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AGRICULTURAL PRODUCTION IN SOUTH AFRICA: INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) SPILLOVER

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–Abstract–

The positive spillover impacts of the efficiency of information and communication technology (ICT) and land accessibility as factor inputs to agricultural productivity are well documented in the literature. Furthermore, input-output efficiency as a measurement of factors contributing towards gross production is no exception in this regard. Few studies on agricultural production and ICT at the household level in South Africa show divergent empirical results. This study investigates the effect of information and communication technology (ICT) and land for farming in the context of household food production in South Africa. Household engagement in agricultural activities is proxy for agricultural production, farm land size is a proxy for land accessibility, telephone and internet use are proxies for ICT in this study. Household data of twenty-one thousand, six hundred and one (21,601) households on agricultural activities and ICTs were generated from the existing survey data of General household survey, 2015 by Statistics South Africa. Majority of the households are not engaging in agricultural activities due to no access to land for farming, but more than 80 percent of the

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households have access to at least one form of ICTs penetration i.e. mobile telephony. The logit regression shows that internet connection in the household have positive and significant impact on household agricultural production but land accessibility is indirectly related and significant to household food production in South Africa. Therefore land accessibility may be a barrier to agricultural activity involvement in South Africa. The study shows that the positive spillover impacts of ICT may not be possible due to lack of access to land for agriculture. Land for farming, CDMA telephony and internet are highly required for agricultural activities in order to promote food production, reduce cost of telecommunications, promoting agricultural research and development via internet accessibility.

Key words:
Agricultural production, Land accessibility, Information and communication technology (ICT), General household survey, Binary logit regression, South Africa

JEL classification code:
Q11, Q15, O3, C83, C81, P42

1. INTRODUCTION

South Africa's democratisation advent in 1994 birthed resurface of land reform and agricultural programs to redress pre-1994 injustices in resources distribution. Two decades after the democratisation, issues of inequality (economic, social and political) are still frequent in public discourse due to more than half of the population trapped in poverty boundary[1] and a quarter of the population is extremely poor (food poverty)[2]. Increasing rate of poverty has been largely attributed to unemployment rate moving in the same direction. Since 1994, the agricultural sector is positioned to serve as source of employment in

[1] http://www.statssa.gov.za/?p=10334
[2] https://africacheck.org/factsheets/factsheet-south-africas-official-poverty-numbers/

order to reduce poverty and increase food production in the rural area in the short-run while in the long-run contributing to economic growth and development. Agricultural sector has experienced four phases of reforms in order to boost production and sustained productivity.

South African economy as the second biggest in Africa is a net-supplier of food produce at the national level but deficit at the household level due to more than 80 percent of households not involved in agricultural activities (Statistics of South Africa [StatsSA], 2016). The number of households engaged in agriculture was 2.33 million in 2016 compared with 2.88 million in 2011. This represents a decrease of 19.1 percent between the two years. The bulk of households engaged in agriculture in South Africa were in KwaZulu-Natal (23.0 percent of country's total), Eastern Cape (21.3 percent) and Limpopo (16.6 percent) in 2016. Free State, Western Cape and Northern Cape reported the lowest numbers of households engaged in agriculture, with 6.8 percent, 3.0 percent and 2.1 percent (of country's total) respectively. Within the provinces, the highest proportion of households that were engaged in agriculture in 2016 was 27.9 percent in Eastern Cape, down from 35.4 percent in 2011. This was followed by 24.1 percent in Limpopo (33.0 percent in 2011) and 18.6 percent in KwaZulu-Natal (28.2 percent in 2011). Western Cape and Gauteng recorded the lowest participation rates, with 3.6 percent (5.2 percent in 2011) and 4.9 percent (7.1 percent in 2011) respectively[3].

Productivity in agriculture ensures availability of food which is the supply-side of food security. Studies show that food inaccessibility is one of the contributors of high level of poverty in South Africa. Incentivising food production at the household level may reduce the challenges of food accessibility and poverty since excess household

[3] http://www.statssa.gov.za/?page_id=1856&PPN=03-01-05&SCH=6979

food production may be converted to income. In engaging the household in the food production, required factors such as land for agricultural production, agricultural skills, farm implements and ICT gargets for information dissemination are needed for innovative agricultural practices. In order for household to attain optimal level of production, technological and managerial innovations - smart production techniques are key inhibitors.

"Smart" technique to agricultural production has being the point of discourse since the beginning of the millennium in order to promote efficiency and productivity in Agricultural practice (Food and Agriculture Organisation [FAO], 2013; Aldosari et al., 2017; Liao, Wang, Li, & Weyman-jones, 2016; Salampasis & Theodoridis, 2013; Zhang, Wang, & Duan, 2016).

Ochieng, Juma and Jakinda (2014) study finds that positive and significant contribution of farm land size and information and communication technology (ICT) on the use of inputs (seeds, fertilizers and labour productivity) has an indirect impact on Agricultural productivity in Kenya. Findings revealed that radio/ICT assisted in the dissemination of agricultural information to smallholder farmers in sub-Saharan Africa and thereby increasing productivity (Hudson et al. 2017). Most of the studies on agricultural production as it relates to land accessibility and ICTs in South Africa were conducted from macroeconomic perspective and the few ones from microeconomic perspective viewed food production from the demand side - food security. These studies evaluated the impact of ICT on agricultural production without the disaggregation of impacts of ICT gargets. In this study, household - microeconomic analysis impact of land accessibility and ICTs - dissagregated on agricultural production is conducted from the supply-side. This study investigates the impact of land accessibility and ICTs on agricultural production in South Africa.

2. LITERATURE REVIEW

The importance of technology ICT to productivity/growth is clearly shown in the theory of innovation and endogenous growth theory (Schumpeter, 1942; Solow & Swam, 1956). Information services provide data that are tied to helping farmers improve their productivity, yields and profitability during the course of their normal business of growing agricultural produce. Information services are one of the most common ICT-related categories for inclusive agricultural value chains (Hudson et al. 2017; Mafizur et al. 2017; Ali & Kumar 2011). They are broken down into sub-categories of information services that involve short-term and long-term productivity enhancements; those that minimize the negative effects of crisis events, for example, by informing on how to protect crops from freezing weather in the short term; and those that improve field-based risk management, for example, by guiding the implementation of crop rotation to preserve the soil in the long term (FAO, 2013).

Food sufficiency - availability in South Africa is not challenging but food accessibility and utilisation have been perennial challenges in the country due to a high level of poverty, income, employment and social inequality (Grobler, 2014; 2015). It is argued that high level of poverty is largely caused by a deficiency of appropriate skills and manpower by the nationals. This study will be streamlined to household food production which will enhance food accessibility that has been a challenge due to a low level of real income of the household but if the household is involved in the direct production of the food, the problem of accessibility can be taken care of. With access to information and communication technology (ICT), agricultural activities can be promoted and made easier since ICT promotes productivity.

Fu, Mohnen, and Zanello (2018) in their study employed firm-level approach to impact of technological innovation on labour productivity in Ghana and Crepon-Duguet-Mairesse (CDM) structural model techniques were used for estimation. The study identifies positive impacts of technological innovation on labour productivity in formal and informal firms but the role of technological innovation overshadowed the managerial innovation and greater in formal firm. With technologies, transition from traditional society - extractive (agricultural) society to high mass consumption state - industrialisation is highly possible since innovation drives efficiency and ICTs ensure the smooth transformation process (Rostow, 1960). The emergence of adequate ICTs in relation to productivity, promotes optimal agricultural value chain and agricultural produce wastes are reduced to the production efficient level. Zhang, Wang and Duan (2016) assert that with continual emergence of ICT, agricultural production has transformed from traditional practice to modern practice in China. The deployment of ICT gargets for dissemination of information to farmers have aided productivity and efficient produce distribution. The study used exploratory techniques to evaluate the impact of ICTs - telephony, short message service (SMS), internet and social media on effective information dissemination to farmers in rural and urban areas in order to increase agricultural production.

Studies in the field of ICT and productivity have driven a new technological revolution that has modified not only the ways of doing business - food production but also the way to perform daily household activities. Due to its widespread applications, ICT has been classified as a General Purpose Technology (GPT) like other capital required for production (Jovanovic & Rousseau, 2005). ICT has attributes considerable of technological progress, a pervasive use in a wide range of economic sectors, as well as by the ability to boost complementary innovations and to generate spillover effects (Solow

& Swam, 1956; Romer, 1990; Bresnahan & Trajtenberg, 1995; Lipsey et al. 2005; Aldosari et al., 2017). These characteristics have produced positive productivity effects throughout the economy (Jovanovic & Rousseau, 2005; O'Mahony & Vecchi, 2005; Venturini, 2009; David, 2013). ICT is now recognised as an important determinant of productivity growth especially if coupled with investments in other intangible assets such as R&D, organizational and human capital (Brynjolfsson & Hitt, 2000; Brynjolfsson & Hitt, 2003).

The direct impact of ICT on agricultural productivity is well documented, it is still unclear whether ICT generates positive spillovers as the empirical evidence so far has been rather weak and inconclusive. While some studies find significant effects (van Leeuwen & van der Wiel 2003; Severgnini, 2011; Venturini, 2011), others strongly reject the existence of spillovers (Stiroh, 2002; Acharya & Basu, 2010; Haskel & Wallis, 2010; Van Reenen et al., 2010, Moshiri & Simpson, 2011). This mixed set of results has lead researchers to doubt the importance of the GPT effects related to ICT (Draca et al. 2007) and has prevented the formulation of appropriate policies aimed to facilitate the absorption and diffusion of new technologies to promote agricultural productivity in South Africa.

The majority of studies that fail to find a positive ICT spillover effect are based on industry or economy-wide data. It is, therefore, possible that the lack of a spillover effect from ICT is the result of an aggregation effect. In this study, household level data are generated to reassess the evidence on ICT spillovers on food production and to understand their role in the South Africa productivity - economic growth.

3. METHODOLOGY

Endogenous growth, innovation and technological theories are the skeletal framework for this study in which the importance of

technology (ICT) is clearly identified as determinant of modern growth and productivity (Solow & Swam, 1956; Schumpeter, 1942). Propositions of these theories spur the inspiration of the models for this study, in which productivity is captured from static model perspective since household microeconomic variables are employed in this study. Technique for estimating the spillover impact of ICT and land accessibility on agricultural productivity in this study lies in the theoretical paradigm of endogenous growth model in which the role of technological progress, labour and capital in productivity are extensively highlighted (Solow & Swam, 1956; Romer, 1990). The theory is developed on the basis of dynamic macroeconomic variables but this study evaluated the same causal-effect relationship with static microeconomic variables. Target variable centered around agricultural productivity at the household level in South Africa. Optimal level of agricultural output depends strictly on optimal mix of factor inputs in relative to factor prices and product market price. To achieve productivity - maximum level of returns to production, static model of optimisation problem is employed with the aid of Hotteling's Lemma approach to profit maximisation.

3.1. Models

The profit maximisation equation may be stated as:

$$Max\pi = pq(w,x) - \upsilon w \quad (1)$$

where p is the average price of agricultural produce, q is the aggregate agricultural output level, w is the vector of factor inputs, x is the vector of farmer and farming attributes and v is the vector of agricultural factor inputs price. The return to the household agricultural production is evaluated by profit maximisation approach due to robustness of the included variables. Therefore, the household return on agricultural activities is represented by profit as stated in equation (2)

$$\pi = \pi(r,\upsilon,p,x) \quad (2)$$

Application of Hotelling's Lemma to equation (1) with respect to agricultural factor inputs prices and aggregate agricultural output price yields reduced form equations for negative factor input demand and agricultural output supply, equation (3) and equation (4) respectively;

$$d\pi/d\upsilon = -w = w(r, \upsilon, p, x) \quad (3)$$

$$d\pi/dp = q = q(r, \upsilon, p, x) \quad (4)$$

The specifications in equations (3) and (4) show that the decision to engage in agricultural activities depends on agricultural factor inputs price and agricultural outputs price, as well as farmer and farming attributes of households tend to affect household's agricultural production, net returns, demand for factor inputs and output levels in South Africa. The connotation is further stated in mathematical form in equation (5)

$$agpr = \eta_1 ghc_i + \eta_2 d_i + \xi_i \quad (5)$$

agpr represents the household agricultural engagement in the last one year and ghc represents the determinants of household agricultural production/activities in the last one year which is categorised into farmers, farming and assets characteristics. The farmers characteristics are the demographic attributes of the household involved in agriculture; age of household head, gender of household head, education level of household head, household size, location etc. Farming characteristics are the direct implements/tools required for agricultural activities; loan, grant, support (agriculture extension program) etc. Asset characteristics are other properties owned by the farmers/households that facilitate agricultural production; access to

land, ICTs equipments for communication and research etc . Mafizur et al. (2017) and Ochieng et al. (2014) model and indicators on agricultural production and ICT in their study form the rationale for variable measurement in this study with modification. Mafizur et al. (2017) employed macroeconomic variables but in this study microeconomic variables are used in order to capture the impact analysis at the household level. In this regard, Ochieng et al. (2014) conducted the impact analysis of ICT program on productivity with the aid of microeconomic variables in Kenya. The household survey data are categorical in nature, applying ordinary least square (OLS) will yield bias estimation, so logistic regression through maximum likelihood technique is one of the sufficient method of estimating categorical data.

Since, the rationale for this study lies in the impact evaluation of ICTs use by household in agricultural production, in which if household engages in agricultural activities; the probability is one and if otherwise zero. Then, stating (5) in probability form yields (6)

$$P_{ri}=E\left(agpr_i= 1/f_i \right) \quad (6)$$

Where f_i is the vector of ghc_i (farmers, farming and assets characteristics of the household) and d_i denotes the dummy variables. f_i implies that probability of an household engaging in agricultural production; 1, but if otherwise not engaging in agricultural production; 0. The vector of farmers' attributes in this study are gender, age and household size; vector of farming characteristics are land and labour, and vector of assets are telephone, cellular and internet.

The outcome of logistic regression are in ratio form which is represented as a relative exponential function.

$$e^{f_i} = e^{\eta_1 ghc_i+\eta_2 d_i+\xi_i} \quad (7)$$

substituting (7) in (6);

$$P_{ri}=E\left(agpr_i= 1/f_i \right)=\frac{1}{e^{\eta_1 ghc_i+\eta_2 d_i+\xi_i}} \quad (8)$$

Assuming $Z_i = \eta_1 ghc_i+\eta_2 d_i+\xi_i$ (9)

Thus, $P_{ri} =\frac{1}{1+e^{-Z_i}}=\frac{e^{Z_i}}{1+e^{Z_i}}$ (10)

The equation (10) represents the cumulative logistic distribution function, where P_{ri} ranges from 0 and1 and Z_i ranges from - ∞ to + ∞.

If P_{ri}, is the probability of household engaging agricultural activities, then $(1-P_{ri})$ is the probability of household not engaging in agricultural activities. It is mathematically stated as:

$$(1-P_{ri})=1-\frac{e^{Z_i}}{1+e^{Z_i}} \quad (11)$$

$$1-P_{ri}=\frac{1}{1+e^{Z_i}} \quad (12)$$

The odd ratio of household agricultural production in South Africa is (10) divided by (12)

$$\frac{P_{ri}}{1-P_{ri}}=\frac{e^{Z_i}}{1+e^{Z_i}}\Big/\frac{1}{1+e^{Z_i}} \quad (13)$$

$$\frac{P_{ri}}{1-P_{ri}}=e^{Z_i} \quad (14)$$

Taking the natural log of (14) to obtain the liner probability equation for estimating household agricultural production:

$$L_i = Ln\left(\frac{P_{ri}}{1-P_{ri}}\right) = Ln\left(e^{Z_i}\right) \quad (15)$$

$$L_i = Z_i \quad (16)$$

Thus,

$$L_i = \eta_1 ghc_i + \eta_2 d_i + \xi_i \quad (17)$$

We estimate the probability effect of vector of farmers' attributes (gender, age and household size), vector of farming characteristics (land and labour) and vector of household assets (telephone, cellular and internet) on household agricultural production with (17). Therefore, equation (17) is a binary logistic equation in which maximum likelihood techniques of estimation are applied since OLS will yield bias estimates due to categorical nature of the target variable, household agricultural production. Thus, the summary of the dataset in this study are presented in table 1.

Table 1: Summary of dataset

Variable	Variable definition	Measurement in the questionnaire	Code of categorical set	Source
agricultural production	Household agricultural activities	Has the household been involved in the production of any kind of food or agricultural products during the past twelve months? (e.g. livestock, crops, poultry, food gardening, forestry, fish, etc.)	1 = Yes 0 = No	StatSA Survey, 2016
gender	Sex of household head	Is ..... a male or a female?	1 = Male 2 = Female	StatSA Survey, 2016
age	Age of household head	What is …..'s date of birth and age in completed years?	-	StatSA Survey, 2016
household size	Household size	Total number of persons in household	-	StatSA Survey, 2016
land	Size of the land that the household use	Approximately how big is the land that the household use for production? Estimate total area if more than one piece.	1 = Less than 500m^2 (approximately one soccer field) 2 = 500m^2 to 9 999m^2 (between one soccer field and one hectare) 3 = 1 but less than 2 hectares 4 = 2 but less than 5 hectares 5 = 5 but less than 10 hectares 6 = 10 but less than 20 hectares	StatSA Survey, 2016

			7 = 20 or more hectares 8 = Do not know	
telephone	Land/CDMA telephone	Does this household have a functional/working landline telephone in the dwelling?	1 = Yes 2 = No	StatSA Survey, 2016
cellular	Mobile telephone	Is there a functional/working cellular telephone available within this household?	1 = Yes 2 = No	StatSA Survey, 2016
internet	Internet connection in the household	Internet connection in the household	1 = Yes 2 = No	StatSA Survey, 2016
labour	Member of household engaging in agricultural activities	How many household members, aged 15 years or older, were involved in these agricultural activities, even if only once in a while?	-	StatSA Survey, 2016

Note: - open-end response

4. RESULTS AND ANALYSIS

The respondents' characteristics are categorised to farmer's attributes, farming characteristics and household assets in this study. The results show that 80.1 percent of the respondents (households) are not involved in agricultural activities while only 19.5 percent of the households are partaking in agricultural activities in South Africa. This results evident that about 20 percent of the households are involved in agricultural production in South Africa. Distribution of the household heads by gender shows that 58.3 percent of the respondents are male while only 41.7 percent are female household head. Age distribution of the household heads revealed that the average age of the household head is approximately 48 year with the

upper age limit to be 58 year and lower age limit to be 35 year. The median age of the household head is 46 year which is close to the mean age. The household size of the respondents show that 23 percent of the respondents are stand alone family size with one family member; 19 percent with two family member; 16 percent with three family member; 15 percent with four family member; 10 percent with five family member; 6 percent with 6 family member and 9 percent with more than 6 family member in South Africa.

Table 2: Respondents' characteristics results and analysis

Farmer (household) attributes		**Farming characteristics**		**Assets**	
Variable	**Percent**	**Variable**	**Percent**	**Variable**	**Percent**
Household agricultural activities		**Size of the land that the household use**		**Land/CDMA telephone**	
Yes	19.5	Less than 500 m^2	13.3	Yes	10.0
No	80.1	500 m^2 to 9 999 m^2	1.3	No	89.2
Sex of household head		1 but less than 2 hectares	0.2	**Mobile telephone**	
Male	58.3	2 but less than 5 hectares	0.1	Yes	95.8
Female	41.7	5 but less than 10 hectares	0.1	No	4.1
Age of household head		10 but less than 20 hectares	0.0	**Internet connection in the household**	
Mean	47.55*	20 or more hectares	0.1	Yes	8.0
Standard Deviation	15.75*	**Member of household engaging in agricultural activities**		No	91.7
Percentile 25	35.00*	1	8.8		
Percentile	46.00*	2	5.4		

50 Percentile 75	58.00*	3	2.1	
Household size		4	0.9	
1	22.8	5	0.3	
2	19.4	6	0.1	
3	16.2			
4	14.9			
5	10.3			
6	6.4			
7	3.8			
8	2.4			
9	1.4			
10	1.4			

Source: Authors' computation, 2018
Note: unspecified and not applicable responses are not reported, * not in percent

The farming attributes of the respondents are captured access to farming land and number of family members used for farming. The results show that 13 percent of the respondents use less than 500 m2 (approximately one soccer field) for agricultural production and 1 percent of the respondents use 500 m2 to 9,999 m^2 (between one soccer field and one hectare) for agricultural production. And less than one percent of the respondents use 1 but less than 2 hectares, 2 but less than 5 hectares, 5 but less than 10 hectares, 10 but less than 20 hectares and 20 or more hectares for agricultural production in South Africa.

The assets of the household as they impact on the agricultural production are captured from the perspective of the information and communication technology [ICT] (land/CDMA telephone, mobile telephone and internet connection in the household). The results show that 10 percent of the households have access to land/CDMA telephone but 89 percent do not have access to land/CDMA telephone. The study further shows that 96 percent of the household have access to mobile telephone and only 4 percent of the households

do not have access to mobile telephone. And, 92 percent of the respondents have internet connection in the household but 8 percent do not have access to internet connection in the household in South Africa.

Table 3: Binary logit estimates for household agricultural production in South Africa

Variable	Coefficient	Wald statistic	p – value	Odds ratio
Constant	11.798	117.364	0.000	132994.842
gender	0.014	0.011	0.915	1.014
age	0.032***	56.045	0.000	1.032
household size	0.118***	25.080	0.000	1.125
land	-0.122***	121.524	0.000	0.886
telephone	-0.037	0.152	0.696	0.963
cellular	-0.116	0.185	0.667	0.890
internet	0.340***	12.769	0.000	1.404
labour	-0.091***	1234.053	0.000	0.913

N = 21,601, Nagelkerke R^2= 0.928 , $\chi 2$ = 18847.457*** (0.000)

Source: Authors' computation, 2018
Note: "*", "**" and "*" indicate at least significant at 1 percent, 5 percent and 10 percent level.**
Reference category: Yes

The empirical results show that gender (sex of household head), age (age of household head), household size and internet (internet connection in the household) are directly related to household agricultural activities in South Africa. The coefficients of land (size of land use for farming by household), telephone (land/CDMA telephone use by household), cellular (mobile telephone use by household) and labour (member of household engaging in agricultural activities) are inversely related to household agricultural production in South Africa. These results imply that sex of household head, age of household head, household size and internet connection in the household have positive impact on household agricultural production

in South Africa. Whilst size of land use for farming by household, land/CDMA telephone use by household, mobile telephone use by household and member of household engaging in agricultural activities have negative impact on household agricultural production in South Africa.

The Wald test revealed that age of household head, household size, size of land use for farming by household, internet connection in the household and member of household engaging in agricultural activities are statistically significant to household agricultural production at 1 percent significance level. But, sex of household head, land/CDMA telephone use by household and mobile telephone use by household are statistically insignificant to household agricultural production at least at 10 percent significance level. The assertions of the wald tests are further validated by the odds ratio of the predictors (sex of household head, age of household head, household size, size of the land that the household use, land/CDMA telephone, mobile telephone, internet connection in the household and member of household engaging in agricultural activities) and as it shows the proportion of their contributions to household agricultural production in South Africa. The results show that sex of household head, age of household head, household size and internet connection in the household have the potential of contributing more proportionately to household agricultural production. The return to scale of production for sex of household head, age of household head, household size and internet connection in the household are higher. Whilst proportionate contributions of land that the household use, land/CDMA telephone, mobile telephone and member of household engaging in agricultural activities to household production are less in South Africa.

Coefficient of variation of the predictors is evaluated using Nagelkerke R square coefficient and the result suggested that sex of household head, age of household head, household size, size of the

land that the household use, land/CDMA telephone, mobile telephone, internet connection in the household and member of household engaging in agricultural activities caused 92.8 variations in household agricultural production but inexact components are responsible for 7.2 percent variations in household agricultural production in South Africa. The overall significance of the predictors to household agricultural production is determined through chi-square test and the result shows that the predictors (sex of household head, age of household head, household size, size of the land that the household use, land/CDMA telephone, mobile telephone, internet connection in the household and member of household engaging in agricultural activities) are jointly significant to household agricultural production at 1 percent significance level in South Africa.

5. CONCLUSION AND RECOMMENDATIONS

The internet connection in the household is the only ICTs proxies that aligned with a priori expectation and this may be due to the importance of internet access to research and development that can spur household agricultural production in South Africa. The study shows that size of the land that the household use for agricultural production currently is significant but has negative relationship with household agricultural production which partially negate the a priori expectation. Land shows some level of statistical significance to agricultural production in South Africa but access to land for farming may be one of the limitations to household involvement in agricultural activities. As a result of these assertions, this study recommends that:

1. The telecommunication operators should ensure access to internet facilities in the household by making internet connection cheaper on the mobile telephone since more than 90 percent of the households are using mobile telecommunication. Also, encouraging households to use internet enabled telephones

such as smart phones. Having access to internet in the household will encourage further research in agriculture that enhance productivity.

2. Government should make land accessible for agricultural production. This will encourage households to engage in agricultural activities and may serve as a source of employment and wealth creation, thereby reducing unemployment rate.

3. There should be a policy to encourage people above 58 years to relocate to the rural areas where they can easily practice agriculture since they would have gain wide range of experience and they getting closer to retirement age, thus eventually retired to agricultural practice.

4. There should be programs subsidizing farm implements so that modern tools can be access for agricultural production and thereby enhancing productivity.

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