Fostering Agricultural Informatization - Analysis of Service Quality of Mobile Network Operators in Rural Communities of Kabwe District, Zambia

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Abstract

The growing use of mobile phone technology in developing countries contributes significantly to economic growth. In agriculture, mobile phones can improve farmers' access to information, modern markets, and high-value crops. They also play a role in farmers' marketing decision and agricultural production patterns, which may affect household income, gender equality and nutrition, and further accelerate rural development and increase food security. However, seizing the opportunities provided by mobile phones depends on connectivity, content, and capacity. Particularly, increased connectivity of farmers on account of service quality of mobile network operators is vital, which unfortunately has not been well addressed in current literature. We thus narrow this research gap using cross-sectional data, obtained by administering a structured and pretested questionnaire to 300 randomly selected smallholder farmers (who are ex-miners) in Kabwe. While agriculture is predominant among most ex-miners as it is an important source of livelihood, use of mobile phones for collecting agricultural information is still below the expected levels. Therefore, the aim of the study is to analyse the service quality that farmers receive from mobile network operators and also to evaluate the determinants of perceived service quality. The result of the paired t-test indicates that the service quality of mobile network operators in rural agricultural communities is significantly less than satisfactory (t- statistic = 6.853 and Pr(|T| > |t|) = 0.000). Further examination using the ordered probit regression reveals that farmers' subscription to multiple mobile network operators, years of subscription, unresolved problem experiences and attainment of basic education significantly influence service quality (Mean VIF = 1.305). Given these findings, the research provides empirical evidence on how to aid farmers to effectively scale up the use of mobile phones for agricultural information access, which eventually leads to auspicious agricultural outcomes. Therefore, in the interest of recuperating dynamism of the agriculture sector, we strongly recommend fostering agricultural informatization through improvements in the service quality of mobile network operators. Also, in favour of sustainable mining, mining companies should partner with mobile network operators and come up with mobile based application that help ex-miners (farmers) in meeting their agricultural information needs.

Keywords

service quality; sustainable mining; rural agricultural communities; mobile network operators

INTRODUCTION

Since 2000, the spread of mobile phone technologies in developing countries has been rapid. Among the 4 billion people using the mobile phone globally, Sub-Sahara Africa (SSA) is the highest regarding penetration with 90 percent adoption rates (Poushter & Oates, 2015). The user-friendliness of mobile telephone in financial transactions, access to information, news, and entertainment, and communication through text and calls with friends and business partners are the reasons behind its success (Pedersen et al, 2002; Poushter & Oates, 2015). It is anticipated that the mobile phone will not only reduce the information asymmetry existing between rural and urban areas but also bridge the information gap between large and smallholder farmers (Aker & Mbiti, 2010). Mobile phones alone cannot perform this function, but they are more suitable to provide

customized and timely content if the appropriate models are established.

With the introduction of mobile phone use in agriculture, the need for information has expeditiously grown. Given the present situation of an ever-growing population (Fess et al, 2011; Savenije, 1998) and rising food prices (Von Braun, 2008), the major dilemma is to strike a balance between policies to improve farmers' income levels and food security. To address this, the use of mobile telephony technologies have significantly improved people's access to information (Aker, 2011; Nakasone et al, 2014), functioning of markets via reducing other types of transaction costs (Aker, 2010; Blauw & Franses, 2016; Duncombe & Boateng, 2009), farmers marketing decision (Tadesse & Bahiigwa, 2015), input and output prices (Jensen, 2007), agricultural production patterns (Lio & Liu, 2006; Nakasone & Torero, 2016), household income (Kikulwe et al, 2014; Sekabira & Qaim, 2017b), gender equality and nutrition (Sekabira & Qaim, 2017a), greater market participation (Donner, 2006) and diversification to high-value crops (Aker & Ksoll, 2016). Eventually, it is predictable that the use of mobile phones will impact the behavioural pattern of farmers facilitating the adoption of improved practices leading to higher yields (Mittal & Tripathi, 2009).

At present farmers' experience, traditional knowledge and their guesswork in the farming decision are no longer effective in changing circumstances (Tripathi, 2010). Also, the existence of imperfect market information, costly face-to-face information delivery, and weak extension services have made disseminating of agricultural information challenging (Belay & Abebaw, 2004). Progressively, mobile phones have guaranteed farmers link to information in an accurate and timely manner. Fascinatingly, the influence of mobile phones as a means of providing useful information to farmers depends on the service quality of the MNO which assures connectivity. The terms mobile network operators and carrier service providers are used interchangeably in this study to refer to a telecommunications organization providing wireless voice and data communication to its subscribers.

While the MNOs are ranked highly in terms of service quality in Africa (LaFraniere, 2005), why is it that there are still complaints among subscribers especially farmers in Zambia which have sometimes culminated in the service providers running afoul of Zambia Information and Communications Technology Authority (ZICTA) and being dragged to court (Lusakatimes, 2013; ZICTA, 2018)? The fact is that the current service quality of MNOs leaves much to be desired despite operations being carried out by two of African's top-ranked MNOs (Airtel and MTN) and one government-owned (Zamtel) (Frederick, 2014). In Zambia, these carrier service providers are supervised by ZICTA to ensure subscribers are provided with quality services as authorized under section 67(1) of the country's ICT Act. Surprisingly, charges have been recurrent for four consecutive years since 2014, ending up in fines against the three MNOs and their penalization for failing to adhere to the quality of service parameters. Nevertheless, there is an excellent potential for improvement considering the disclosure by Caruana (2002) and Cronin Jr & Taylor (1992) that a customer-oriented MNO is not enforced to adhere to the quality of service (QoS) guidelines but somewhat willingly and freely does so to achieve ultimate customer satisfaction. The question most policy-makers, practitioners, and researchers are asking is what the current customer satisfaction situation in rural agricultural communities is, given farmers' pressing need to access information using mobile phones.

Myriad studies have conceptually discussed the state of service quality of mobile operators in general (Angelova & Zekiri, 2011; Grönroos, 1984; Khan, 2010; Santouridis & Trivellas, 2010; Van der Wal et al, 2002) but empirical evidence on agricultural communities is scarce. With this background, the objective of the study is to provide evidence of the service quality being offered to rural agricultural communities by MNOs in Zambia which would imply that if decent service quality were in place, customers would be satisfied and there would be no need for any litigation. It is unfair for farmers to subscribe to MNOs in order to communicate and access information yet receive inconsistent and poor services with dropout in service. Also, communication using such MNOs becomes unreliable and very costly to any economy as it indirectly affects production in agricultural communities. This study, therefore, contributes to the literature on the improvement of service quality delivery of MNOs in rural agricultural communities as this has great potential to recuperate the dynamism of the agricultural sector.

CONCEPTUAL FRAMEWORK

Service quality is an indicative measure of the match between the service level delivered and expectations of the customer. It is one of the competitive advantages of any business and the secret for gaining a significant market share. Customer satisfaction, on the other hand, is a feeling of disappointment or pleasure as a result of comparing a service's experience with the expectation (Kotler & Keller, 2006). Regarding their relationship, service quality would be antecedent to customer satisfaction where the latter came as a result of former (Anderson et al, 1994; Fornell et al, 1996). More to that, satisfaction and service quality have certain things in common, but service quality is a component of customer satisfaction (Wilson et al, 2012; Zeithaml et al, 2010).

One of the things farmers look for in an offer is service quality (Solomon et al, 2014). Therefore, Figure 1 presents the framework of the study. Service quality is a focused assessment of farmers' expected and perceived service regarding reliability, responsiveness, empathy, assurance, and tangibility (Parasuraman et al, 1985). Service quality view is most

likely influenced by socioeconomics (age, education and gender) and institutional factors (MNO subscribed to, and length of subscription).

The desired situation is where the perceived is higher than the expected service quality. The dashed line in Figure 1 represents the resulting win-win situation where farmers become satisfied, and the MNOs gain more subscribers when the desired service situation is achieved. In both cases, this contributes to economic growth through the higher gross domestic product (GDP) facilitated by increased agricultural production and profits from MNOs. Also, rural development is achieved as investmentsin mobile technologies which further reduce the digital divide is made.
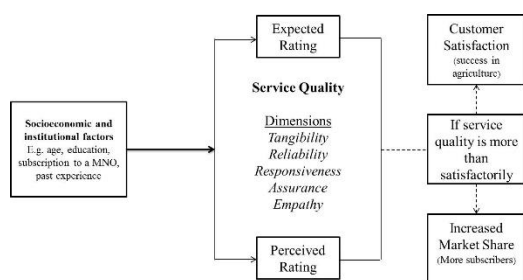

Figure 1: Conceptual Framework

MATERIAL AND METHOD
Data

We use data extracted from a household survey conducted in 2016 in central Zambia where farmers (who are ex-miners) significantly contribute to the national basket. The survey was a baseline study for a project intended to empower smallholder farmers through the introduction of mobile phone-based technologies in agriculture. The areas are covered by at least one mobile phone network or all the three which also offer mobile money services, weather forecasts updates, job alerts, and internet services. Farmers in these rural communities (Mpima, Kamakuti, Kalonga, Prospect, and Lukanga) grow maize as their primary crop, in addition to beans, groundnuts, millet, cassava, cotton, sorghum, sweet potato, and tobacco. Dairy and fish farming are also prevalent. We used a two-stage sampling procedure to select households for the study. In the first stage, five agricultural communities were selected from rural areas in and around Kabwe district. Then, randomly selecting farmers in each of these communities was performed in stage two using farmers' list from the Ministry of Agriculture. 100 households (a total of 300) from each network (MTN, Airtel and ZAMTEL) were sampled.

Using a pre-tested and structured questionnaire, household heads were interviewed by well-trained and experienced enumerators. The questionnaire focused on service quality rating of both expected and perceived service quality variables, MNO subscribed to, problems experienced with primary mobile operator subscribed to and other socio-demographic

details. The rating on different service quality dimensions was explicitly asked in order to understand the service quality of MNOs in these communities profoundly. We tried to minimize measurement error by carefully constructing the questionnaire using common layouts for customer surveys (Asubonteng et al, 1996; Cronin Jr & Taylor, 1992), comprehensively training the team of enumerators and pre-testing the instrument in the local setting. Most of the interrogations related to service quality were on a five-point scale (Very good, good, fair, poor, very poor), which were easy to answer for farmers. We do not anticipate methodical discrepancies in the precision of the answers among respondents from different carrier service providers, so that measurement error should not culminate in bias in the estimation.

Measurement of key variables

The primary explanatory variable is a subscription to a mobile operator. Usually, farmers subscribe to more than one MNO and so while we account for the number of operators subscribed to, we also consider their primary MNO by giving farmers a choice to choose their most preferred operator.

Service quality is the outcome of interest, and various dimensions of service quality variables are adopted from the classical study done by Parasuraman et al (1985) which provided the criteria for service quality measurement. As already highlighted a five-point scale of the service quality rating for before and after service experience is used. The service quality dimensions presented in Table 1 are not mutually exclusive, yet make available a central framework for comprehending the expectations of subscribers, and matters that delineate the service from the perspective of evaluators.

Table 1. Variables used in service quality assessment

Dimensions of service quality	Description	Representative variables	Expected Mean	Perceived Mean
Tangibility	Physical aspects of what is provided to subscribers.	SIM registration process	4.09 (0.92)	3.2 (1.41)
Reliability	Ability to fulfill what was promised accurately.	Service dropout	3.66 (1.33)	2.92 (1.18)
		Congestion	3.46 (1.28)	2.88 (1.34)
		Speech quality	4.13 (1.28)	3.95 (1.33)
		SMS success rate	3.89 (1.21)	3.87 (1.17)
		Internet quality	4.13 (1.15)	3.0 (1.56)

Responsiveness	Adapting to the needs of customers by the prompt provision of flexible services	Call Centre access	3.8 (1.22)	2.35 (1.58)
Assurance	Involves secure operations coupled with competent workforce. Courtesy is also extended to the customers.	Fault repair time	3.81 (1.22)	2.52 (1.37)
Empathy	Individualized attention to the users.	Complaint resolution time	3.96 (1.20)	2.54 (1.57)

Notes: Figures in parentheses are standard deviations of the mean.

Estimation procedure and analytical framework

The SERVQUAL model proposed by Parasuraman et al (1985) is used to determine the level of service quality owing to the fact that it is one of the best approaches to measure the quality of services delivered to customers (Parasuraman et al, 1988). Brown et al (1993) add that this method has proven to be reliable and consistent. The presentation of the model clearly stating "expected" and "perceived" service implies that such kind of evaluation is drawn from the customer perspective. Therefore, we employ a three-step approach to meet the study's objective.

First, we use the one sample t-test to establish whether the perceived service is fair in quality. Informed by the scale (1 = very poor, 2 = poor, 3 = fair, 4 = good and 5 = very good), we use 3 as the hypothesized mean to verify whether the rating on each respective service quality dimension has a fair service delivery. Second, regardless of the one sample t-test result, we use the paired t-test to compare the dimensions of service quality before and after service to ascertain the level of service quality provided to farmers. The difference between customers' expectation and the perception of actual service experienced describes the satisfaction of customers and service quality of the MNOs. Service quality is high or more than satisfactory if the experience is rated higher than expected and low or

less than satisfactory if otherwise (Jain & Gupta, 2004).

Finally, the ordered Probit model is employed to determine the factors that influence service quality rating an ordinal dependent variable with a five-point rank from poor to very good. The functional form is specified as follows;

$$Y^* = X_i\beta + u_i, \tag{1}$$

$$Y = j \ if \ \alpha_{j-1} < Y_i^* \le \alpha_j, \tag{2}$$

Where Y^* is the latent unobservable continuous variable which will be formed into five groups (denoted by j) and four thresholds (denoted by α) which are cut off points between the 5 categories, X_i is a vector of factors that determine service quality rating for each ith respondent, β is the parameter to be estimated and u_i are random errors.

RESULTS AND DISCUSSION

Descriptive statistics

We first present unconditional statistics in Table 2. Female and male representation is almost 50% although the latter is more. Female participation in mobile phone related studies is very vital because Andone et al (2016) conclude that they spend more time on the phone than males. Education of farmers is relatively high which is consistent with the basic requirement in that education is a strong determinant of mobile phone ownership (Tadesse & Bahiigwa, 2015). For this study, good education levels also mean that farmers are most likely able to rate the service quality delivery not so different from subscribers in urban areas.

Contrary to our expectations, most farmers have not heard about the QoS guidelines for MNOs. This creates a problem as it suggests that consumer protection priority is missing and service quality expectations of farmers are not harmonized. Expressed differently, there is possibly a lack of customer education on aspects of service quality in agricultural communities. More revelations of other descriptive statistics indicate that most farmers are less than 30 years which is consistent with the finding of Tadesse & Bahiigwa (2015) that younger people own and use the phone more than the older ones. Also, almost 50% are subscribed to more than one network which is a sign of customer disloyalty but needs further investigation as almost 60% have experienced unresolved problems in the past. Additional statistics indicate that farmers have been loyal to one primary MNO for about five years and this displays the trust of farmers in the MNO. Finally, the difference between the expected and perceived service quality rating is so high that, without a thorough evaluation procedure, an attempt to surmise that service quality is less than satisfactory would not be dismissed.

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Table 2. Descriptive statistics of variables

Variable	Descriptive statistics	MNO subscribed to			Combined
		MNO$_u$	MNO$_g$	MNO$_e$	
Gender	Percentage of females	60 (0.49)	40 (0.49)	48 (0.50)	49.33 (0.50)
Education	Percentage with basic education	90 (0.30)	100 (0)	100 (0)	96.67 (0.18)
Subscription	Percentage subscribed to one mobile operator	40 (0.49)	52 (0.50)	50 (0.51)	47.33 (0.50)
Age	Percentage below 30 years	70 (0.46)	52 (0.50)	28 (0.45)	50 (0.50)
QoS	Percentage who have heard about the quality of service guidelines	10 (0.30)	0 (0)	28 (0.45)	12.67 (0.33)
Problems	Percentage who experienced unresolved problem	50 (0.51)	80 (0.40)	46 (0.50)	58.67 (0.49)
Length of subscription in years	Mean (Std.Dev.)	5 (2.07)	5.7 (3.41)	6.5 (2.72)	5.73 (2.83)
Expected service quality rating	Mean (Std.Dev.)	3.7 (1.20)	4.0 (1.01)	4.8 (0.43)	4.17 (1.03)
Actual service quality rating	Mean (Std.Dev.)	3.0 (1.20)	3.6 (1.34)	2.7 (1.56)	3.09 (1.41)

Notes: For the sake of the greater good, ethics, and confidentiality, MNOs are not identified by their real names instead MNO$_u$, MNO$_g$ and MNO$_e$ are used in the presentation of all the results. Figures in parentheses are standard deviations of the mean.

Is the service quality provided to farmers fair?

It is gratifying for farmers to subscribe to a MNO and get a service they perceive as fair or better still excellent. To effectively probe the scenario in agricultural communities, we employ a scale where a rating of 3 and above denotes fair service delivery while below 3 indicates poor delivery. Therefore, 3 is the reference in the comparisons. Table 3 reveals that SIM registration, speech quality during calls, SMS success rate and internet quality is delivered in a way that farmers would describe as fair, with the delivery of the first three listed services significantly above fair (good). For call Centre access, fault repair time and complaint resolution time which strongly depict customer care orientation of MNOs, their ratings are significantly below fair. This calls the customer care of MNOs to question on the grounds that farmers will have MNO-related problems and not access the call Centre which in turn will affect the fault repair time and complaint resolution time. This discourse is consistent with the evidence in Table 2 where a majority of farmers have unresolved problems. Considering the distance from these agricultural communities to the town center where physical contact with the MNO can be made, such a situation embitters the farmers and has severe prospects in affecting mobile phone use.

For customer-oriented firms, customer care takes the service procedure a step further, treating the customer as a unique individual making up the core of a business (Wilson et al, 2012). Therefore, if MNOs are serious about caring for its customers, rather than merely serving them, their entire operations must be geared to making life more convenient and more comfortable for the farmers. How does the customer use a fair service like speech quality during voice calls when service dropout is persistent? Therefore, in spite of a few well-delivered services by MNOs, we cautiously conclude that overall service quality provided to farmers is below what would be deemed as fair.

Table 3. One sample t-test on the dimension of service quality

Service quality variable	MNO subscribed to			Combined
	MNO$_u$	MNO$_g$	MNO$_e$	
SIM registration	2.9 (0.207)	3.2 (0.211)	3.5 (0.174)***	3.2 (0.115)**
Service dropout	3.3 (0.112)***	2.4 (0.161)***	3.1 (0.190)	2.9 (0.096)
Congestion	3.3 (0.143)**	2.2 (0.186)**	3.1 (0.201)	2.9 (0.109)
Speech quality	4.4 (0.145)***	3.7 (0.201)***	3.8 (0.201)***	4.0 (.108)***
SMS success rate	4.1 (0.149)***	3.9 (0.182)***	3.6 (0.161)***	3.9 (.100)***
Internet quality	3.1 (0.196)	3.1 (0.216)	2.9 (0.251)	3.0 (0.127)
Call center access	2.4 (0.213)***	2.9 (0.213)	1.7 (0.213)**	2.4 (0.129)**
Fault repair time	2.5 (0.160)***	3.0 (0.193)	2.1 (0.202)	2.5 (0.111)**
Complaint resolution time	2.2 (0.200)***	2.9 (0.201)	2.5 (0.254)**	2.5 (0.129)**

Notes: Figures in parentheses are standard errors of the mean, while *, **, and *** indicate statistical

significance levels at 10%, 5%, and 1%, respectively.

Is the service quality provided to farmers more than satisfactory?

Customers are essential stakeholders in any business enterprise, and their satisfaction is a priority as it involves meeting their needs profitably. Given the benefits derived from increased mobile phone use in agriculture, service quality of MNOs is pivotal. Table 4 indicates that except for SMS success rate and speech quality during voice calls, all other services are significantly less than satisfactorily. Further investigation of service quality in respective MNOs shows very slight change from the overall finding. For example, farmers who subscribe to MNO$_e$ experience service quality significantly less than satisfactory in all the dimensions. This, without a doubt, is customer dissatisfaction as defined by Parasuraman et al (1988). Such a condition is likely to cause many farmers to quit using mobile phones as they gradually get exasperated. It is obnoxious that farmers make efforts to subscribe and only get SMS and speech quality more than satisfactory yet congestion in the network is prevalent. Also in general, farmers expect an average service quality of 4.17 yet after experience perceive the service to be 3.09 (Table 1). This difference is significant at 1% significance level as the t-statistic = 6.8533 and the P-value is 0.000. Clearly, the service is less than satisfactory, thus , improved service quality is an urgently prerequisite to pacify subscribers.

Table 4. Service quality assessment

Service quality variable	Difference between expected and perceived service			
	MNO$_u$	MNO$_g$	MNO$_e$	Combined
SIM registration	-0.9 (0.281)***	-0.9 (0.249)**	-1.2 (0.196)***	-0.9 (0.142)***
Service dropout	-0.3 (0.157)**	-0.9 (0.267)***	-1.0 (0.297)***	-0.7 (0.145)***
Congestion	0.2 (0.270)	-0.7 (0.279)**	-1.3 (0.248)***	-0.6 (0.160)***
Speech quality	0.9 (0.296)***	0.2 (0.202)	-1.2 (0.201)***	0.2 (0.153)
SMS success rate	0.9 (0.225)***	0 (0.173)	-1.0 (0.164)***	0 (0.126)
Internet quality	-0.4 (0.301)	-0.8 (0.284)***	-2.1 (0.251)***	-1.1 (0.171)***
Call center access	-1.0 (0.344)***	-0.6 (0.300)*	-2.8 (0.214)***	-1.4 (0.184)***
Fault repair time	-0.6 (0.294)**	-0.7 (0.238)***	-2.6 (0.206)***	-1.3 (0.161)***
Complaint resolution time	-1.3 (0.338)***	-0.8 (0.255)***	-2.1 (0.313)***	-1.4 (0.179)***

Notes: Negative signs signpost perceived service less than expected service. Figures in parentheses are standard errors of the means, while *, **, and *** indicate statistical significance levels at 10%, 5%, and 1%, respectively.

What are the determinants of service quality rating?

Service quality rating is made before and after customers experience services provided to them by MNO. The rating is critical as it depicts the service experience of the customers. Farmers will rate the same services differently due to various factors. Table 5 presents the determinants of service quality rating and the estimation is free from multi-collinearility because the mean VIF is less (see Appendix A: Table A1). Education, the number of years of subscription to the primary MNO, farmers' resolution to subscribe to one or more MNOs, the main MNO subscribed to, and the experience of unresolved problems in the past significantly determine overall service quality. Regarding specific service quality dimension (empathy, responsiveness, and assurance) the same determinants are in effect with the addition of expected service rating and having read the quality of service guidelines. As farmers subscribe to more than one MNO, they are able to compare and rate which MNO is doing better. This enables them to accurately evaluate whether the service they receive is good or not. Also, because the use of mobile phone demands some level of education, service quality rating is easy for farmers as they can judge the service delivery in the light on their needs and what was promised.

There are differences in service quality between the MNOs. Thus, farmers subscribed to a particular MNO will rate the service different from those in another MNO. Consistent with common sense, farmers who experience unresolved problems with their MNO will rate the services different from those who have not. Likewise, those with higher expectation and have read the QoS guidelines will have a different perception of the quality of service offered. Different from our expectations, age and gender do not impact the service quality rating. Such findings are essential for MNOs, mainly so that they can segment their market in agricultural communities and most essentially understand what influence customers' experience rating regarding their service delivery.

Table 5. Determinants of perceived service quality

Variables	Overall Service Quality	Other Service Quality Dimensions		
		Complaint Resolution Time (Empathy)	Call Centre Access (Responsiveness)	Fault Repair Time (Assurance)
Education	0.900 (0.560)*	2.755 (0.412)***	-7.849 (0.405)***	-1.950 (0.350)***
Age	0.311(0.212)	-0.263 (0.214)	-0.177 (0.216)	-0.220 (0.243)
Length of subscription	0.084(0.037)**	0.160 (0.040)***	0.041 (0.035)	0.130 (0.036)***
Subscription	0.528(0.212)**	0.734 (0.230)***	0.135 (0.227)	0.781 (0.214)***
Expected service quality rating	0.136(0.115)	-0.241 (0.109)**	-0.276 (0.088)***	-0.256 (0.099)**
Gender	0.105(0.214)	0.323 (0.215)	-0.242 (0.220)	-0.201 (0.206)
MNO subscribed to	-1.342(0.270)***	0.552 (0.128)***	0.589 (0.153)***	0.555 (0.132)***
QoS	0.050(0.318)	0.980 (0.288)***	0.855 (0.306)***	0.712 (0.299)**
Problem	1.605(0.259)***	-1.127 (0.249)***	-0.943 (0.276)***	-1.325 (0.210)***
Cut1_constant	0.614(0.665)	3.691 (0.761)	-8.245 (0.584)	-2.341 (0.534)
Cut2_constant	1.393(0.676)	3.961 (0.767)	-7.897 (0.585)	-1.717 (0.518)
Cut3_constant	2.240(0.682)	4.550 (0.763)	-7.391 (0.591)	-0.733 (0.529)
Cut4_constant	2.664(0.683)	5.255 (0.749)	-6.967 (0.581)	-0.313 (0.539)

Notes: Cut 1 to 4 constants are the thresholds described in the empirical strategy section. Figures in parentheses are standard errors of the odds ratio, while *, **, and *** indicate statistical significance levels at 10%, 5%, and 1%, respectively. Source: Authors' estimation.

Implication for rural and agricultural development

There is a need for agricultural stakeholders to carefully select the MNO to be used when transmitting information and also what MNO's service to incorporate in mobile-based applications if mobile phone use in agriculture is to be successful. Selection of services that are delivered poorly or MNO with less than satisfactory services will prevent any good innovation from achieving its intended purpose. Regarding policy intervention, urgent action facilitating MNO's improvement of service quality, especially in rural areas is obligatory. Unlike subscribers in urban areas, farmers may not have reliable platforms to register their displeasure in the services they are provided with. Therefore, policy

measures are a necessity for rural agricultural communities. More than that, MNO need to improve their service quality delivery proactively. The number of years farmers have consistently subscribed to MNO signposts the level of patience they have and most importantly their trust in the MNOs. Excellent service quality delivery in agricultural communities has great potential to increase the number of subscribers considering most farmers have remained active subscribers to their MNO despite expectations not being met. The consequence of such a realistic act by MNOs is a win-win state of affairs for them and agricultural communities.

CONCLUSION AND RECOMMENDATIONS

Farmers just like any customer are looking for quality services in every offer at all times. For that reason, the study focuses on measuring service quality of MNOs as a better way to gauge whether the services provided to the farmer are satisfactory enough to scale up mobile phone use in agriculture. As a platform for receiving voice-message information and text messages (SMS), mobile phones facilitate connection to new information sources and highly customized knowledge with the opportunity of real-time access. The effect is agricultural development, in general, as a reduction in knowledge gap between small and large farmers is achieved.

Our results indicate that service quality of MNOs in rural agricultural communities is significantly less than satisfactory, although individual cases of MNOs and service quality variables show slight variations. Among the determinants of service quality, education, length in years of subscription to the primary MNO, farmers' subscription decision to one or more MNOs, the main MNO subscribed to, and the history of having unresolved problems are the most significant. Also, many farmers are not informed about the QoS guidelines, and this suggests that the national watchdog (ZICTA) and MNOs have not been successful at customer education programs.

Finally, this study contributes to improving understanding of the present state of the service quality levels provided in agricultural communities. Therefore, we recommend rethinking the service delivery mechanism in an attempt to enhance service quality of MNOs. In fact this seems to be constraining farmers from leveraging the full benefits of the information channelled through the mobile phones and mobile-based technologies. Eventually, as mobile penetration continues to proliferate among agricultural communities due to service quality of MNOs, scope exists for superior rural productivity. Over time, solutions to the issues regarding mobile phone effective usability and sustainability will be discovered as more exploration is done in this area.

Appendix A

Table A1: Variance inflation factor

Variables	VIF	1/VIF
Problem	1.492	0.67
Education	1.419	0.705
MNO subscribed to	1.364	0.733
Gender	1.364	0.733
Expected service quality rating	1.325	0.755
subscription	1.242	0.805
Length of subscription	1.22	0.819
Age	1.205	0.83
QoS	1.117	0.895
Mean VIF	1.305	

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