdiya (2022), who found that age had a negative impact on farmers' use of ICT. The gender of the household head had a negative effect on the use of mobile phone, social media, and internet search engines as the source of marketing. The female household heads are associated with lower usage of the digital marketing technologies. The possible reason could be due to income disparities and digital literacy.

The education level of the household head had a positive and significant effect on mobile phone, social media, and internet search engines usage as the source of platforms for marketing. An increase in education by one year enhanced digital technologies usage by about 12.6%, 18.7%, and 18.8%, respectively. A farmer can market their products on mobile phone, social media, and internet search engines and learn how to save and retrieve information from the tools by being exposed to education. Through education, individual farmers can learn how to find and use the most recent information on enhanced farming practices and enhanced marketing methods. Farmers who have received education are better able to read and understand content from digital technologies. Okello (2017) supports the findings by indicating that education significantly influenced how ICT tools were used by pineapple agri-prenuers.

Household size had a significant and positive influence on mobile phone, social media, and internet search engines usage. This implies that an increase in household size will yield an increase in the likelihood of the use of mobile phones, social media, and internet search engines by 10.5%, 10.4%, and 10.7%, respectively. This could be the case since individuals of larger families frequently have a variety of interests and skill sets. Some members are skilled at managing social media profiles, which helps the farm's internet operations have a more active online presence. The more the household members, the more ownership of different digital platforms. Once more, the need for enhanced market communication, information availability, and access to reliable marketplaces for the products may be the driving forces behind the adoption of digital technologies in large households. Farmers benefit from having a large family because they may employ certain family members to train them how to use digital technologies.

Access to extension services was significant and it had a positive effect on the use of social media and internet search engines as a source of market information and marketing. An increase in extension services by one will induce an increase in social media and internet search engine usage by 0.52 and 1.27 percentage points, respectively. Extension agents spread innovation by encouraging farmers to share their ideas and experiences, as well as making it more affordable to obtain knowledge. The results are in conformity with Tambo *et al.* (2019) that having access to extension services plays an imperative role in improving production and use of innovation to the farm.

Years of experience has a negative impact on the use of internet search engines as the platform for marketing. The results imply that with the additional year of experience, the likelihood to use internet search engines decreases with 0.3% percentage points. More experienced individuals might rely on established knowledge and networks rather than attempting to use new ones. On the same hand, household heads with more experience may be less comfortable or familiar with new technologies as compared to less experienced heads.

Access to extension services was significant and had a positive effect on usage of mobile phone, social media, and internet search engines. An increase in access to extension by one enhanced the usage of mobile phone, social media, and internet search engines by 87.7%, 56%, and 62.2%, respectively. Extension workers may help farmers better understand the benefits of digital marketing technologies and making the adopt these tools for marketing purposes. Chikaire *et al.* (2017) noted that having access to extension services assist farmers with knowledge and information which in turn is likely to help farmers acquire leadership potential which will help them in disseminating information on important techniques or innovation.

Electricity installation had a positive and significant effect on mobile phone and social media usage. The results indicate that households that have electricity installed at their homes had a higher probability of using mobile phones and social media by 79.4% and 51.1%, respectively. Mobile phones require electricity, so access to electricity would enable the smooth and effective operation of mobile phones. The findings are in line with Okello (2017) who found a positive correlation between electricity installation and mobile phone usage. Zodidi (2022) also revealed a positive and significant effect of access to electricity on the usage of ICT tools.

The accessibility of digital technologies has a negative effect on the usage of mobile phone, social media, and internet search engines. As accessibility to these tools increase, the likelihood to use them decreases by 1.037, 1.007, and 0.776 percentage points, respectively. The reason for negative relationship could be other barrier such as literacy, high data costs, or technical difficulties that prevent the farmers from fully adopting these digital marketing technologies. Relevance of the digital marketing tools had a negative effect on social media and internet search engines usage. The negative relationship could be due to limited infrastructure. There may be slow connectivity, expensive to use them as they require data bundles. Farmers may feel using the tools for marketing is not worth the cost.

The affordability of the digital marketing technologies was significant and had a positive effect on mobile phone, social media, and the internet search engines. The results mean that as these digital marketing tools become more affordable, smallholder farmers are likely to use these tools by 1.204, 1.319, and 1.055 percentage points, respectively. The affordability of these digital marketing tools increases their usage since the financial burden of accessing and using them is lowered, making it feasible for smallholder farmers to engage in digital marketing activities.

5. Conclusions and Recommendations

The purpose of this paper was to investigate the factors that influence the use of digital technologies in the marketing of green leafy vegetables among smallholder farmers in Lari sub-county. In achieving the objective, the multivariate probit regression model was used. The multivariate probit results showed that education level, access to extension services, electricity installation, credit access and affordability positively influenced the use of mobile phone, social media, and internet search engines in marketing of green leafy vegetables. However, age and accessibility of the digital marketing tools had a negative influence on the use of the Internet in the marketing of green leafy vegetables. The study concludes that the use of digital technologies can either be negatively or positively influenced by various factors. Therefore, the study recommends that the government, with the assistance of extension authorities, start more informational programs to encourage smallholder farmers to adopt digital technologies for agricultural marketing and accessing information. Factors like age should be considered when the new technology is introduced.

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