INFLUENCE OF PERCEPTION AND QUALITY OF ICT-BASED AGRICULTURAL INPUT INFORMATION ON USE OF ICTS BY FARMERS IN DEVELOPING COUNTRIES: CASE OF SIKASSO IN MALI

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ABSTRACT
Small-scale cereal farmers dominate agricultural activities in developing countries. These agricultural activities are characterized by low productivity due to lack of agricultural input information. This lack is restrained by the low use of ICTs caused by some factors such as the farmers' perception of ICTs and the ICTs' delivered information quality. We investigated these factors and their effects on ICTs' use by small-scale cereal farmers in developing countries. Sikasso region in Mali was selected as a case. A convenient sample size of 300 cereal farmers was selected. Partial Least Squares Structural Equation Modelling technique was used to analyse the data. The results suggested that the perception i.e. relative advantage, compatibility and simplicity and the delivered information quality were able to explain 77.9% of the variance in the Use of ICTs to access and use agricultural input information. From these results, it is important to take the Relative Advantage, Compatibility, Simplicity and Information Quality as the main factors determining the use of ICTs in developing countries in the cereal production context. A further line of inquiry could be to gather data from other developing countries to validate or find out more factors in such settings.

KEYWORDS
Agriculture, Productivity, Information, Use, ICT, Input, Mali

1. INTRODUCTION
Agriculture constitutes the backbone of developing countries' economy. Small-scale farmers dominate it and cereals constitute the main part of the agricultural production in these countries. For instance in Mali, the agriculture sector is dominated by small family farms (68%) which grew by 7.7% in 2010 and contributed 37% to the country's Gross Domestic Product in 2008 (Angelucci et al., 2013). In addition, cereals constitute the main part of the Malian agricultural production: millet 41%, maize and rice 15%, sorghum 26% and fonio 3% (MAFAP, 2013). In Ethiopia, in the year 2010/11, over 96 percent of cereals were produced by smallholder farmers (Bwalya et al., 2012).

The agricultural activities are characterised by low productivity. A sustainable agricultural intensification is necessary to reach better food security levels (AGRA, 2014). Such objective cannot be achieved without the greater adoption of inputs that permit an increase of the yield (IFDC, 2004). It was emphasised that one of the sources of productivity increase is technological improvements through access to improved farm input technologies (Staatz & Temé, 2015). Farmers should be able to achieve higher yields if they use good practices, have access to inputs and use them.

Agricultural inputs' adoption and use depend largely on the availability (access) and use of agricultural input information. For instance, in Tanzania, farmers' decision to adopt inputs are greatly influenced by the amount of information that is available (Msoffe & Ngulube, 2016). Hence, well-informed farmers make wise decisions, which in turn are responsible for improving agricultural productivity.

Information and Communication Technologies (ICTs) such as mobile phone and telecentres play a key role in the dissemination of information on agricultural inputs for more access and use of agricultural input information. For instance, telecentres have been set up in many developing countries such as India, Tanzania, Uganda, Zambia, Mali (Kaddu, 2011; Kameswari et al., 2011; Souter, 2010) to disseminate agricultural input information towards farmers. In addition, Mobile applications have been used to disseminate agricultural input information to farmers. We can cite Senekela and MyAgro in Mali; Nokia Life in India, Indonesia, Nigeria and China; Indian Farmers Fertilizer Cooperative Limited (IFFCO) Airtel Initiative and E-choupal in India; TigoKilimo in Tanzania; Ukisaan and Kissan in Pakistan (Chung, 2015; GSMA, 2015; Pshenichnaya & Clause, 2013; Singh et al., 2016; Siraj, 2010). Therefore, ICTs' services on agricultural input information are available in developing countries. In other words, (small-scale cereal) farmers have been exposed to these ICTs.

Despite this availability of different ICTs channels, access and use of agricultural input information remain a problem for farmers in developing countries. For instance, in Kenya, there is still room for improvement since a large number of the country's 3.5 million smallholder farmers still work without basic agricultural inputs (KTM, 2013). In addition, in Tanzania, the increasing use of ICTs has not benefited the agricultural sector (Mtega & Msungu, 2013). Though efforts have been made to apply ICTs in the agricultural input information sector, the contribution of ICTs to the access and use of agricultural input information is far from expectations (Kante et al., 2016).

1.1. Study's Motivation

The insignificant contribution of ICTs to the access and use of agricultural input information in developing countries is due to the low use of ICTs. Mittal & Mehar (2012) argue that overall ICTs' have not yet been able to create an impact as expected, possibly because there are challenges (factors) in putting the new knowledge to use. An investigation needs to be conducted into these challenges (factors) affecting farmers' use of ICTs to access and use agricultural input information and their relationships to inform the design and delivery of this information service to small-scale cereal farmers.

Studies picked out that the perception of ICTs by farmers influence their use of ICTs on agricultural input information. For instance, in Kenya, it was argued that farmers found the access to production information via mobile phone complicated (Odhiambo, 2014). In addition, in Benin, a study concluded that the use of ICT requires positive attitude from the actors (Adegbidi et al., 2012). Nevertheless, what are these perceptions and to what extent are they influencing ICTs' use by small-cereal farmers remain two questions that were not answered by these studies.

Another key factor emerging as an important factor in the use of ICTs on agricultural input information is the information quality. It refers to the characteristics of the content (Msoffe & Ngulube, 2016). The content delivered to farmers is important to them. For instance, it was reported that farmers voiced the need to improve the quality, reliability and timeliness of the information delivered to them (Mittal & Mehar, 2012). Information is seen as a valuable and useful tool to people in their attempts to cope with life but the value of information depends on many conditions including accessibility, relevance, accuracy and currency (Chilimo & Sanga, 2006; Heeks & Molla, 2009). Therefore, it is important for information providers to ensure that they disseminate information that satisfies farmers' need and is appropriate to their farming practices (Msoffe & Ngulube, 2016). However, what are these characteristics and to what extent do they influence small-scale cereal farmers ICTs' use remain questions that need to be addressed.

1.2. Study's Objective

The overall objective of this study was to identify the influence of perception and quality of ICT-based agricultural input information on the use of ICTs by small-scale cereal farmers in developing countries focusing on the case of Sikasso in Mali.

The specifics objectives are:

1. to establish farmers' perception of ICTs on agricultural input information and to identify its effects on the use of these ICTs;
2. to establish agricultural input information quality as perceived farmers and to identify its effects on the use of these ICTs.

This study refers to cereal as millet, sorghum, maize, rice and fonio. Adoption is the decision to start using something such as ICTs in this case. We refer to Adoption and Use interchangeably to specify that decision. This paper assumes that: a) the use of agricultural inputs will increase the agricultural productivity; b) other factors can affect ICTs' use and c) other factors can affect the agricultural productivity. Finally, in this study agricultural input information is any information on crop planning (better information on higher yield crops and seed varieties), buying seeds (identify the best time to plant and source of inputs), planting (use better fertiliser and apply better techniques). This paper is an improvement of two conference proceedings (Kante et al., 2017a; 2017b).

The study is organised as follow: a literature review discusses the state of ICTs on agricultural input information in developing countries and particularly in Mali focussing on the emerging constructs. The literature review also provides a theoretical background and a conceptual framework for this study. The research methodology section discusses the study design, sampling and research tools. The next section, which is results and discussion, deals with the findings and discusses them. Finally, the last section provides the conclusions of the study and makes a recommendation for future inquiries.

2. LITERATURE REVIEW

The first subsection presents the development of ICTs on agricultural input information in Mali. The last subsection describes the constructs used to measure farmers' perception of ICTs and agricultural input information quality and to identify their effects on the use of ICTs on agricultural input information. It also provides the identified gap. The section defines and transforms the identified empirical constructs into theoretical constructs by exploring the models in the field of IT adoption research that fit the most these constructs.

2.1. Developments of ICTs on Agricultural Input Information in Mali

The most dominantly used ICT channel to access and use agricultural information in Mali and elsewhere is the mobile phone. The mobile phone was introduced in Mali in the 1990s with only one network provider. Its use has grown since then in terms of the number of network providers, coverage, subscriptions and services offered. For instance, in 1999, there were 6,375 mobile phone subscribers, 4.5 million subscribers in 2009 and 10.3 million in 2014 (GSMA, 2015; Issa FOFANA, 2010).

ICT services on the mobile phone for farmers started in 2011. Myagro (N'gasene), another ICT service for farmers started to disseminate information on agricultural input for farmers in 2011. Orange Mali (network provider) launched the ICT Value Added Service (VAS) Senekela in 2014 in the region of Sikasso. These are the two ICT services disseminating agricultural input information in Mali towards cereal farmers.

Senekela relies on a call-centre with agronomists who give advice to the farmers - in French and in Bambara (A local language) - on all their daily questions in the agricultural domain including planting methods, the seeds to use, sowing time and application of fertilisers.

The service had 177,817 customers in 2014 (GSMA, 2015). This number is very small compared to the potential users in the country where 73% of the population worked in the agricultural sector and the operator (Orange Mali) has two-third of 12, 832,814[1] customers in the country. This provides evidence that the adoption (use) of the service by small-scale cereal farmers to access and use agricultural input information is very low.

Myagro enables farmers to purchase high-quality agricultural inputs (certified seeds and fertiliser) on layaway (agreement in which the seller reserves an item for a consumer until the consumer completes all the payments necessary to pay for that item) through an SMS-based platform and a network of local vendors. It helps farmers to get information that would increase their crop yields by using modern planting techniques and providing access to simple agricultural machines that can make their work more efficient and effective and eventually increase their profitability. The service started with approximately 3,500 customers. It has reached over 18,000 customers by the year 2016. The same observation (limited users) goes for this ICTs' service also in terms of users (farmers using it to access and use agricultural input information).

2.2. Theoretical Background

This section describes the constructs used in this study. It then goes on by extracting them from theories, model, and thereby transforming them into theoretical constructs. The section also provides a conceptual framework.

2.2.1 Farmers' Perception of ICTs on Agricultural Input Information

The perceived attitudes (relative advantage, simplicity, observability, compatibility and trialability) are important in the adoption and use of ICTs (Atkinson, 2007; Rogers, 1983). However, Compatibility, relative advantage and complexity are the most perceived construct in the use of ICTs (Carter & Belanger, 2004).

The Relative Advantage, Compatibility and Simplicity were empirically identified as affecting the use of ICTs to access and use agricultural input information. Table 1 summarises the authors and developing countries where these factors were identified. Therefore, these three factors will be used to measure farmers perception of ICTs on agricultural input information.

The Relative Advantage, Compatibility, Simplicity and Information Quality were some of the keys factors that came out (Table 1). Adegbidi et al. (2012) quoting Lunkuse (2004) argue that the relative advantage of an innovation as its perceived usefulness, that is "the degree to which the user's subjective probability that using a specific system will enhance his or her productivity". In this case, it is farmers' subjective probability that using ICTs on agricultural input information will enhance his/her knowledge (information) on access and use of agricultural inputs, which in turn will enhance his/her productivity. The Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters (Adegbidi et al., 2012). Simplicity is the degree to which an innovation (ICTs in this case) is perceived as relatively easy to understand and use (Rogers, 1983). This study, therefore, states that:

H1. Relative Advantage has a positive effect on ICTs' use to access and use agricultural input information

H2. Compatibility has a positive effect on ICTs' use to access and use agricultural input information

H3. Simplicity has a positive effect on ICTs' use to access and use agricultural input information

[1]Source: Malian Regulatory Authority of Telecommunications /ICT and Post (http://amrtp-mali.org/OM/)

Table 1. Factors Matrix

Factors	Empirical Evidence	Developing Country
Relative Advantage	(Adegbidi et al., 2012; Al-Ghaith et al., 2010; Chung, 2015; Palmer, 2015; Rezaei-Moghaddam & Salehi, 2010; Surendran, 2012)	Benin, India, Indonesia, Iran, Kenya, Mali, Nigeria, Pakistan, Tanzania, Uganda, Senegal
Compatibility	(Adegbidi et al., 2012; Atkinson, 2007; Carter & Belanger, 2004; Palmer, 2015; Rezaei-Moghaddam & Salehi, 2010; Surendran, 2012)	Benin, India, Indonesia, Iran, Kenya, Mali, Nigeria, Pakistan, Tanzanie, Ouganda, Sénégal
Complexity/Simplicity	(Adegbidi et al., 2012; Al-Ghaith et al., 2010; Atkinson, 2007; Carter & Belanger, 2004; Dandedjrohoun et al., 2012; Palmer, 2015; Rezaei-Moghaddam & Salehi, 2010; Surendran, 2012)	Benin, India, Indonesia, Iran, Kenya, Mali, Nigeria, Pakistan, Tanzania, Uganda, Senegal
Information Quality	(Atajeromavwo et al., 2010; Hatakka & De, 2011; Heeks & Molla, 2009; Mittal & Mehar, 2012; Msoffe & Ngulube, 2016; Myagro, n.d.; T. Palmer, 2014, 2015)	India, Kenya, Mali, Nigeria, Tanzania, Pakistan, Uganda

Source: Adapted from Kante et al. (2016)

2.2.2 Information Quality

Farmers question the effectiveness of this information. For instance, in India, a study on ICTs and Agriculture development argue that information relating to the availability of agricultural inputs and prices were also perceived as "less appropriate" by 72,5% of Gyandoot[2] farmers (Meera et al., 2004). Similarly, a study on an agricultural value added service (VAS) conducted in Mali found that the information provided was incomplete (Palmer, 2014). Many farmers do not have adequate information on how to use the inputs that they access (ibid).

Agricultural input information quality influences the use of ICT in developing countries. For instance, in Uganda, it was argued that the value of (agricultural input) information depends on many factors including accessibility, relevance, accuracy and currency (Kaddu, 2011). In addition, in a study on ICT for development in developing countries, it was reported that the participants said that for information to be useful or valuable, it needs to be timely, understandable, directed, from a trusted source, inclusive and non-subversive (Beardon et al., 2005). Moreover, in Mali, participants in a case study on Senekela revealed that the agronomy and market price advisory provided by Sènèkèla might not meet all of their information needs. There are some characteristics affecting information quality accessed through ICTs (GSMA, 2015). Furthermore, to leverage the full potential of information dissemination enabled by mobile telephony along with supporting infrastructure and capacity building amongst farmers, it is essential to ensure the quality of information, its timeliness and

[2]A district in India

trustworthiness (Mittal & Mehar, 2012). Therefore, the quality of the information will contribute to the frequent use of ICTs in the agricultural inputs sector, which will lead to more contribution. Thereby, there is a need to look at the quality of the information delivered and to identify its effect on the use of ICTs on agricultural input information. Hence, we hypothesised that:

H4. Information Quality has a positive effect on ICTs' use to access and use agricultural input information

Agricultural input information completeness means that all the data necessary to meet the current need for farm input information was provided by the ICTs. The accuracy means that the information on agricultural inputs was correct for the users' need of information on agricultural inputs. It implies that information is free from bias (Siyao, 2012). Timeliness means that the farmers can get the information on agricultural inputs when they need it. Relevance means that the information is suitable for the current information need for agricultural inputs. Appropriateness means that the information is suitable for the current need for agricultural input information.

2.2.3. Conceptual Framework and Hypotheses

Theories and Models intend to explain users' adoption of a technology like small-scale cereal farmers use of ICTs to access and use agricultural input information. IS research was built upon the use of theories (Lim et al., 2009).

Doing a literature review from 1998 to 2006, covering 386 research articles, Lim et al. (2009) identified 154 theories in the field of IS research. Among these, they were ten widely used theories. When it comes to Information Technology and Individuals study, they identified five most used theories: the Technology Acceptance Model (TAM), the Theory of Reasoned Action (TRA), the Diffusion of Innovation Theory (DOI/IDT), the Theory of Planned Behaviour (TPB) and the Social Cognitive Theory (SCT).

Nevertheless, in the field of agricultural input information and technology adoption research, the DOI has been applied in Benin (Adebedi et al, 2012) to propose a model for ICTs' adoption by rice farmers. In Iran, TAM and DOI have been applied to predict the factors affecting intention to the adoption of precision agriculture technologies among agricultural specialists (Rezaei-Moghaddam & Salehi, 2010). These models in Benin and Iran have shortcomings. For instance, the model in Benin did not address the Social Influence as a factor in the use of ICTs by rice farmers. Moreover, the targeted cereal crop was only rice while it was argued that the most important cereals in Africa are maize, sorghum and millet, with wheat and rice increasing in importance (Wood & Cowie, 1988).

DOI has five characteristics which determine the rate of adoption: relative advantage, compatibility, complexity, trialability and observability (Rogers, 1983). The theory attempts to predict the behaviour of individuals and social groups in the process of adoption (use) of innovation, considering their personal characteristics, social relations, time factor and the characteristics of the innovation (Tomaš-Simin & Janković, 2014). It categorises the adopters of a technology into innovators, early adopters, early majority, late majority and laggards forming a bell shaped curve (Rogers, 1983). This study is part of a wide research that aims to propose a model for more use of ICTs by small-scale cereal farmers to access and use agricultural input information using the DOI as the basis theory. However, this paper is interested only in the influence of perception and quality of ICT-based agricultural input information on the use of ICTs.

The Diffusion of Innovation Theory has the construction Adoption (Use), Relative Advantage, Compatibility and Simplicity as defined in this study and has been applied in the field of agricultural input information. Thus, we chose to use these factors. Nevertheless, the theory does not have the construct Information Quality that was empirically supported.

We extract the construct Information Quality from this model, which approach is that lack of access to information exposes individual and communities to vulnerabilities (Heeks & Molla, 2009).

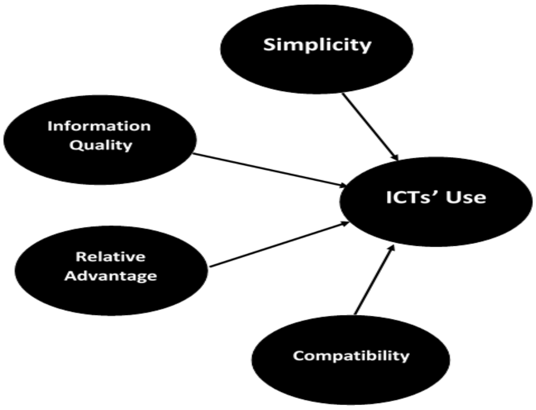

Figure 1: Conceptual Model

3. RESEARCH METHODOLOGY

Research methodology is divided broadly in two: quantitative and qualitative. The study was conducted through quantitative methods. A quantitative research is based on traditional scientific methods, which generates numerical data and usually seeks to establish causal relationships (or association) between two or more variables, using statistical methods to test the strength and significance of the relationships. A cross-sectional survey strategy was adopted.

3.1. Population, Sample and Sampling procedure

Sikasso was the third administrative region of Mali with a surface area of 71,790 km2 and a population of 2,643,179 and 406,774 households in 2009 (RGPH, 2013). It has seven districts (Sikasso, Bougouni, Kadiolo, Kolondieba, Koutiala, Yanfolila and Yorosso). The region of Sikasso was purposively selected because it was the main coarse grain (millet, sorghum, maize and fonio) production area in Mali (DRPSIAP, 2011). The choice of our district was based on: a) ICT services in the area and b) cereal production (maize, millet, sorghum, fonio and rice). Two ICTs' services were operating on agricultural input information in Mali especially in Sikasso as discussed above. Bougouni was the Sikasso district with the largest number of farmers using the ICT Myagro (Kante & Myagro, 2016). For Senekela, Koutiala was the district where the service has the largest number of farmers but these farmers were mainly trial users. Therefore, we chose Bougouni. The district has a cereal production of 105,805.07 tonnes and a population of 69,750 households (DRPSIAP, 2011; RGPH, 2013).

Bougouni has 9 communes where cereals are produced (DRPSIAP, 2011) and the ICTs on agricultural input information cover four (4) of these 9. Therefore, our strata were these four communes. Among these 4 communes, only Zantiebougou's farmers produce all the cereal crops (that were the interest of this study) (DRPSIAP, 2011; PROMISAM, 2012) and also the commune has the largest number of farmers using the ICT Myagro (Kante & Myagro, 2016). Thus, we chose that commune (Table 2).

Table 2: Samples (communes) from Districts

District	Number of Communes	Commune Chosen	Number of Villages	Sample
Bougouni	4	1 (Zantiebougou)	16	4

We adopted a purposive sampling for the selection of our villages from the selected commune. In the commune of Zantiebougou, the village of Sirakoro, Zantiebougou, Monzondougou Koloni and Oure had the largest number of farmers using ICTs on agricultural input information with respectively had 152, 473, 194 and 139 households (RGPH, 2013). A random sampling was adopted for the respondents.

The sampling frame was a list of households of cereal farmers. A sample size of 200 cases was enough (Kline, 2013). We proposed to collect data from 300 respondents, which would be at least 50% above the required number. We spread out this number to the four selected sites proportionally (Table 3).

Table 3: Sample Distribution

<table>
<tr><th>District</th><th>Commune</th><th>Village</th><th>Households</th><th>Sample</th></tr>
<tr><td rowspan="4">Bougouni</td><td rowspan="4">Zantiebougou</td><td>Zantiebougou</td><td>473</td><td>473*300/958 = 148.12 ≈ 148</td></tr>
<tr><td>Monzondougou koloni</td><td>194</td><td>194*300/958 = 60.75 ≈ 61</td></tr>
<tr><td>Sirakoro</td><td>152</td><td>152*300/958 = 47.59 ≈ 48</td></tr>
<tr><td>Oure</td><td>139</td><td>139*300/958 = 43.52 ≈ 43</td></tr>
<tr><td>1 district</td><td>1 commune</td><td>4 villages</td><td>958</td><td>300</td></tr>
</table>

3.2. Data Collection Tools and Methods

Data were collected between May and July 2016 through a survey questionnaire adapted from researchers (Atkinson, 2007; Ventkatesh et al., 2003). This period coincides with the beginning of the rainy season, which is the planting season, in Mali. Hence, it was the time where farmers look for agricultural inputs and information on agricultural inputs.

We used and adapted the survey instrument from Atkinson (2007) and Ventkatesh et al. (2003) to refer to ICTs on agricultural input information. Respondents were requested to fill the questionnaires and return them to enumerators as appropriate. If they could not fill, statements were read out to them and they were asked to indicate their level of agreement or disagreement on a 5-point Likert scale: 1=strongly agree, 2=agree, 3= neutral, 4=disagree, and 5=strongly disagree.

3.2.1. Instrument Translation

The instrument of data collection adapted was in English and we needed to collect data in Mali, in the region of Sikasso. Therefore, there was a need to translate the instrument into French and Bambara (A local language spoken in the study area). The increasing need for non-English language data collection instruments and other survey materials has clearly given recent figures (Pan & de la Puente, 2005). The Census Bureau Guidelines (Pan & de la Puente, 2005) was used to translate the instrument.

3.2.2. Instrument Validation

The instrument was also validated before the main study to assess its validity and reliability. The widely pretesting technique cognitive interview was used to pre-test the survey instrument with six respondents (6) who were grounded in the field of ICT4D. It helped us to contextualise the instrument. In Addition, a pilot study was conducted with forty small-scale cereal farmers in the study area. This helped us to assess and validate our survey instrument. To enhance the instrument reliability and validity, some items were dropped.

3.2.3. Field Approach

For the identification of the respondents, we visited first the villages and thereby identified the community leader. We then explained to him/her the aim of the study. We scheduled with him/her the best time to conduct our study in the village. Participation in this study was voluntary.

3.3. Data Analyses

We entered the data collected into IBM SPSS v20 for analyses that involved simple frequency tables and descriptive statistics such as means and standard deviations. Data were analysed using the Partial Least Square Structural Equation Modelling (PLS-SEM). PLS-SEM models are path models in which some variables may be effects of others while still be causes for variables later in the hypothesized causal sequence (Garson, 2016). PLS-SEM models are an alternative to covariance-based structural equation modelling (traditional SEM). It is highly recommended in the field of Information System research. For instance, Evermann & Tate (2010) identify IS as the primary user of PLS.

PLS-SEM has two models. The outer model determines the meaning of the constructs in the inner model (Garson, 2016). On the other hand, the structural model or inner model represents the causal model. Table 4 and 5 display the criterions on the measurement of each model.

Table 4: Measurement Model Assessment Criterion

Validity type	Criterion	Description	Literature
Indicator reliability	Indicator loading > .600	Loadings represent the absolute contribution of the indicator to the definition of its latent variable.	(Urbach & Ahlemann, 2010)
Internal consistency reliability	Cronbach's α > 0.6	Measures the degree to which the MVs load simultaneously when the LV increases.	(Garson, 2016; Urbach & Ahlemann, 2010)
Internal consistency reliability	Composite reliability > 0.6	Attempts to measure the sum of an LV's factor loadings relative to the sum of the factor loadings plus error variance. Leads to values between 0 (completely unreliable) and 1 (perfectly reliable).	
Convergent validity	Average variance Extracted (AVE) > 0.5	It involves the degree to which individual items reflecting a construct converge in comparison to items measuring different constructs.	(Garson, 2016; Henseler et al., 2016; Urbach & Ahlemann, 2010)
Discriminant validity	Fornell-Larcker	Requires an LV to share more variance with its assigned indicators than with any other LV. Accordingly, the AVE of each LV should be greater than the LV's highest squared correlation with any other LV.	(Urbach & Ahlemann, 2010)

Table 5: Structural Model assessment criterion

Validity type	Criterion	Description	Literature
Model Predictability	Predictive relevance Q^2 > 0.05	By systematically assuming that a certain number of cases are missing from the sample, the model parameters are estimated and used to predict the omitted values. Q^2 measures the extent to which this prediction is successful.	(Garson, 2016; Henseler et al., 2016; Urbach & Ahlemann, 2010)
Model validity	Model fit SRMR < 0.08	SRMR is a measure of approximate fit of the researcher's model.	(Garson, 2016; Henseler et al., 2016)
Model validity	R^2 > 0.100	Coefficient of determination	(Urbach & Ahlemann, 2010)
Model validity	Path coefficients: Critical t-values for a two-tailed test are 1.65 (significance level = 10 percent), 1.96 (significance level = 5 percent), and 2.58 (significance level = 1 percent).	Structural path coefficients are the path weights connecting the factors to each other.	(Garson, 2016)

4. RESULTS AND DISCUSSION

We entered the data into SPSS with rows making entries for each respondent and columns capturing the responses for the corresponding question asked. The data screening showed that 40 questionnaires were either partially filled or filled by those who were not producing cereals disqualifying them for analysis. In addition, 38 responses had a low rate of responses. Thus, we had 222 valid responses. We had 178 ICT users against 44 non-users. There were four missing values distributed throughout the variables. We used the mean replacement for these missing values. This section discusses the findings.

4.1. Descriptive Statistics

There are two ways that a distribution can be non-normal, and they can occur either separately or together in a single variable (Kline, 2013). Skew implies that the shape of a unimodal distribution is asymmetrical about its mean. Positive skew indicates that most of the scores are below the mean, and negative skew indicates just the opposite. The Kurtosis measures the relative peak of the mean in a distribution. For a unimodal, symmetrical distribution, positive kurtosis indicates heavier tails and a higher peak and negative kurtosis indicates just the opposite, both relative to a normal distribution with the same variance (Kline, 2013).

As shown in Table 6, some of our variables absolute skew value were above +1 as suggested (Groeneveld & Meeden, 1984). Absolute values from about -1 to over +1 of this index are described as indicating "extreme" kurtosis. Our data distribution was not satisfying these two rules. This justifies our use of PLS-SEM, which is robust against Multivariate normality (Garson, 2016).

Table 6: Descriptive Statistics

Construct	Items	Mean	Std. Deviation	Skewness		Kurtosis	
				Statistic	Std. Error	Statistic	Std. Error
Relative Advantage	N'gasene/Senekela is better than using books or newspaper to get AII (ra-18)	1.41	.912	.094	.163	.506	.325
	N'gasene/Senekela is more interesting than other source of information that I have used to get AII (ra_19)	1.48	.906	-.172	.163	.367	.325
	Using N'gasene/Senekela made contribution to the access and use of AII than it would not be possible without them for me (ra_20)	1.38	.908	.129	.163	.221	.325
Compatibility	N'gasene/Senekela is suitable to the way that I like to get information on agricultural inputs (cp_21)	1.42	.840	-.596	.163	-.825	.325
	I think other farmers should use N'gasene/Senekela to access/use AII (cp_22)	1.45	.949	.176	.163	.639	.325
	Using N'gasene/Senekela made what I was doing about AII seem more relevant (cp_23)	1.59	1.063	.138	.163	-.164	.325
Simplicity	When using N'gasene/Senekela, I had no difficulty finding the information that I wanted (sp_24)	.84	.892	.406	.164	-1.432	.327
	I had no difficulty understanding how to get around in N'gasene/Senekela (sp_25)	.93	1.009	.551	.164	-.972	.327
	When using N'gasene/Senekela, I had no difficulty implementing the information that I got (sp_26)	.91	1.032	.702	.164	-.833	.327
Information Quality	The information I got from N'gasene/Senekela was complete i.e. all the data necessary to meet my current need for farm input information was provided (iq_33)	1.28	.838	.030	.163	-.246	.325
	The information I got from N'gasene/Senekela was relevant i.e. the information is suitable for the current need (iq_34)	1.50	.992	.055	.163	-.453	.325
	The information I got from N'gasene/Senekela was appropriate i.e. in the suitable format and quantity (iq_35)	1.35	.842	-.327	.163	-.665	.325
ICTs' Use	I use/plan to use N'gasene/Senekela regularly when preparing to plant my crops (use_36)	1.13	.774	.486	.163	.716	.325
	I intend to use/continue to use (use_37) N'gasene/Senekela	1.16	.789	.327	.163	.037	.325
	I recommend farmers to use N'gasene/Senekela (use_38)	1.48	.870	-.595	.163	-.726	.325

4.2. Respondents Characteristics

We described the characteristics of our respondent in terms of gender and age in Table 8. These results showed that 75.23% of our respondents were female. There were more female farmers using ICTs on AII: 74.72% female ICTs' users against 25.28% male. Although the man was the head of household in most cases, the woman was chosen by the household head to address the questionnaire if she wanted to. In addition, the women were the ones looking for information through ICTs for the household.

In most cases, farmers are expected to buy seeds and fertilisers via one large payment, which is almost an unachievable task. The Mobile Layaway plan helps small-scale farmers to pay for agricultural inputs (fertilisers, seeds, and training packages) on a layaway basis, using their mobile phone. This phenomenon is similar to how people buy talk-time for telephone conversations. Registered farmers can save easily when continuously topping up their Myagro (the most used ICTs' service in the area) accounts via the purchase of additional cards. The Mobile Layaway plan makes saving for these larger purchases as easy as buying a bar of soap or cup of oil. This method of payment (small amount) attract women than men. It explains the high number of Women using the service to access and use agricultural input information for the household.

A study entitled "Information technologies as a tool for agricultural extension and farmer- to-farmer exchange: Mobile-phone video use in Mali and Burkina Faso' by Sousa et al. (2016) argue that older male farmers have privileged access to agricultural information (including agricultural input information). Our findings on the gender and access to agricultural input information are in contrast with the finding of Sousa et al. (2016). However, they support the findings of Al-Ghaith et al. (2010) in Saudi Arabia.

In terms of age distribution, over 51% of the respondents were between 30 to 45 years old. A high rate 66.09% of these respondents were using ICTs was observed among women between 30 to 45 years (Table 7).

Table 7: ICTs' Use Distribution by Gender and Age

Age	ICT Use				Total	
	Yes		No			
	Female	Male	Female	Male	Frequency	Percentage
< 30	27	5	5	0	37	16.67%
30-45	76	17	18	4	115	51.80%
> 45	30	23	11	6	70	31.53%
Total	133	45	34	10	222	100%

Table 8 summarizes the skills of our respondents. The basic literacy rate was higher among ICTs' users than non-users. The same observation was made about the mobile phone skills (making a call and following up the given instructions). However, 54.5% and 67.57% of the respondents respectively could not write an SMS, take a picture, or download a video.

Nevertheless, farmers have access to somebody in the household who has the required skills if he/she is not the one using ICTs. With the advent of smartphones, it has become possible even for the illiterate farmers to use mobile phones with ease (Singh et al., 2016). The immediacy provided by touch screen technology in conjunction with audio-visual feedback can enable illiterate people to engage with digital information. Aker (2011) argues that the use of ICTs in rural extension may prove to be even more relevant in a context of widespread illiteracy, or even inexistent, access to extension services in much of rural Africa.

Table 8: Skills Distribution

Skills			Yes		No	Total
			ICT' user	ICT's non-user		
Literacy	Basic	Able to read and write alphabet letters and numbers	67.56%	13.51%	18.93%	100%
	Mean	Able to write a personnal letter or a brief description of an event	10.36%	4.50%	85.14%	100%
	Advanced	Fill out a form	7.65%	4.05%	88.30%	100%
Mobile phone skill	Write an SMS		29.28%	16.22%	54.5%	100%
	Call and follow up instruction given by a customer care centre		72.52%	16.22%	8.26%	100%
	Take a picture or download a video		51.80%	15.77%	67.57%	32.43%

4.3. Measurement Model Fit

PLS-SEM assessment typically follows a two-step that involves separate assessments of the measurement models (outer) and the structural model (inner). This section discusses the outer model assessment.

4.3.1. Convergent Validity

As shown in Table 9 provides the results of the assessment of the indicator reliability, Cronbach's alpha, Composite reliability and Average Variance Extracted.

- Composite Reliability

The reliability is defined as the truthiness to which a question extends in its claim to measure what it intended to measure. Construct reliability assessment routinely focuses on composite reliability as an estimate of a construct's internal consistency. Unlike Cronbach's alpha, composite reliability does not assume that all indicators are equally reliable, making it more suitable for PLS-SEM, which prioritises indicators according to their reliability during model estimation (Hair et al., 2014). The Composite reliability should be equal or greater than 6 for exploratory research (Garson, 2016; Kline, 2013). Table 9 shows that the Composite Reliability of each one of our construct was greater than 0.850, demonstrating a high reliability.

- Cronbach's Alpha

Cronbach's alpha also assesses the question of whether the indicators for latent variables display reliability. By convention, the same cut-offs apply: greater or equal to .80 for a good scale, .70 for an acceptable scale, and .60 for a scale for exploratory purposes (Garson, 2016; Kline, 2013). Table 9 shows that the Cronbach's alpha of each one of our construct was greater than 0.8, which is a good scale.

- Average Variance Extracted (AVE)

The AVE measures the percent of variance captured by a construct by showing the ratio of the sum of the variance captured by the construct and measurement variance (Gefen et al., 2000). In an adequate model, AVE should be greater than .5 (Garson, 2016; Urbach & Ahlemann, 2010). Table 9 shows that the AVE of each one of our construct was greater than 0.7.

- Indicator Reliability

Measurement loadings are the standardised path weights connecting the factors to the indicator variables. The loadings squared represent the indicator reliability value. Garson

(2016) argued that by convention, for a well-fitting reflective model, path loadings should be above .70. Table 9 shows that the indicator reliability of each one of our items was greater than 0.7.

Therefore, the convergent validity of each one of these constructs was established.

Table 9: Convergent Validity

	Items	Loadings	Indicator reliability	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Compatibility	cp_21	0.890	0.792	0.864	0.917	0.785
	cp_22	0.887	0.787			
	cp_23	0.882	0.778			
ICTs' use	u_i_o_aif_36	0.842	0.709	0.820	0.893	0.735
	u_i_o_aif_37	0.837	0.701			
	u_i_o_aif_38	0.892	0.796			
Information Quality	iq_33	0.882	0.778	0.869	0.919	0.792
	iq_34	0.891	0.794			
	iq_35	0.897	0.805			
Relative advanatge	ra_18	0.932	0.869	0.922	0.950	0.864
	ra-19	0.932	0.869			
	ra_20	0.921	0.848			
Simplicity	sp_24	0.945	0.893	0.928	0.954	0.874
	sp_25	0.932	0.869			
	sp_26	0.927	0.859			

4.3.2. Discriminant Validity

The Fornell-Larcker method states that the construct shares more variance with its indicators than with any other construct (Garson, 2016; Hair et al., 2014). To test this requirement, the AVE of each construct should be higher than the highest squared correlation with any other construct (ibid.). As shown in table 10, the discriminant validity of each one of our constructs was established according to this criterion.

Table 10. Fornell-Larcker Discriminant Validity Criterion

	Compatibility	ICTs' use	Information Quality	Relative advantage	Simplicity
Compatibility	**0.886**				
ICTs' use	0.837	**0.857**			
Information Quality	0.819	0.818	**0.890**		
Relative advanatge	0.827	0.806	0.811	**0.930**	
Simplicity	0.429	0.503	0.406	0.487	**0.935**

4.4. Structural Model Fit

The primary criterion for the evaluation of the causal model is the coefficient of determination (R^2). The second is the path coefficient (β) and the third one is the Predictive relevance (Q^2).

The last criterion is to test the moderating variables if there is any. The results of these assessments are described in this section.

R^2 is the measure of the proportion of the variance of the dependent variable about its mean that is explained by the independent variable(s) (Gefen et al., 2000). As shown in figure 2, the Relative Advantage, Compatibility, Simplicity and Information Quality explained 77.9% of variance in the dependent variable Use of ICT on agricultural input information (u_i_aif).

Structural path coefficients are the path weights connecting the factors to each other. We found that Compatibility has the strongest effect on Use of ICT on AII (0.382), followed by Information Quality (0.311). The Relative Advantage and Simplicity come as the third and fourth in the model with respectively (0.171) and (0.127).

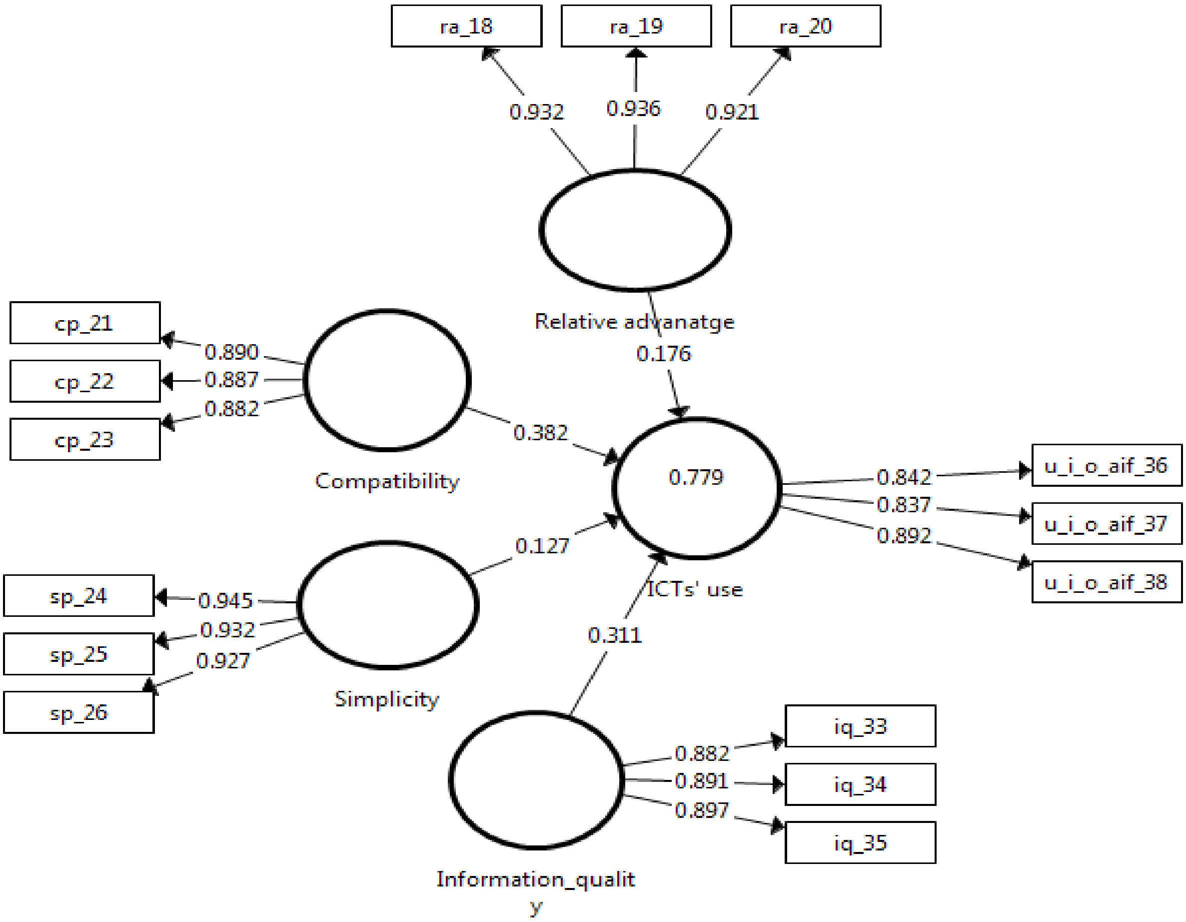

Figure 2: Model Results

4.5. Hypotheses Validation

After validating the measurement and structural model, we assessed our hypotheses.

Table 11: Hypotheses Testing

Hypothesis	β	T Statistics	P Values	Model
H1. Relative advanatge -> ICTs' use	0.176	2.584***	0.010	Supported
H2. Compatibility -> ICTs' use	0.382	6.529***	0.000	Supported
H3. Simplicity -> ICTs' use	0.127	3.060***	0.002	Supported
H4. Information Quality -> ICTs' use	0.311	5.054***	0.000	Supported

Critical t-values for a two-tailed test are 1.65 (significance level = 10 percent), 1.96 (significance level = 5 percent), and 2.58 (significance level = 1 percent).

The Information Quality (IQ) was found to be an important factor in the use of ICT (Briceño-Garmendia et al., 2004) in developing countries. In Mali, our findings confirmed those of Palmer (2015) about IQ having a positive effect on the use of ICT (Senekela) on agricultural input information. In addition, studying the Information System success in Malaysia, Hussein et al. (2007) argued that the Information Quality is one of the IS dimensions of success. Moreover, using the DOI to establish the factors affecting the adoption and usage of online services in Saudi Arabia, Al-Ghaith et al. (2010) labelled the Information Quality as e-service quality and found a positive effect of it on the service use.

On the characteristics of the information quality, the appropriateness of presentation (iq_35) was the most reliable in measuring the information quality, followed by relevancy (iq_34) and lastly the completeness (iq_33). This finding can be explained by the fact that farmers are given agricultural input information in their local language. They are more comfortable with their local language than any other.

Researchers have emphasised that the perception is positively related to ICT adoption/use by farmers (Barakabitze et al., 2015; Bosch et al., 2012; Kaddu, 2011; Sen & Choudhary, 2011; Siraj, 2010). In addition, studies related to agricultural input report the same result between ICT' use and users' perception (Adegbidi et al., 2012; Kaba et al., 2006; Rezaei-Moghaddam & Salehi, 2010). These findings were supported by our study. The Relative Advantage and Compatibility were found to positively affect the Adoption of Mobile phone in India (Kapoor et al., 2013). This same study argues that Complexity was negatively affecting mobile phone adoption. These findings were confirmed by our study. We used Simplicity instead of Complexity arguing that Simplicity was positively affected ICTs' adoption while Complexity was negatively affecting their use.

5. Conclusion

Farmers especially cereal farmers face many challenges such as best time to plant, how to access agricultural inputs, best techniques for planting because of the lack of information on agricultural input information. This lack of information can be addressed by ICTs in developing countries. The use of such ICTs will depend on many factors mainly the farmers' perception of ICTs and the ICTs' provided information quality.

Our findings established that the perception and information quality of these ICTs constitute major drivers, especially for small-scale cereal farmers. Due to their satisfaction with the delivered information and their positive perception, farmers would start/keep using ICTs to access and use agricultural input information, which will lead to the use of agricultural inputs. In turn, the agricultural inputs' adoption and use will lead to a better productivity of cereals.

From these results, it is important to focus on the Perception and Information Quality of ICTs on agricultural input information to realise more use of ICTs and therefore for more contribution to the access and use of agricultural input information as the basis for the increase of the productivity of cereal crops. Some of our respondents were helped to fill out the form and that could bias the quality of the data. However, Bowling (2005) concluded that the legitimacy of a study is difficult to establish with some methods than others. Further inquiry could be for instance to test these factors in other developing countries and for other crops

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