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Socioeconomic drivers of mobile phone adoption for marketing among smallholder irrigation farmers in South Africa

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Abstract: Lack of access to markets occasioned by missing market information has constrained market participation among smallholder farmers in developing countries. Advances in Information and Communication Technologies (ICT) have helped in connecting rural farmers through mobile phone to market sources. This study investigated the adoption of mobile phone for marketing of agricultural produce among Qamata Irrigation Scheme (QIS) smallholder farmers in South Africa and the determinants of adoption. Two stage random sampling technique was used to interview 97 smallholder farmers employing a semi-structured questionnaire. Data generated was analysed using descriptive statistics and probit regression model. Analysis result shows that 71% of the smallholder farmers currently use mobile phone for agricultural marketing. Majority of the respondents (55%) used mobile phone to market their produce among relatives and neighbours. Probit regression result indicates that gender, social grant as main income source, private traders and local market marketing channel, monthly income, political and economic factors

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PUBLIC INTEREST STATEMENT

Widespread ownership of mobile phone across Africa continent present opportunities to connect rural farmers to market sources. Yet lack of market access occasion by missing market information persist among smallholder farmers. We investigated the adoption of mobile phone for marketing of agricultural produce among irrigation smallholder farmers in South Africa and the determinants of adoption in this study. Findings from the study show that majority of participants from the currently use mobile phone for agricultural marketing. Most of them used mobile phone to market their produce among relatives and neighbours. Empirical result from the study indicates that gender, social grant as main income source, private traders and local market marketing channel, monthly income, political administration of irrigation scheme and access to financial capital influence mobile phone adoption in agricultural marketing. Addressing erratic network and high airtime tariff challenges may intensify adoption of mobile phone as marketing tool among smallholder irrigation farmers in South Africa.

influence mobile phone adoption in agricultural marketing. Hence, we recommend mobile phone as marketing tool among smallholder irrigation farmers in South Africa. Concerted efforts should be made to address erratic network and high air-time tariff challenges to encourage mobile phone adoption in marketing among smallholder farmers in the country

Subjects: Marketing Research; Retail Marketing; Adoption and Fostering

Keywords: agricultural marketing; irrigation; mobile phone; probit; smallholder farmer; South Africa

1. Introduction

Prompt delivery of vital market information to smallholder farmers via mobile phones could serve as an impetus for economic development, poverty alleviation and increase food security in sub-Saharan Africa. Several studies conducted in Ethiopia, Uganda, Tanzania, Zimbabwe and China have confirmed that mobile phones can be used to provide information to the farmers and rural households through SMS and multimedia-support systems (Chhchhar, Qureshi, Khushk, & Maher, 2014; Martin & Abbott, 2008; Masuka et al., 2016; Nyamba & Mlozi, 2012; Tadesse & Bahiigwa, 2015; Wei & Zhang, 2008). The effectiveness of mobile phones in facilitating information access among farmers is far reaching since it provides communication link even in isolated circumstances, and aids in reaching the farmers living in remote areas. Mobile phone helps farmers in accessing best agronomic practices and query agricultural experts (Banerjee, 2010). It can also facilitate agricultural decision making, provide information related to crops, weather forecasting, seeds, fertilizers, bio-pesticides, soil fertility, pest and disease diagnosis, demand and supply of agricultural products, different schemes and technologies (Singh, Bhanotra, Niketha, Wani, & Kumar, 2015).

Despite the immense potentials of mobile phones in enhancing agricultural production and link smallholder farmers to remunerative markets, limited market access still persist among smallholder farmers in most developing countries (Kawa & Kaitira, 2007; Magesa, Michael, & Ko, 2014). The prevalence of limited market access, particularly in rural areas often necessitate farmers and entrepreneurs to travel several kilometres to designated market due to poor communication facilities. In most cases, they frequently rely on intermediaries who normally exploit their ignorance of market information. Hence, accurate and timely market information, precisely for perishable agricultural produce, has been identified as a veritable means of significantly reducing transaction and travel cost. However, the high cost of delivering such valuable market information through face-to-face interaction, crumbling extension services and poor market information has paved the way for the use of modern Information and Communication Technology (ICT) like mobile phones in disseminating agricultural information to targeted farmers.

The explosion of mobile telephony has made sub-Saharan Africa (SSA) “the fastest-growing region in the world for mobile phone users in the past five years, with mobile subscribers having increased 18% a year for the past five years to total 253 million as of June 2013” (WALL STREET JOURNAL, 2013). With a GDP of \$357 billion, South Africa is one of the largest and most advanced telecommunications markets on the African continent (World Bank, 2012). The mobile telecommunications explosion has also been evident in the make-up of the use of ICT services in South Africa, where the use of mobile services has reached near saturation levels (Nedohe, 2014). Yet, little or no information exist on the use of mobile phone in facilitating market access among the impoverished smallholder farmers in the former homelands of South Africa. This paper therefore seek to investigate the socio-economic drivers of mobile phone adoption as ICT tool for agricultural marketing among smallholder farmers participating in Qamata Irrigation Scheme (QIS) in the Eastern Cape Province of South Africa.

To investigate the drivers of innovative use of mobile phone for agricultural marketing among smallholder irrigation farmers in South Africa, we adopted the Theory of Reasoned Action (TRA) and Technology Acceptance Model (TAM) (Donner, 2007; Frias-Martinez & Virsesa, 2012; Islam, 2011). Based on these two theories, we identified variables of interest that were hypothesized in the probit regression model as drivers of mobile phone use in agricultural marketing in the study area. Technology Acceptance Model posits that perceived ease of use and perceived usefulness are major determinants of adopting new technologies, while Theory of Reasoned Action proposes that actions of individuals are mainly influenced by their attitude towards a particular conduct and subjective norms and we have adopted these to explain farmer's decision to adopt mobile phone for agricultural marketing or otherwise in this study. Through review of literature (Gilwald, Moyo, & Stork, 2012; Goldstuck, 2012; Mtshali, Naidoo, & Zungu, 2007; Simpson & Calitz, 2014) on mobile phone adoption, we identified farmers' socio-economic and marketing related and other factors that may influence the use of mobile phone in agricultural marketing. The rationale for choosing TAM is because of its robustness and widespread usage in many empirical studies in different contexts and settings (Chuttur, 2009; Legris, Ingham, & Collette, 2003; Shaikh & Karjaluo, 2014). In addition, TRA is very general, "designed to explain virtually any human behaviour" (Ajzen & Fishbein, 1980), hence, it has been suggested to be appropriate for studying the determinants of computer and computer related devices (such as mobile phone) usage behaviour as a special case (Davis, Bagozzi, & Warshaw, 1989). Although these theories are robust in its own sense, however, integrating with other models and theories can provide further predictive power about the adoption of the technology. Therefore, the current study integrates all these theories to investigate the adoption of mobile phone in agricultural marketing among irrigation smallholder farmers. It is anticipated that this study will provide a quick insight about the current stage of mobile phone adoption in the area of study.

2. Methodology

Study Area: The study was conducted among smallholder farmers participating in QIS, which is located in Intsika Yethu Local Municipality in Chris Hani District Municipality of Eastern Cape Province, South Africa. The Qamata area climate varies from mild temperature conditions of 14°C–23°C along the coastal areas to extreme conditions of 5°C–35°C within the inland areas (Lent et al., 2000) and the rainfall ranges between 6 mm and 86 mm. The scheme spans a total surface area of about 2601 ha (ARDRI, 1996, p. 6). It stretches across two tribal authorities, namely; Qamata Tribal Authority in the North, and St. Marks Tribal Authority in the South (Republic of REPUBLIC OF Transkei, 1986, p. 2). The study area is predominantly rural with 95% of the population living in the rural areas while 71% of the population depend on subsistence farming (Chitsa, 2014)

Data and Sampling Procedures: The cross sectional data used in this study come from a two stage random sample of 97 farmers participating in QIS. In the first stage, five of the 32 sections of QIS was selected using non-probability quota sampling based on the premise that the five sections selected constitute largest area of the scheme with representative population of smallholder farmers participating within the scheme. The second stage involves simple random sampling of select representative sample of farmers based on the number in each section. To ensure selection of representative sample from 1731 farmers within the five section identified in the first stage, Raosoft Sample Size Calculator was used based on the inputs of margin of error (9), confidence level (95%), response distribution (50%) with the population of 1731 to generate 112 farmers for interviews. Of the 112 that were interviewed, only 97 gave valid and complete information sufficient for analysis. Table 1 shows how the 112 farmers were drawn from 1731 irrigation farmers within the five sections.

Semi-structure questionnaire was developed by the researcher based on the review from these literature (Aker and Mbiti 2010; Qiang, Kuek, Dymond, & Esselaar, 2011; Mittal and Mehar 2012; Huq, Farhana and Rahman 2017). The questionnaire captured farmer's socio-economic characteristics such as age, gender, income, level of education etc., mobile phone usage, market and market

Table 1. Sampling Procedure

Sections	Irrigation Farmers Population	Number of Irrigation Farmer Selected
Section 1	194	13
Section 2	326	21
Section 3	558	36
Section 4	177	11
Section 5	476	31
Total	1 731	112

Source: Authors computation

participation characteristics. Variables such as age, income and education were grouped into categories because pilot survey revealed the reluctance of respondents to disclose their actual age and income in the study area. The questionnaire was administered to the respondents by trained enumerators made up postgraduate students (i.e. honours) using face-to-face method in August 2016.

Method of data analysis: The analytical technique used in this study includes descriptive statistics such as frequencies, means, percentages, pie and bar charts, and tables, employed in profiling the socioeconomic characteristics of the smallholder irrigation farmers. We further used probit regression analysis to estimate the determinants of the adoption of mobile phone in agricultural marketing. Agricultural marketing in this study is define as sales of surplus agricultural produce by irrigation farmers using several marketing channels such as local markets, private traders and relative and neighbours.

The Probit model: The Probit model is a log-linear approach used to measure the effects of the independent variables on the dependent variable. The Probit regression analysis, was used since the OLS estimating procedure will be inappropriate as the dependent variable is dichotomous. In this model, Mobile Phone Adoption (MPA) represents the dependent variable (Y). The model was estimated with the assumption that Y, MPA for agricultural marketing, is related to the following variables, as explicitly stated in Table 2 below:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_n X_{ni} + v \tag{1}$$

Y_i	=	Mobile Phone Adoption (MPA = 1, 0 otherwise)
		Farmers that use mobile phone for calls, SMS or both in agricultural marketing are consider adopter, whereas those that have never used mobile phone services (i.e. calls and SMS or both) for agricultural marketing are consider as non-adopters
		$X_{1i}, X_{2i} \dots X_{ni}$ = vectors of explanatory variables $\beta_0 \beta_1, \dots, \beta_n$ = coefficients of the explanatory variables

3. Results and discussion

3.1. Socio-economic characteristics of the households

Presented in Table 3 is the socio-economic characteristics of the smallholder irrigation farmers that participated in the study. The smallholder farmer characteristics examined include age, gender, marital status, level of educational, monthly income, main sources of income and the arable land size of the farmers. Most of the farmers (61%) were 50 years and above with only a few (11%) below 20 years of age. This imply that farmers in the study area may

Table 2. Description of the variables used in the probit model

Variables	Description	Measurements
X ₁	Gender distribution of the farmers	1 = male, 0 = otherwise
X ₂	Age distribution of the farmers	1 = ≥ 50 years, 0 otherwise
X ₃	Marital status of the farmers	1 = Married, 0 otherwise
X ₄	Educational status of the farmers	1 = at least attended high school, 0 otherwise
X ₅	Farming as main income source for the farmers	1 = Yes, 0 otherwise
X ₆	Social grant as main income source for the farmers	1 = Yes, 0 otherwise
X ₇	Size of farmer's arable land in hectares	1 = Yes, 0 otherwise
X ₈	Private traders as farmer's major marketing channel	1 = Yes, 0 otherwise
X ₉	Relatives or neighbours as farmer's major marketing channel	1 = Yes, 0 otherwise
X ₁₀	Local market as farmer's major marketing channel	1 = Yes, 0 otherwise
X ₁₁	Level of monthly income of farmer	1 = ≥ R1000, 0 otherwise
X ₁₂	If political administration of QIS affects produce marketing	1 = Yes, 0 otherwise
X ₁₃	If economic factor (i.e. financial capital access) affects produce marketing	1 = Yes, 0 otherwise
X ₁₄	If social factor (e.g. cultural belief) affects produce marketing	1 = Yes, 0 otherwise

Source: Authors computation

be ageing, and this may have serious implications on sustainability of agriculture among the younger generation who are supposed to succeed the older ones. The female farmers' population are slightly above their male counterparts indicating that female may be more active in the irrigation scheme than male farmers. This finding is similar to Chitsa and Gidi studies on QIS where female constitute higher percentage (Chitsa, 2014; Gidi, 2013). Almost half of the farmers (49%) completed primary schools, whereas 43 per cent attended high schools. Only 1%, 4%, 2% had matric, diploma and degree qualifications respectively. Forty-four per cent of the farmers earned less than 1,000 Rand monthly, while 48 per cent received R1,000–R4,999 monthly, very few (6%) earned R5,000 and above monthly. Majority of the farmers (71%) were affirmative when asked if farming is their main source of income and almost 20 per cent (19.59%) claimed social security grant received from government as the main source of income. Greater percentage of the farmers (71%) have less than or at most one hectare of arable land while few (6%) have five hectares or more.

3.2. Mobile phone services used for agricultural marketing by smallholder farmers

As shown in Figure 1, 48 per cent of the smallholder farmers employed voice calls in the marketing of their agricultural produce. This may be connected to the perishability of their produce, which necessitate the urgency of communication between the farmers and potential buyers. Only 10 per cent of the farmers employed Short Message Services (SMS) in their marketing. This low percentage may be due to the fact writing messages may be burdensome to many farmers and may require a certain level of literacy that may be lacking among the smallholder farmers.

Table 3. Socio-economic characteristics of the respondents

Variables	Frequency	Percentage
Age		
< 20 years	11	11.34
30–39 years	11	11.34
40–49 years	15	15.46
50–59 years	27	27.84
≥ 60 years	33	34.02
Gender		
Male	46	47.42
Female	51	52.58
Marital status		
Married	44	45.36
Never married	29	29.90
Divorced	7	7.22
Widow	17	17.53
Education level		
Primary school	48	49.48
High school	42	43.30
Matric certificate	1	1.03
Diploma	4	4.12
Degree	2	2.06
Monthly Income		
< R1,000	39	44.32
R1,000–R4,999	43	48.86
≥ R5,000	6	6.82
Farming as main income source		
Yes	69	71.13
No	28	28.87
Social grant as main income source		
Yes	19	19.59
No	78	80.41
Arable land size		
≤ 1 ha	47	71.21
1.1–5 ha	15	22.73
> 5 ha	4	6.06

Source: Authors own survey

3.3. Benefits of mobile phone adoption in agricultural marketing

The bar chart in Figure 2 shows the various benefits derived from the adoption of mobile phone in agricultural marketing by the smallholder farmers. Forty-four per cent of the respondents claimed that there is no substantial different derived from their use of mobile phone in marketing their produce. However, 18 per cent confirmed that use of mobile phone facilitated easy access to the market. Since the scale of production of the farmers are generally low, this category of farmers may be those that use informal marketing channels such as relative and neighbours, local markets where they have already established contacts that can easily buy their small produce. Thirteen per cent of the farmers claimed that the use of mobile phone link them to the market where their

Figure 1. Mobile phone marketing services adopted by the smallholder irrigation farmers.

Source: Authors own survey

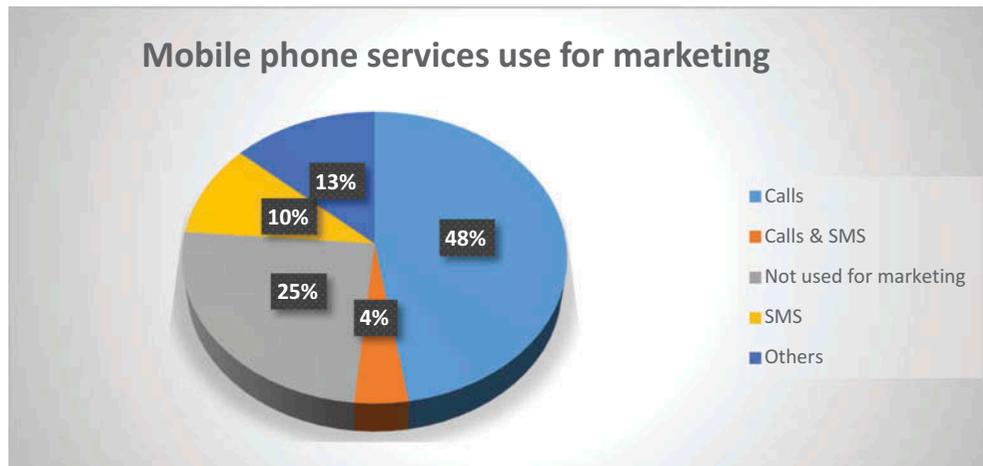
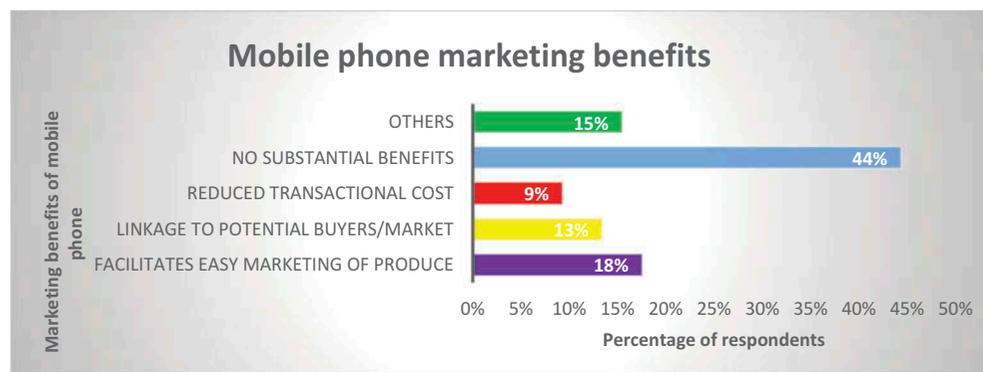


Figure 2. Marketing benefits derived from the adoption of mobile phone in agricultural marketing by the smallholder irrigation farmers.

Source: Authors own survey



produce could be sold on time. Moreover, 9 per cent of the respondents affirmed that the adoption of mobile phone reduced their transactional cost substantially and 15 per cent derived other benefits that were not specified.

3.4. Extension services facilitated through mobile phone

Benefits derived from the use of mobile phone among smallholder farmers is shown in Figure 3 below. The study identified three major extension services that are commonly facilitated by the smallholder farmers over the phone without direct interactions with the extension officers. These include procurement of fertilizer, arranging for tractor and transport services. Twenty-two per cent of the farmers had arranged for tractor services in the past using mobile phone, 15% ordered for the supply of fertilizer with the aid of mobile phone and 3% patronized transportation service for their produce using mobile phone.

3.5. Challenges to mobile phone adoption among smallholder farmers

Major challenges hindering the adoption of mobile phone in agricultural marketing among smallholder farmers in the study area is presented in Figure 4 below. Most of the respondents said that inability to purchase airtime with which they can make use of the mobile phone services constitute major challenge to their adoption. This is understandable considering the fact that almost half of the respondents live on less than R1,000 monthly. For these farmers, R5 airtime may be unaffordable due to their family responsibilities. However, 10% identified erratic network as major confronting their adoption of the mobile phone in marketing their produce. This may be because the study location is far from major towns, hence, poor

Figure 3. Extension services patronized through mobile phone by the smallholder irrigation farmers.

Source: Authors own survey

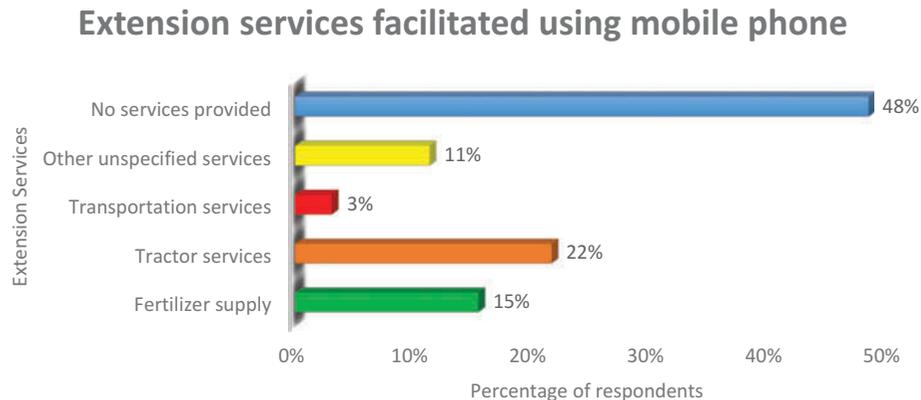
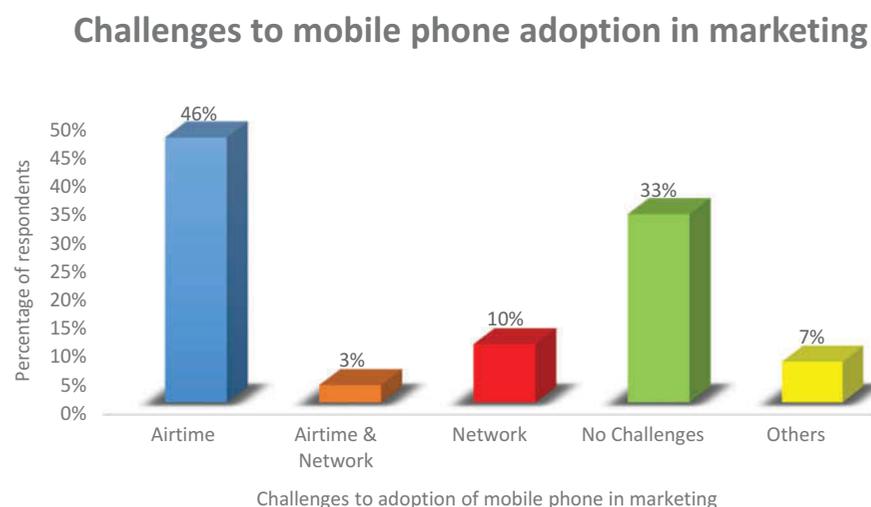


Figure 4. Challenges mitigating the adoption of mobile phone among smallholder irrigation farmers.

Source: Authors own survey



reception often persist in the area. Seven per cent claimed that there are other challenges, which are not specified, but 33% are of the opinion that none of these constitutes challenges to the adoption of mobile phone in marketing their produce.

3.6. Determinants of mobile phone adoption for agricultural marketing

The probit regression estimates and the corresponding marginal effects is presented in Table 4. The pseudo R^2 (adjusted coefficient of determination) shows that the dependent variables included in the probit model explained 41.32% of the variations in the mobile phone adoption probability. The variables that are statistically significant in the probit model include gender of the farmer, monthly social grant as main income source, private traders as main marketing channel, local market as main marketing channel, monthly income, and effects political and economic factors on agricultural marketing. The explanation of the significant independent variables presented below is based on the estimates of the marginal effects that show the change in the dependent variable for a 1 unit change in the value of the predictor variable. The gender of the farmer was significant at 10% with an inverse relationship with the farmer adopting mobile phone in agricultural marketing. This implies that relative to male irrigation farmers, female irrigation farmers are 24 percentage points less likely to adopt mobile phone services for marketing. This finding aligned with previous studies on QIS, which reported high participation of women in the scheme (Chitsa, 2014; Gidi, 2013).

Table 4. Probit regression estimates of the determinants of mobile phone adoption in agricultural marketing

Variables	Probit Regression		Marginal Effects	
	Coefficients	Robust SE	dy/dx	SE
Age	0.6860	0.5363	0.1362	0.1381
Gender	-1.2220*	0.6691	-0.2419*	0.1454
Marital status	-0.8564	0.6129	-0.1765	0.1316
Education level	0.6098	0.5254	0.1200	0.1456
Farming as main source of income	-0.1933	0.7486	-0.0496	0.1498
Social grant as main source of income	-1.7969***	0.6727	-0.3564**	0.1672
Size of arable land	-0.0991	0.2529	-0.0179	0.0612
Private traders as marketing channel	1.7883**	0.9214	0.3470**	0.2104
Relatives/neighbour as marketing channel	0.9409	0.7037	0.1979	0.1532
Local market as marketing channel	1.3867**	0.6875	0.2754**	0.1374
Income level	1.1264*	0.6358	0.2032*	0.1296
Political factor	-2.0553**	0.9420	-0.4125**	0.1781
Economic factor	-1.6463*	0.9340	-0.3215*	0.1772
Social factor	0.6657	0.9401	0.1166	0.2149
Constant	1.5107	1.2310		
Number of observation	54			
Pseudo R ²	0.4132			
Prob. > Chi ²	0.0116			

***, **, * indicate significance at 1%, 5% and 10% respectively

Source: Authors own survey

In addition, receiving social security in form of monthly grant was strongly significant at 1% with an inverse relationship with the farmer adopting mobile phone in agricultural marketing. This implies that the probability that a farmer would adopt mobile phone in marketing decreases by 35.64% if the farmer's main source of income is social grant. This is because majority of the farmer whose main source of income is social grant spend it on feeding and so may not have enough to pay for mobile phone airtime, which is necessary for facilitating agricultural marketing. Another plausible explanation is that, since these farmers received their main income from social grant, their production may be at subsistence level, which may not necessitate active participation in the output market. Choosing private traders and local market as main marketing channel were both significant at 5% with a direct relationship with the probability of the farmer adopting mobile phone in agricultural marketing. These imply that the probability that a farmer adopt mobile phone in marketing increases by 34.70% and 27.54% among the farmers that use private traders and local marketing channels respectively. Similarly, the monthly income received by the farmer was significant at 10% with positive relationship. This implies that the probability that a farmer adopt mobile phone in marketing increases by 20.32% among the farmers that receive more than R1,000 monthly. This means that utilization of mobile phone in marketing increases with increase in income of the farmer. This was anticipated a priori since increase in income would increase farmers' disposable income with which he/she can buy airtime. Moreover, political and economic factors as factors negatively affecting agricultural marketing were significant at 5% and 10% respectively with inverse relationships. This means that farmers that were affirmative to the

questions that both political and economic factors negatively affect agricultural marketing are less likely to adopt mobile phone in marketing. Their probability of adoption decrease by 41.25% and 32.15% for political and economic factors respectively.

4. Conclusion

This study revealed that socio-economic characteristics of irrigation farmers drive the adoption of mobile phone in agricultural marketing in Qamata Irrigation Scheme, South Africa. Evidence from the probit regression model revealed that female irrigation farmers are less likely to adopt mobile phone services for marketing than their male counterparts. Similarly, we observed that farmers receiving social security grants from government as main source of income are less likely to adopt mobile phone services for the marketing of their agricultural produce. However, farmers patronizing local and private traders marketing channels tend to adopt mobile phone for produce marketing than their counterparts using relative and neighbour channel. Mobile phone services such as voice calls and Short Message Services (SMS) are employed by the majority of the smallholder farmers. Most of the farmers are confronted with the challenges of inability to afford airtime and erratic network from service providers like MTN, Cell C and Vodacom. The farmers often used relatives and neighbours, private traders, local marketers, co-operatives, private companies and state marketing agencies as main marketing channels. It can therefore be concluded from this study that the socioeconomic characteristics influenced the use of mobile phone in agricultural marketing in the study area.

5. Recommendations

Sequel to the findings, the following recommendations are made. The government through the Independent Communications Authority of South Africa (ICASA) should canvass for the extension of strong and reliable mobile telecommunication network to rural areas to encourage effective utilization among rural smallholder farmers. Major mobile telecommunication service providers such as MTN, Vodacom and Cell C should be tasked to provide subsidized service package like SMS and Call services for smallholder farmers in the rural areas. Government extension officers should also be encouraged to employ mobile phone in communicating new technologies and innovations with farmers but due considerations should be given to the socioeconomic characteristics of farmers while doing this. Lastly, the Department of Agriculture and Agrarian Reforms (DAAR) should embark on more enlightenment programmes among smallholder farmers to encourage the use of mobile phone in agricultural marketing where market participation is dismally low.

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