Determinants of the Use of Cell phones in Access to Beef Cattle Market Information for Smallholders in Mpwapwa District, Tanzania

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Abstract: *Cell phone is said to be an innovative communication device which allows consumers, traders and farmers to search market appropriate information for timely decision-making to save time and travelling costs. However, determinants of using this technology in beef cattle market information seeking for smallholders in Tanzania - particularly in Mpwapwa District, are not well established. Thus, this study analysed the determinants of the use of cellphones in accessing beef cattle market information in Mpwapwa District. Data were collected from 120 respondents using a structured questionnaire and focus group discussion guide. The questionnaire-based data were analysed using the Statistical Package for Social Sciences in which the main analytical model was binary logistic regression. In the model, the dependent variable was access to beef cattle market information via cell phones with two options; did not access (0) and accessed (1). Research findings revealed that the nature of using cell phones in access to beef cattle market information was mostly determined by distance from home to the nearest cattle market; the variety of information demands; income earned per year; level of local network coverage and access to mobile financial services (M-Pesa). On the basis of these findings it is concluded that the smallholder beef cattle producers can use cell phone technology in market information sharing to enhance their marketing participation. Therefore, the study recommends that cell phones service providers should extend their services more in the rural areas of Mpwapwa District.*

Key words: Determinants, cellphones, market information, smallholders

INTRODUCTION

Information needs is growing rapidly due to up-and-coming of modern Information and Communication Technologies (ICTs). According to Mittal and Mehar (2012) access to insufficient agricultural market information has paved a way towards the use of modern ICTs including cell phones to share crop and livestock market information for involved stakeholders. Literature has shown that the rapid expansion of cell phones ownership has increased participation of smallholders' access to market information for their produce (Marini and Wiedemann, 2006). Similarly, a study by Muto and Yamano (2009) found that the growth of cell phones local coverage in Uganda has increased concomitantly with an increase in sales of banana outside the producers' district centres. Henceforth, with appropriate communication technology smallholder beef cattle producers would have been informed about the prevailing cattle market prices and demands for reduced market search costs, increased bargaining power and beef marketing participation.

A study by Aker (2008) has shown that although traditional agricultural market information systems provide information to farmers, buyers and consumers via radios and message boards, market actors have not been active participants in sharing the information gathered

to enhance timely decision-making. Mnenwa and Maliti (2009) explain the absence of an information system in Tanzania as a cause of high level of information asymmetries, causing inefficiencies in the marketing system in terms of pricing and condition set for increased efficiency in marketing.

Likewise, Shepherd *et al.* (1997) explained market information dissemination as a regular public dissemination of prevailing market prices, commodity volumes, market conditions and available price trends. A study by Kristjanson *et al.* (2004) which put an emphasis on improved cattle husbandry for enhancement of cattle performance, also suggests more research on determinants of smallholder livestock keepers' access to appropriate information regarding marketing of cattle. According to Aker (2008), cell phone is an innovative communication device which allows consumers, traders and farmers to search market information appropriate for timely decision-making to save time and travelling costs. However, the determinants of using this technology in beef cattle market information sharing among smallholders in Tanzania particularly in Mpwapwa district are not well established. Thus, this study analysed the determinants of the use of cell phones in access to beef cattle market information for smallholder beef cattle producers in Mpwapwa district.

METHODOLOGY

Description of the Study Area

The study was conducted in Mpwapwa district located in Dodoma region, Tanzania. The district was selected for the research because it is connected to four mobile telephone service providers and it is one of the catchment areas for beef cattle marketing in the country. According to URT (2013) the traditional beef cattle population in the district is 262,076.

Research Design and Methods of Data Collection

A cross-sectional research design was used to collect data once from individual beef cattle smallholders, an individual being the sampling unit. The study collected both primary and secondary data and used both quantitative and qualitative data collection methods. The sampling frame consisted of all beef cattle smallholders in Rudi and Mpwapwa divisions, in four wards namely Rudi, Chipogoro, Gulwe and Godegode where by four villages distinctively Chilendu, Gulwe Chipogoro and Godegode were surveyed. The surveyed villages were selected purposively based on the availability of cattle population and cell phones local network coverage. In addition, the study used systematic sampling to select 30 respondents from each village to get a sample of 120 respondents. Information regarding the number of existing beef cattle farmers in the surveyed villages was obtained from the district, ward and village levels. Criteria for using systematic sampling to select 30 respondents from each village included ownership and marketing of cattle seasonally or annually. Hence systematic sampling was used to ensure that all members of population had equal chances of being selected. Quantitative data were mainly collected using a structured questionnaire. Qualitative data were collected from focus group discussions. A focus group discussion guide was used in discussion to gather information from 32 beef cattle smallholders who participated in four group discussions (eight participants in each of the four villages). The number of eight participants per session is the one recommended by Barbour (2011). Likewise, secondary data about primary and secondary cattle markets were obtained from the village and livestock district offices as well as the Ministry of Livestock and Fisheries Development reports.

Data Analysis

The questionnaire-based data were analysed using the Statistical Package for Social Sciences (SPSS) whereby descriptive statistics including means, percentages, frequencies and multiple responses were computed. In addition, binary logistic regression model was employed to analyze the odds of some covariates indicating determinants of the use of cell phones influencing chances of market information access among beef cattle smallholders. The theoretical basis of the model was to determine the likelihood of using cellphones and its influence towards access to rapid cattle market information. This hypothesis was tested using a binary logistic regression model since such a model is ideal for variables in which the dependent one is dichotomous. The dependent variable was a dummy of the determinants of using cell phones in access to beef cattle market information, whereby access to beef cattle market information was 0 if an individual beef cattle smallholder did not have access to any cattle market information via cell phones in the previous 12 months. Conversely, access to market information was 1 if an individual smallholder had access to any type of cattle market information via cell phone in the previous 12 months. This dependent variable was regressed on the above seven covariates to determine the influence of each of them on the dependent variable.

The formula for binary logistic regression that was used is:

$\text{Log}[Pi/1-Pi] = \beta o + \beta_1 X_1 + \beta_2 X_{2 + \ldots +} \beta_n X_n$ (Agresti, 2002; Powers and Xie, 2000).....(1), where:

Log [Pi/1-Pi] = Natural logarithm of the odds of some covariates indicating determinants of the use of cell phones in access to market information.

Y = 0 if a beef cattle smallholder didn't access market information via cell phone in the previous 12 months.

Y = 1 if a beef cattle smallholder accessed market information via cell phone in the previous 12 months

β_0 = Constant of the equation

β_1 to β_n = Logistic regression coefficients of the covariates
n = Number of covariates
X_1 to X_n = Covariates entered in the model
X_1 = Number of cattle owned
X_2 = Age of respondent
X_3 = Estimated income earned per year
X_4 = Approximate distance from home to the nearest cattle market place
X_5 = Ownership of a cell phone
X_6 = Access to market information about cattle sales volumes
X_7 = Access to information about beef cattle grades applicable

Likewise, inferential analysis was done by using Chi-square test at $p \leq 0.05$ concomitantly with cross tabulations to test the associations between some categorical independent variables and factors determined access to cattle market information via cell phones. The Chi-square model used is:

$$X^2 = \sum \frac{(o - e)^2}{e} \quad \text{.....(2)}$$

Where:
χ^2 = the value of Chi-Square statistics
o = Observed frequencies in the contingency table
e = expected frequencies in the contingency table

Qualitative Data Analysis
The qualitative data obtained were analysed thematically to highlight diversity among the individual experiences and results were reported concurrently with quantitative and secondary data.

RESULTS AND DISCUSSIONS

The Nature of Using Cell phones in Access to Market Information

The Chi-square test showed that there was a significant association between access to beef cattle market information and the use of cell phones ($\chi^2 = 10.085$; $p \leq 0.001$) indicating that rapid access to beef cattle market information is determined by the use of cell phones. Furthermore, findings in Table 1 emphasise that more than seven-eighths (90 percent) who usually sell their cattle at home places were using cell phones in access to cattle market information. Likewise the Chi-square test indicated that there was a significant association between access to market information via cell phones and selling of beef cattle at home places ($\chi^2 = 10.085$; $p \leq 0.001$). This implies that the use of cell phones enabled smallholders to share instant cattle market information about prices, volumes, and beef cattle grades applicable in the various market places hence increased bargaining power and reduced price-cheating customs when selling cattle at home places.

Similar observations were reported by Sife *et al.* (2010) as well as Nyamba and Mlozi (2012) who indicated that cell phones had enhanced the ability of smallholder's access to market information for better price thus reduced chance of being cheated by brokers. Additionally the Chi-square test confirmed the significant association between the use of cell phones in access to beef cattle market information and access to M-Pesa services (χ^2 8.386; $p \leq 0.004$). This indicates that access to market information via cell phones is associated by the use of mobile banking, which enables smallholder beef cattle producers to overcome problem of cash theft after cattle sales and encourage savings among cattle producers in the rural areas. Of 27 percent respondents who responded to multiple responses enquiry more than one-fifth

(22.5 percent) indicated the use of cell phones had increased their abilities in sending and receiving cash for various financial transactions including school fees for their children. The findings imply that the use of cell phones, which facilitates mobile banking services, could reduce risk of travelling with bulk cash in rural areas where bank facilities are not available.

The Use of Cell phones in Access to Market Information and Network Coverage

The findings in Table 1 show that 45 percent of the interviewed respondents had access to moderate network connection whereas 39.2 percent had access to high network connection. The study revealed that there were telecommunication towers in Rudi and Chipogoro villages where most of the respondents indicated high network connections in contrast to Gulwe and Godegode villages where there were no telecommunication towers but residents were able to access network connection through the nearby village's telecommunication towers mainly Msagali and Mpwapwa headquarters thus moderate network connection.

However, the network connection was considered favourable because 97 percent of cell phone users were able to communicate via cell phones throughout day and night by using both short message service (SMS) and voice calling modes, the most reliable network being Airtel 54.2 percent and Tigo 23.3 percent. The Chi-square test showed the significant association between access to beef cattle market information via cell phones and level of network coverage ($\chi^2 = 4.587$; $p \leq 0.032$) indicating that access to beef cattle market information via cell phone is determined by the level of network coverage in the area of residence. Similarly, the Chi-square test indicated that there is significant association between access to market information via cell phones and location of respondents ($\chi^2 = 4.473$; $p \leq 0.034$) this entails that market information searching were determined by many factors including distance from home to the market places.

These findings concur with the findings reported by Aker (2008) and Abel-Ratovo *et al.* (2012) who explained the distance as an environmental determinant that increases the use of cell phones in access to market information for both sellers and buyers before travelling to distant market places. The distance from home to the nearest market place in the surveyed area ranged from 1-55km with average of 13.51km. Some of the most important cattle market places in the study area include Kibakwe; Chipogoro; Rudi; Fufu; Chogola; Malolo; and Mima. Other cattle market places are Ilolo; Msagali; Gulwe; Chisalu; and Chinyika. According to the Ministry of Livestock and Fisheries Development (2014) report, currently there are over 400 primary cattle markets in Tanzania. These markets are under the jurisdiction of Local Government Authorities and most of them are held once per week.

Table 1: The Use of Cell Phones and Access to Market Information (N = 120)

Access to beef cattle market information Number of variables	Frequency	Percent	χ^2	P-value
The use of cell phone	79	65.8	10.085***	0.001
Selling cattle at home place	108	90.0	10.337***	0.001
Access to M-Pesa Service	27	22.5	8.386***	0.004
Level of network coverage				
High network connection	47	39.2		
Moderate network connection	54	45.0	4.587*	0.032
Division of residence				
Rudi	60	50.00		
Mpwapwa	60	50.00	4.473*	0.034

Note: ***, **,* significant at 0.1, 1 and 5percent levels respectively ($P \leq 0.001$, $P \leq 0.01$ and $P \leq 0.05$)
Source: Survey data (2014).

The Impact of Using Cell phones in communicating Cattle Market Information
The findings revealed that cell phones had been useful for smallholders in many ways in terms of communication and dissemination of information related to beef cattle in the study area. Findings in Table 2 indicate that 22.1 percent were using the devices to share information with their fellow beef cattle producers on the existing prices in the various local market places. More than one-fifth (21.5 percent) reported that cell phone saves time and cost on the market searching process while about one-fifth (19.2 percent) said it enables beef cattle smallholders to secure better price. Similar findings from focus group discussions (FGDs) revealed that the price assurance increases bargaining power since information is power, thus smallholders may opt to sell their cattle whenever there is better price in the market. Furthermore, 18.9 percent said that the use of cell phones had simplified the dissemination of information in case of cattle theft hence it is easier to search stolen cattle now than it was in the previous time before the introduction of the technology and 18.3 percent reported that the interactions with many cattle buyers had increased because of cell phones using.

Several researchers including Jagun *et al.* (2008); Masuki *et al.* (2010); Rabayah and Qalalwi (2011) have indicated the same observations that the use of cell phones has increased cooperation within farmers, enables to reach important customers and facilitates linkage between famers and buyers in the rural areas. This implies that the use of cell phones has shown a positive impact in communication and dissemination of information among various stakeholders in rural areas. Generally, access to the knowledge about prevailing cattle market prices, quality and quantity demands prior cattle selling are noticeable determinants of cell phones usage for beef cattle smallholders that enhances negotiation for better prices in a cost effective manner.

Table 2: Impact of Cell Phones for Cattle Market Information Sharing (N = 120)

Positive impacts	Count	Percent of responses	Percent of cases
Helps in communication with fellow beef cattle keepers on the existing price in the different local market places	77	22.1	100.0
Increases interaction with many cattle buyers	64	18.3	83.1
Searching stolen cattle becomes easier by disseminating theft information via cell phones	66	18.9	85.7
Saves time and cost on the market searching process	75	21.5	97.4
Enabled cattle keepers to secure better price	67	19.2	87.0

Total	**349***	**100.0**	**453.2***

NB: *Multiple responses
Source: Survey data (2014).

Cell phones and Access to Beef Cattle Market Information in the Past 12 Months
Findings showed that about two-third (65.8 percent) of respondents shared beef cattle market information from various localities via cell phones in the past 12 months; that is from September 2011 to September 2012. Similarly, five-eighth (62.5 percent) of respondents used their own cell phones in access to market information shared; while few respondents (3.3 percent) used friend's cell phones as follows, 2.5 percent used friends device without paying and 0.8 percent borrowed friend's/relative's phone and recharge airtime to access cattle market information. Similar study by Martin and Abbott (2011) also noted that 70 percent of farmers in Uganda rural areas used cell phones to access market information from fellow farmers and buyers from different distant markets.

Furthermore, the study revealed that four-fifth (84.2 percent) of respondents preferred voice calling while only 1.7 percent preferred both voice calling and short message services (SMS) modes of communication using cell phones. In discussion with respondents, various opinions were given out concerning the preference for voice calling to SMS first of all they said that voice calling allows rapid interactions with many actors involved in the process such as extension agents; cattle buyers and fellow farmers. Other reasons mentioned were the high SMS prices; visual disabilities; unfamiliarity; illiteracy; and inadequate skills on the use of SMS in rural areas.

These findings confirm earlier findings by Okello *et al*. (2010), Furuholt and Matotay (2011) and Abel-Ratovo *et al*. (2012) which indicated that the use of voice calling outweighed the SMS mode in the rural areas due to significant factors including constraints on the use of SMS format as well as individual's two-way interaction preference. Implying that farmers prefer communication mode that provides two-way interaction for questions and clarification of information sought.

Table 4: Cell Phones and Access to Market Information in the Past 12 Months (N = 120)

Access to market information	Frequency	Percentage
Accessed	79	65.8
Own phone	75	62.5
Friend's phone	4	3.3
Mode of communication preferred		
Voice calling	101	84.2
Both voice calling and Short Message Services (SMS)	2	1.7

Source: Survey data (2014).

Cell phones and Access to Market Information Disseminated by Extension/Ward/Village Executive Officials
The study revealed that nearly three-fifth (57.5 percent) of respondents had access to beef cattle information disseminated by extension agents as well as ward and village executive officials on various aspects with time. Findings in Table 5 showed different types of information related to beef cattle disseminated by the government officials via cell phones for smallholders in the study area. More than two-fifth (41.1 percent) reported that they had received information concerning the outbreak of cattle diseases; about 39.9 percent said they

had received quarantine information; while 15.5 percent said that they had received information concerning access to cattle movement permit documents. Other type of information disseminated via cell phones was beef cattle grades applicable in the market 2.4 percent and 1.2 percent information about the cause of un-conducive price based on the special requests.

Similarly, results from focus group discussions (FGDs) revealed that information related to dipping, vaccination dates, and livestock keepers meetings/seminars were disseminated by Village Executive Officials (VEOs) via cell phones. Furthermore, respondents reported that, one could call VEO to ask whether the cattle movement permits have already arrived in the village office from the district headquarters hence access to the service.

Additional findings from chi-square indicate a significant association (χ^2 = 19.228; p = 0.000) between the use of cell phones to access beef cattle market information and access to other information related to beef cattle disseminated by the local government officials via cell phones. This entails that those who were using cell phones to access market information were likely to have access to information disseminated by the government officials timely. These findings suggest that cell phones had enabled communication and dissemination of information related to beef cattle farming instantly for immediate act particularly during disease outbreaks thus a number of animal deaths could be prevented.

Table 5: Types of Information Disseminated by Extension/Ward Executive/Village Executive Officials (N = 120)

Information type	Count	Percent of responses	Percent of cases
Beef cattle grades applicable	4	2.4	5.7
Cause of un-conducive prices	2	1.2	2.9
Quarantine information	67	39.9	95.7
Disease out breaks information	69	41.1	98.6
Access to cattle movement permit documents	26	15.5	37.1
Total	**168***	**100.0**	**240.0***

NB: *Multiple responses: Chi-square = 19.228 P = 0.000 ($p \leq 0.001$)
Source: Survey data (2014).

Odds of Having Access to Beef Cattle Market Information via Cell phones

The odds of smallholders having access to beef cattle market information via cell phones were determined by using binary logistic regression for which the model and covariates presented in the data analysis section were used.

One of the vital outputs of the binary logistic regression model was the Omnibus test of the coefficients of the model. The Omnibus test is a test of the capability of all predictors (independent variables) in the model jointly to predict the response (dependent) variable. If significance is found, it means that there is adequate fit of the data to the model and at least one of the predictors is significantly related to the response variable (Garson, 2008). Therefore, based on this description, and by looking at the results in Table 6, which indicate that there was significance at the 0.001 level (p = 0.000), the data entered in the model adequately fitted the model, and at least one of the predictors is significantly related to the response variable.

Table 6: Omnibus Test of Model Coefficients

		Chi-square	Df	Sig.
Step 1	Step	62.738	7	0.000
	Block	62.738	7	0.000
	Model	62.738	7	0.000

Likewise, the model summary, which is presented in Table 7 showing Cox & Snell R square and Nagelkerke R square, was chosen as an important output of the binary logistic regression model. The Cox-Snell R square and Nagelkerke R square are attempts to provide a logistic analogy to R square in Ordinary Least Square (OLS) regression; hence are called pseudo R square. Nagelkerke R square is a modification of Cox-Snell R square to assure that Cox-Snell R square varies from zero to one, as does R square in OLS regression. If Cox-Snell R square is not modified, its maximum value is usually less than one, making it difficult to interpret.

Table 7: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square (R^2)	Nagelkerke R Square(R^2)
1	83.992[a]	0.418	0.582

Garson (2008) notes that Nagelkerke **(**R square**)** is normally higher than Cox-Snell R square and is the most reported of the pseudo R square estimates. Therefore, based on the results in Table 7, which show that Nagelkerke R square was 0.582, it means that the covariates entered in the model explained 58.2 percent of variance in the dependent variable.

Other vital outputs of the model were Wald statistics, which are presented in Table 8. The Wald test is an alternative test, which is commonly used to test the significance of individual logistic regression coefficients for each independent variable. The Wald statistic is the squared ratio of the un-standardized logistic coefficient to its standard error. Wald statistic corresponds to significant testing of ϐ coefficients in Ordinary Least Square (OLS) regression. Wald coefficients associated with individual independent variables help us realise the relative importance of each independent variable.
In other words, a Wald coefficient is a measure of the unique contribution of each independent variable in the context of the other independent variables and holding constant other independent variables. A bigger Wald statistic implies that the independent variable associated with it has high contribution to the occurrence of the dependent variable, which in this case is access to beef cattle market information via cell phones for smallholders. The effect, which can be negative or positive, of an independent variable on the dependent variable is denoted by the sign (negative or positive) of individual logistic regression coefficients (ϐ values) for the independent variable that is generated concomitantly with the Wald statistic. A negative sign associated with a ϐ coefficient shows that, that particular variable decreases the logit of the dependent variable (i.e. it decreases the probability that that event (in this case access to beef cattle market information via cell phones) will be realised, and vice versa.

For example in Table 8, the age of respondents, and the number of cattle owned reduce chances of beef cattle smallholder's access to cattle market information via cell phones since their ϐ values are associated with negative signs; their logistic regression coefficients (ϐ values) were negative implying that they had negative effects on the dependant variable. The reason might be that elders were likely to cope with innovative technology slowly while smallholders with a little number of cattle were not influenced to use cell phones in cattle market information seeking since they had little to be sold.

The other variables increased chances of smallholder's access to beef cattle market information via cell phones since they had positive signs implying that they had positive effects on the dependent variable, but average income of individual smallholder per year had no effect on access to beef cattle market information via cell phones since its ϐ value was 0.

Table 8: Variables in the Equation

Covariates	β	S.E.	Wald	Df	Sig.	Exp(β)
Age of respondent	-0.028	0.025	1.260	1	0.262	0.973
Number of cattle owned	-0.025	0.014	3.096	1	0.078	0.975
Approximate distance to the nearest cattle market	0.057	0.018	10.088	1	0.001	1.059
Income per year	0.000	0.000	5.291	1	0.021	1.000
Access to information about beef cattle grades	0.429	0.682	0.397	1	0.529	1.536
Cattle sales volumes information	2.396	0.868	7.620	1	0.006	10.979
Ownership of cell phones	1.088	0.788	1.907	1	0.167	2.968

Source: Survey data (2014).

From the results in Table 8, approximate distance from home to the nearest cattle market had a significant impact on the likelihood of smallholder's access to beef cattle market information via cell phones (p = 0.001). Moreover, it is the same variable that had the biggest impact (Wald statistics = 10.088) of all other variables that were entered in the binary logistic regression model, followed by access to information about cattle sales volumes (p = 0.006) with a Wald statistic of 7.620. Average income per year had no effect on the response variable but showed a significant impact on the likelihood of smallholder's access to beef cattle market information via cell phones (p = 0.021) with a Wald statistics of 5.291. The other Wald statistics and their level of significance are as presented in Table 8.

The Wald statistics shown in Table 8 are also presented in Fig. 1 to illustrate the extent to which each of determinants contributed to the probability of smallholders in various settings having access to cattle market information by using cell phones.

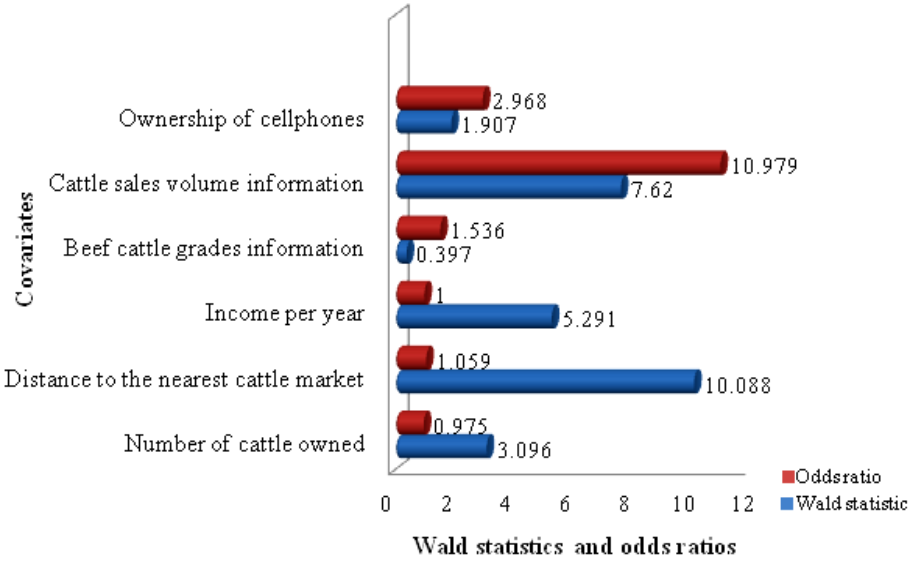

Figure 1: Contributions of independent variables to the odds of access to beef cattle market information via cell phones

Source: Survey data (2014)

According to the results presented in Table 8 and Figure 1, the most important variables that contributed highly to the use of cell phones increasing chances of getting access to cattle market information were approximate distance from home to the nearest cattle market, access to information about cattle sales volumes, and average income earned by the individual smallholder per year. The magnitudes of effects of other independent variables on the dependent variable (access to cattle market information via cell phones) are as presented in Table 8 and Figure 1.

In view of findings in Table 8, the chances of smallholders with different determinants of ages, income levels, distances, and different demands on the types of market information were not the same as indicated by the Exp (ϐ), which measures the chances of access to beef cattle market information via cell phones among smallholders. The odds ratio is the natural log base, e, to the exponent, ϐ, where ϐ is the parameter estimate. The odds ratio is the predicted change in the odds for a unit increase in the corresponding independent variable. Odds ratios less than 1.0 correspond to decreases in the odds; odds ratios more than 1.0 correspond to increases in the odds.

In addition, an odds ratio equal to 1.0 means that the respective independent variable has no effect on the dependent variable; and an odds ratio close to 1.0 means that the respective independent variable almost has no effect on the dependent variable (Wuensch, 2008). Therefore, based on the results in Table 8, there is enough evidence to support that an increase in the information obtained about cattle sales volume demands from the different market places, increases chances of getting cattle market information via cell phone by a factor of about 10.979, controlling for other variables in the model.

CONCLUSIONS AND RECOMMENDATIONS

This study identified determinants of the use of cell phones to access beef cattle market information for smallholders in Mpwapwa District. The identified determinants include approximate distance from home to the nearest cattle market places, types of market information demanded (cattle sales volume and beef cattle grades applicable), income per year, and the ownership of the cell phones. This implies that smallholders who were located far from cattle market places could have been active participants in beef cattle market information sharing to enhance their bargaining power and decision-making using cell phone technology.

Other identified determinants were the level of network coverage, access to mobile banking (M-Pesa) services, and location of the smallholder beef cattle producer. Therefore, the study recommends that cell phones service providers should extend their services more in the rural areas of Mpwapwa District.

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