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# Challenges Smallholder Farmers Face in Extracting Value from Agricultural Information

**Research Paper**

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## ABSTRACT

Agricultural information can enhance smallholder farmers' knowledge and decision-making ability, where the ubiquity of ICTs has resulted in an exponential increase of ICT based agricultural information services. However, there is still poor utilization of agricultural information. This study examines challenges that impede smallholder farmers from deriving value from agricultural information despite availability of information services. A mixed-method research approach was employed to gather data from 200 farmers using semi-structured interviews, Likert scale surveys and five focus group discussions. The findings indicate that the challenges faced include low education levels, poor quality information, poorly designed information channels, and high cost of information access. Suggested strategies include training, improving design of information channels, stakeholder collaboration, translating information into local languages and interventions in accelerating use of ICTs. This study will be significant in implementation of impactful information dissemination initiatives. Subsequent research should be focused on investigating the effectiveness of the suggested strategies.

## Keywords

Information sources, information channels, human capital, personalisation, cordification.

## INTRODUCTION

Information and knowledge play a key role in enhancing agricultural productivity (Brhane et al., 2017). Access to the right information and knowledge can result into better decisions which consequently leads to improved yields and income (Asenso-Okyere & Mekonnen, 2012; Rehman et al., 2013). Access to market information can help farmers to know where to sell agricultural products, while price information can improve transport links and strengthen collective negotiations with buyers, information related to modern agricultural practices can improve yields, and weather information can help farmers deal with weather related uncertainties (Mbagwu et al., 2018; Siyao, 2012). Rapid innovations that lead to agricultural transformation are enabled by consistent exchange of information and knowledge between different stakeholders and farmers (Opolot, 2016).

In the developing economies of the world, such as the Pacific, East Asia and sub-Saharan Africa, more than 70% of farms are small-scale (Hoang, 2020). Agriculture in sub-Saharan Africa (SSA) is predominantly practiced by smallholder farmers on land mostly two hectares or less (Staatz & Dembele, 2008). Smallholder farmers represent 80% of all farms in SSA and contribute up to 90% of agriculture production (Wiggins, 2009; Alliance for a Green Revolution in Africa, 2014). In India, agriculture is practiced predominantly by small and marginal holding farmers with average land holdings of 0.38 hectares (Gururaj et al., 2017). Smallholder farmers receive improved agricultural information and knowledge from extension agents, research institutions, middlemen, and input dealers, mainly through physical interaction (Elly & Silayo, 2013). Traditionally, they receive agricultural information and knowledge from neighbors, family and friends through social engagements and direct observation (Lwoga et al., 2011). Information shared through social interactions include agronomic, market, and credit information (Anaglo et al., 2020). With the proliferation and ubiquity of ICTs especially mobile phones and internet, there has been an exponential increase in ICT based agricultural information services (Aker, Ghosh & Burrell, 2016; Mittal et al., 2010; Richardson, 2006). These services provide smallholder farmers with a wide range of agricultural information including market, weather, distribution, and agronomic information (Aker, 2011). For example, the government of Malawi through the Ministry of Agriculture uses Esoko platform to send text messages to farmers reminding them to listen to relevant radio programmes on agriculture. M-farm in Kenya provides subscribers with price information on various crops. Additionally, these services provide weather alerts, crop advice, and link buyers with sellers (Harris & Achora, 2018). In Chile, the DatAgro service delivers price, weather, and market information to farmers (World Bank, 2011). RML AgTech, formerly known as Reuters Market Light (RML), provides market prices, weather, and crop advisory services to farmers in India (Devalkar et al., 2018). ICTs have been hailed for their potential to transform the agricultural sector in developing economies by their ability to reduce search costs of information, provide more timely information, link buyers and sellers, and improve access to credit among other benefits (Aker et al., 2016; Harris & Achora, 2018).

Despite the availability of information from numerous information sources and interventions, agriculture in developing economies is still characterized by low productivity, due to poor access and low utilization of available agricultural information and knowledge (Fuglie et al., 2019; Kante et al., 2017; Krishna & Naik, 2017; Lwoga et al., 2010; Stilwell, 2010). Some studies attribute low access and low utilization of improved agricultural information and knowledge to challenges in rural areas, such as limited agricultural extension personnel, poor mobile phone networks, poor internet connectivity, and poor rural electrification (Barakabitze et al., 2015). However, there is no study that has attempted to examine challenges that hinder smallholder farmers from deriving value from the available agricultural information, which may also result into low access and utilization of agricultural information. Easdown and Starast (2004) and Siyao (2012) state that agricultural information is valuable to smallholder farmers if it is accessed, used, and understood, and if smallholder farmers are willing to seek it out. This creates a need for a study to explore challenges smallholder farmers face in extracting value from agricultural information and measures that can be used to avert these challenges to improve access and utilization of available agricultural information.

The main objective of this study, therefore, was to establish challenges that prevent smallholder farmers from extracting value from agricultural information, and also suggest strategies that can be used to enable smallholder farmers to extract more value from agricultural information. This study was grounded in the value of information and information-seeking behavior theories. Various information valuation methods were discussed, and a demonstration of how value can be measured in relation to

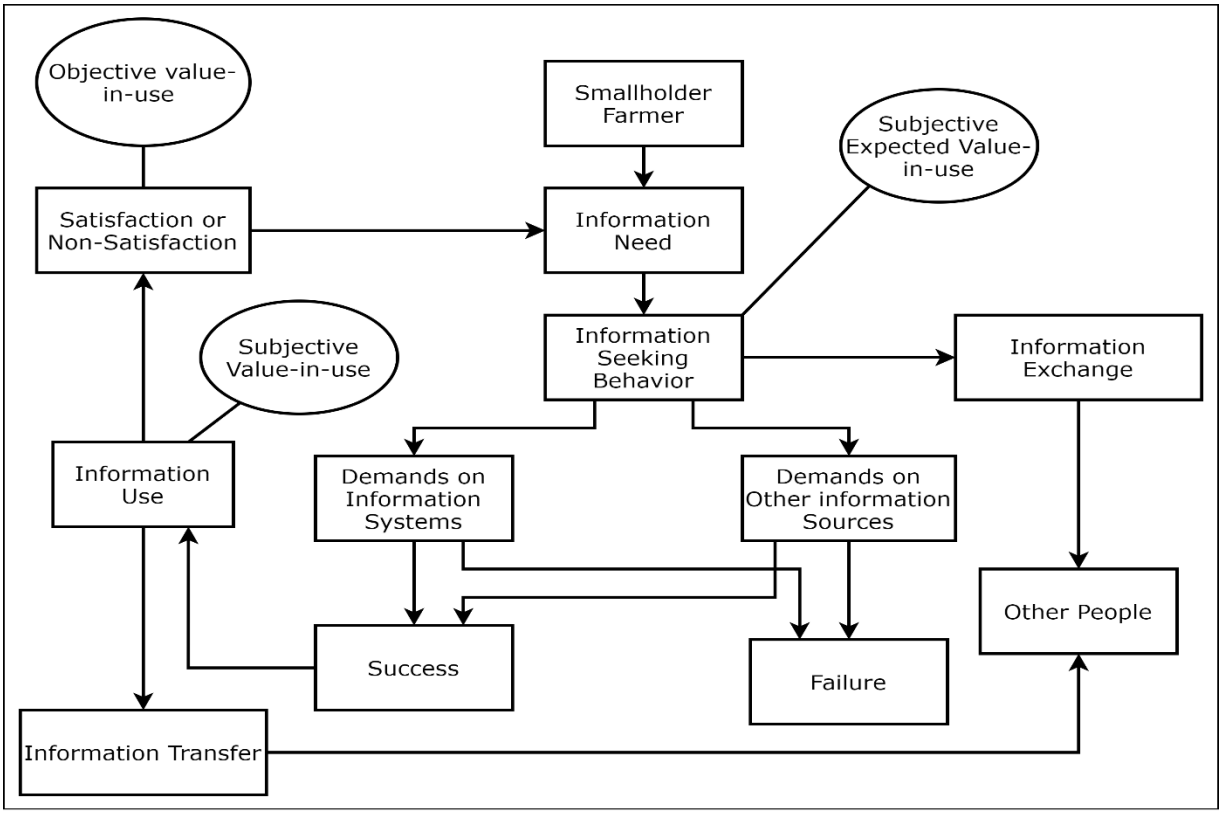
agricultural information was made. The study also highlighted the process through which smallholder farmers extract value from agricultural information and factors that shape their value perceptions.

## LITERATURE REVIEW

In what follows, we review selected studies that attempt to explain the process of extraction of value from agricultural information, noting how this concept relates to information seeking and information use. The theoretical framework presented in Figure 1 is grounded in the value of information theory developed by Repo (1986) and information-seeking behavior theory drawing from the studies by Wilson (2006), Babu et al. (2012), and Rahman et al. (2020). These theories provided insights on smallholder farmer information needs, information sources and channels, information-seeking behavior, and the way in which smallholder farmers value agricultural information. This was significant in understanding challenges smallholder farmers face in extracting value from agricultural information.

**Figure 1**

*Theoretical Framework for Exploring Challenges Smallholders Face in Extracting Value from Agricultural Information*




The theoretical framework depicted in Figure 1 above indicates that the process of information value extraction begins with the recognition of a need, as perceived by a smallholder farmer (Wilson, 2006). A smallholder farmer may make demands upon formal systems or non-information functions guided by their information-seeking behavior (Rahman et al., 2020; Wilson, 2006). Information-seeking behavior is influenced by psychological, demographic, role-related and interpersonal, environmental, and source characteristics (Babu et al., 2012; Rahman et al., 2020; Wilson, 2006). A smallholder farmer may also

seek information from other people indicated by "information exchange". The choice to select an information source is shaped by farmers' subjective expected value-in-use perceptions (Repo, 1986). A farmer may experience "failure" or "success" during the search endeavor. If the information is relevant to the information needs at hand, it will be applied. The opinions of individuals of the value of information, while being used in their work, is termed subjective value-in-use, according to Repo (1986). Information use may respectively satisfy or fail to satisfy a smallholder farmer's need and, if it satisfies an information need, the information will have provided objective value-in-use (Repo, 1986). If it does not satisfy a need, it may be recognized as being of potential relevance to the need of another person and, consequently, may be "transferred" to that person (Wilson, 2006).

## Value of Information

The term value is for the most part shaped by subjective perceptions, either qualitative or quantitative. Value interpretation according to Huatuco et al. (2001) falls into these categories: (i) cost reduction, which is the traditional view when measuring the value of information due to the quantitative nature of cost; (ii) a commodity in the marketplace which means information value is determined by market forces; (iii) information is valuable when it allows quality decision making; (iv) value of information depends on when, where, and in which format information is conveyed; and (v) the value information contributes in meeting the goals and objectives. Purohit et al. (2015) defines value of information as the difference in benefits or outcomes or profits in the presence or absence of information. The following studies highlight the ways in which the value of information has been measured.

### *Historical Cost Valuation*

Here, the information is valued based on the original cost of information acquisition (Moody & Walsh, 1999). The principle is that the asset value is estimated based on the cost at acquisition time. The assumption is that a firm, under normal circumstances, will only spend money to acquire an asset if it believes the economic benefits received can justify the costs. Information is represented by the costs of capturing, producing, or purchasing information (Moody & Walsh, 1999). The advantage of this is that costs for collecting information are quantifiable, but benefits are subjective, and the disadvantage is that undesirable results can be obtained if the historical cost method is used in its standard form, because it supports the creation of more information regardless of how it is used.

### *Valuation in Risk Perspective*

The information valuation for risk management assesses the appropriateness for controls and justification of budgets for information security management (Spencer, 2000). The motivating factors for this valuation approach are: (i) exclusive possession (Information remains valuable if it remains exclusive); (ii) utility (information is valuable if it remains useful to the organization); (ii) liability (the value of information depends on the ramifications if a trust is breached); (iii) convertibility (when information is representative for value that is convertible to other assets, the information should be valued to at least the conversion value); (iv) operational impact (the value of information is based on the impact the absence of the information and/or data could have on the organization).

### *Usage Over Time Valuation*

According to Chen (2005), this approach is based on two fundamental principles, namely that value is reflected through usage; and value changes over time. The valuation model is derived from two measurable and observable metrics, viz. usage and time. The model captures both the information value changes over time and the value differences between different information sets. The baseline model assumes that the past usage history serves as an indication of the importance of the information for the

present time. It indirectly infers the information value at present time by factoring in the recency (information is more valuable if it is used more recently) and the degree of the information usage (used more heavily than others). The model must combine both recency and degree of usage aspects, with strong bias towards one aspect or another.

### *Utility Valuation*

Glazer (1993) states that valuing information based on its utility means that revenue generation based on the information that is used can be attributed to the value of information in part or whole. This methodology is based on the role of information as a component in the value chain (Glazer, 1993). From any given transaction between a firm and stakeholders, there is valuable information describing the transaction that took place or some related information that can be stored within the organization's data repositories. Glazer identifies three components of value that can be derived from these transactions, which are: (i) transaction information can aid in future selling/buying of complementary products; (ii) transaction information can contribute to more efficiency in future transactions; (iii) the transaction information can have an exchange or market value to a third party.

In the same fashion, the value of the exchange of information within the organization can be computed from its contribution to the reduction of production or operations cost. According to Glazer (1993), the sum of the information value that can be derived from these exchanges of information gives the total information value for the organization. One of the key benefits of Glazer's methodology is that it can assist companies in identifying information that is valuable but not been exploited for its value. The major weakness of this method is that the estimation of the value of information is both highly subjective, and time-consuming to assemble.

### *Valuation Based on Information Use*

Repo (1986) developed an information valuation approach based on information use. According to Raban (2007), information is known as an 'experience good' meaning that it must be used before actual value unfolds. Information use refers to the application of the received information to enable continuation of an activity through making of decisions (Opolot, 2016). According to Oboko (2018), the value of information is determined through its use and depends on conditions such as accessibility, relevance, accuracy, and currency. Repo (1986) further states that valuation of information arises out of the process of use, with seeking of information in the knowledge work. This means that information can only be stated by the user of information while he is performing his knowledge-work task and from the results of the task. Repo (1986) stated that assessment of value due to information use constitutes three expressions of value, namely: user perceived value before information is used (subjective expected value-in-use); experience value (subjective value-in-use); and objective value-in-use (after information is used).

Subjective expected value-in-use is based on past experiences and/or expectations of the information products and services available. On the other hand, subjective value-in-use of information is based on opinions of individuals of the value of information while being used in their work. Objective value-in-use of information is based on the value of real effects the information has had on a task, and its results.

Repo's approach is appropriate for the valuation of agricultural information, because each smallholder has unique information needs, where consequently, the choice to use information or select an information source is influenced by subjective preferences and value perception when seeking for information, when using information, and after information is used (Brhane et al., 2017; Raban & Rusho, 2018). Relatedly, Easdown and Starast (2004) and Siyao (2012) state that agricultural

information is valuable to smallholder farmers if it is accessed, used, understood, if smallholders are willing to seek it.

## Information Value Extraction

### *Information Needs*

Information value extraction begins with the realization that a smallholder farmer's personal knowledge is inadequate to satisfy a goal that needs to be achieved (Rahman et al., 2020). Farmers' information needs according to Visakhi & Srivastava (2002) include field acquisition, agricultural inputs, agricultural technology, agricultural credit, agricultural marketing, and food technology. Several studies have been carried out to identify the information needs of smallholder farmers in developing economies. In Bangladesh, India, Sri Lanka and Thailand, smallholder farmers need information on fertilizers, market prices, and pesticides (Lokanathan & Kapugama, 2012). In the Iringa District of Tanzania, Elly and Silayo (2013) reported that 70% of smallholder farmers require information about crop and livestock husbandry, marketing, funding options, and value addition. Cassava farmers of River State, Nigeria require information related to the procurement of planting materials, produce price and loan facilities for sustaining their farming activities (Aziagba & Okede, 2011). For this reason, in order to satisfy these information needs, a farmer may engage in information seeking.

### *Information Sources and Channels Used by Smallholders*

Information needs also create an awareness of information sources and channels, which motivates a farmer to examine the various information sources and channels. Several studies have been conducted to explore information sources and channels used by smallholder farmers in developing economies (Rahman et al., 2020). Sources of agricultural information of smallholder farmers of Bangladesh, India, Sri Lanka, and Thailand were self-knowledge, family and friends, government extension workers, input suppliers, traders, and collectors and mass media according to Lokanathan and Kapugama (2012). Cassava farmers of Nigeria preferred information from colleagues, extension workers, agricultural institutions, news media, and banks (Aziagba & Okede, 2011). Rural farmers in the Iringa District of Tanzania received agricultural information through interpersonal communication, social gathering, farmers' groups or associations, village or cell leaders, cell phones, input suppliers or agro-dealers, extension workers, and radios, public addressing systems, agricultural exhibitions, reading on village sign boards, and NGOs, respectively (Elly & Silayo, 2013). Most smallholder farmers in Zambia relied on personal experience and informal social networks (family, friends, neighbors, and colleagues) to meet their information needs (Kaniki, 2001; Rahman et al., 2020).

### *Information-Seeking Behavior*

The variation of information needs causes users to exhibit different information-seeking behaviours (Morville & Rosenfeld, 2007). In a study done by Oboko (2018), smallholder farmers decide to use or seek agricultural information only when their information needs are properly aligned with their information-seeking behavior. Information-seeking behavior refers to those ways in which smallholder farmers articulate their information needs, seek, evaluate, select and use information (Dervin, 1998; Kari, 1998). Information-seeking behavior involves personal reasons for seeking information; the kinds of information which are being sought; and the ways and sources by means of which necessary information is sought (Nwone & Mutula, 2018; Oboko, 2018). According to Kopiyawattage et al. (2018), information-seeking behavior is associated with finding the right information sources, information-seeking strategies, and characteristics of information. Information seeking starts when an individual smallholder farmer recognizes an inadequacy in his/her knowledge that needs to be resolved

in order to deal with a problem and decides to seek information to fill the inadequacy (Brhane et al., 2017). This study adopts the terms "information seeking" and "information use" as processes through which value is extracted or derived from information. Information seeking and information use are also related to Repo's (1986) subjective expected value-in-use; subjective value-in-use; and objective value-in-use. Similarly, Easdown and Starast (2004) and Siyao (2012) state that agricultural information becomes valuable to smallholder farmers only if it is accessed, used, understood, if smallholders are willing to seek it.

### *Factors that Influence Choice of Information Sources, Information-Seeking Strategies and Information*

Factors that may influence choice of information sources, information-seeking strategies, and information include information quality, level of education and training, design of information channels, and cost of access among others. The higher the information quality, the more preferable this information will be (Zimmer et al., 2007). Information quality is related to the characteristics of content (Kante et al., 2017). Kaddu (2011) also argued that the value of information highly depends on the quality of information. Information quality implies reliability, relevance, timeliness, comprehensiveness, specific accuracy, and trustworthy source (Yap et al., 2020).

Level of education and training also shape demand for specific types of information services (Agwu & Adeniran, 2009; Daudu et al., 2009; Jenkins et al., 2011; Mahindarathne & Min, 2019; Opolot, 2016). Information users with high levels of education and training are more likely to seek and make use of less-refined, less-finely targeted information, more publicly provided information, and rely more frequently on formal information channels. In contrast, those who have low levels of education and training seek and use more heavily processed information and rely more intensively on commercial intermediaries and informal sources. Yap et al. (2020) states that low levels of education and training are also associated with low awareness of information sources, and lack of information search skills.

Information seeking and information use can also be shaped by the cost of information and information sources or channels. Prior empirical studies (Yap et al., 2020; Zimmer et al., 2007) argued that information seekers tend to minimize the access cost, and use the most convenient and cheapest sources, thus, where as a result, accessible information sources are used more frequently.

Design of information channels is also an important factor that shapes value perceptions of information seekers. Poorly designed information channels can negatively affect users' interaction and experience with a given information source, thereby explaining why smallholder farmers may not fully engage with ICT-based agricultural information services (Aker et al., 2016; Kante et al., 2017; Mahindarathne & Min, 2019; Wyche & Steinfield, 2016). These factors were important in understanding challenges smallholder farmers face in extracting value from agricultural information.

## METHODOLOGY

To address the research question, the study adopted a convergent parallel mixed methods design, which triangulates various research instruments during the analysis and interpretation phase (Creswell & Creswell, 2017; Leedy & Ormrod, 2005). The qualitative approach was the main approach, because it entails studying human action in their natural settings (Creswell & Creswell, 2017). The quantitative approach enabled the researcher to use descriptive statistics to analyse patterns that emerged from examining data. Qualitative data was collected using semi-structured interviews and supplemented with data elicited from focus group discussions. This was done in a single data collection phase also known as concurrent design (Creswell & Plano-Clark, 2017). Quantitative data was collected through the closed

questions that were integrated in the semi-structured interviews. A detailed literature review was conducted and questions were developed from themes that emerged from literature. The themes included: demographics, information quality, design of information channels, and cost of information.

To determine the challenges faced in extracting value from agricultural informtion, respondents were asked to state the degree to which the challenges impede them from extracting value from agricultural information using a four point Likert-scale. A short survey was administered towards the end of the interview in order to assess the respondents perceptions of various characteristics of information and information channels.

A study sample was taken from six villages in three districts in Uganda that were purposively selected. These districts and villages include Wakiso (Sanda and Sserinya), Kabarole (Mabaale and Kinyamangi), Mityana (Kagundu and Kakindu). The two districts of Wakiso and Mityana were purposively selected due to their proximity to the capital city which implies that they are likely to interact with numerous sources of information, practice mixed farming, and were also likely to produce a variety of crops and animals due to high food demands from the city. Kabarole District was selected to have a representative district that is not close to the city and has a high concentration of smallholder farmers that practice mixed farming.

Purposive sampling involves selection of sampling units from a part of the population likely to contain the most information on the characteristics of interest to the researcher (Guarte & Barrios, 2006). It may allow the researcher to target sample populations likely to provide information of most relevance to the research questions.

Simple random sampling was used to select the respondents for the interview from each of the six villages across the three districts. A total of 35 respondents was expected from each village making a total sample size of 210 respondents. However, a total of 200 respondents turned up for the interviews from across the three districts. Kabarole District saw 58 respondents, Mityana 70 respondents, and Wakiso 72 respondents. According to Israel (2012), a sample size greater or equal to 20 can yield meaningful results in a survey study. The identification of the study respondents was based on consultations made with district agricultural officers in the respective study districts in order to cover a wide array of smallholder farmers characteristics, such as level of education, gender, and age. In order to reduce bias, together with the agricultural officers, two farmer groups from each district were requested to randomly choose smallholder farmers to participate in the study. The farmer groups include Balandiza Kimeze Group (SSerinya Village), Mende Farmer's Development Group (Sanda Village), and Mabaale Tukole Farmer’s Group (Mabaale Village). Kinyamangi Farmer's SACCO (Kinyamangi Village), Zibulatude Farmer's Group (Kagundu Village) and Harari Kabaka Mumuli Farmer's Group (Kakindu Village). The sample was easily accessible and organised although traditionally semi-structured interviews can not be used to achieve a representative sample.

Respondents who volunteered in focus group discussions were selected using a snowballing technique, with the help of smallholder farmers that participated in the interviews. A total of 60 respondents participated in the focus group discussions, with at least 10 participants per session. Two focus group discussions were conducted in each district. The focus group discussions and interviews continued until the researcher observed repetions in arguments and that data saturation had been reached (Teddlie & Tashakkori, 2009). Quantitative and qualitative data were analyzed separately, using SPSS version 23 and NVIvo respectively, and were then combined to compare and validate the findings. Qualitative data was analyzed iteratively through reflections to ensure that the themes presented an accurate picture of what was recorded. Some of the qualitative themes from literature were also transformed into counts,

and these counts were used in descriptive statistical analysis. Likert-scale type data was analyzed and means generated. Means of 2.50 or above were classified as major challenges or negative perceptions while means below 2.50 were categorized as neither challenges, nor positive perceptions.

## RESEARCH FINDINGS AND DISCUSSION

### Profile of Respondents

Table 1 shows the demographic and social economic characteristics of smallholder farmers. The survey comprised of 200 respondents. Kabarole District constituted 58 respondents, Mityana District constituted 70 respondents, and Wakiso District constituted 72 respondents. The results show that 123 (61.5%) respondents were women and 77 (38.5%) were men. A majority of respondents were between the ages of 31 and 40 (69 or 34%). Respondents who were 30 years and below comprised 23% (46) of the total number. The rest of the respondents were above 40 years of age with 40 and 50 years, constituting 21% (42) and above 50 years constituting 21.5% (43). This is consistent with the study by (Livingston et al., 2011), which found that the majority of smallholder farmers are women, with 47% (94) of respondents owning 1 to 5 acres of land.

**Table 1**

*Respondents Economic Characteristics*

| **Characteristics** | **N** | **(%)** |
|---|---|---|
| *Sex* | | |
| Female | 123 | 61.5 |
| Male | 77 | 38.5 |
| | | |
| *Age* | | |
| Below 30 | 46 | 23.0 |
| 31-40 | 69 | 34.0 |
| 40-50 | 42 | 21.0 |
| Above 50 | 43 | 21.5 |
| | | |
| *Land Acreage* | | |
| Below 1 | 88 | 44.0 |
| 1-5 | 94 | 47.0 |
| Above 5 | 18 | 9.0 |
| | | |
| *Mobile Phones* | | |
| With Mobile Phones | 182 | 91.0 |
| Without Mobile Phones | 18 | 9.0 |

Those that owned less than one acre of land comprised 44% (88) of the total number of respondents; the rest of the respondents, that is 9% (18), owned above 5 acres of land; 88.5% (177) of respondent practiced mixed farming; those that grew crops only numbered 15 (7.5%) and those that reared animals only numbered 8 (4%). This is consistent with literature, which describes the nature of smallholder farmers in sub-Saharan Africa in terms of their acreage size and type of farming (Wiggins, 2009). A majority of respondents (88%) grew bananas. Beans represented 70% of cases. Other common crops that were grown include coffee with 65% of cases, maize with 65.5%, cassava with 65.5%, and tomatoes

with 37.6% of cases. The crops that were grown least included millet (6.2%), watermelon (10.8%), and cashew nuts (14.9%), pineapples (5.2%), potatoes (5.2%), groundnuts (1%) and vegetables (3.1%). Pigs and chickens were reared the most, comprising of 72.7% of cases and 71.6 % of cases, respectively. Goats and cattle were also common in smallholder farming communities comprising 49.7% and 36.6% of cases, respectively. Fish and sheep were not common amongst smallholder farmers, constituting (3.8%) and (2.2%), respectively. Sixty smallholder farmers participated in the focus group discussions, with women comprising 61.7% (37), and men 38.3% (23). A majority 91% (182) of respondents had mobile phones and of those, 37.9% were smart phones.

## Challenges Faced in Extracting Value from Information

Table 2 summaries the challenges smallholder farmers face in extracting value from agricultural information. The findings revealed that the major challenges faced include low levels of education (M = 3.14); poor quality information (M = 2.70); poor design of information channels (M = 2.80); and high cost of information (M = 3.10).

**Table 2**

*Challenges Smallholder Farmers Face in Extracting Value from Agricultural Information*

| Challenges faced in extracting value from agricultural information | Mean |
|---|---|
| Low levels of education and training | 3.14 |
| Poor quality information | 2.70 |
| Poor design of information channels | 2.80 |
| High cost of information | 3.10 |

### *Low Levels of Education and Training*

The findings in Table 3 show that a majority of respondents have low levels of education with ordinary and primary levels constituting 68% (136) of the total sample. During the interviews, 23.5% (47) respondents had received some form of agricultural training, while 76.5% (153) did not have any form of agricultural training. Most respondents obtained agricultural information from diverse sources although they preferred information from local and informal sources mainly family, friends and farmer groups. Agricultural information from family and friends comprised 90.4% cases (178), farmer groups with 61.4% cases (121), radio and television with 52.3% cases (103), extension agents with 51.3% cases (101), middlemen with 49.4% cases (95), non-governmental organisations (NGOs) with 44.7% cases (88), print media including newspapers with 23.9% cases (47), research institutions with 21.8 cases (43) and internet with 15.7% cases (31).

**Table 3**

*Level of Education and Gender Distribution*

| Education | Gender | | Total |
|---|---|---|---|
| | Female | Male | |
| Primary | 39.8% | 27.3% | 35.0% |
| Ordinary Level | 30.9% | 35.4% | 33.0% |

| **Education** | **Gender** | | **Total** |
|---|---|---|---|
| | **Female** | **Male** | |
| Advanced Level | 11.4% | 9.1% | 10.5% |
| Diploma | 4.1% | 9.1% | 6.0% |
| Bachelors | 3.3% | 7.8% | 5.0% |
| Post-graduate | 0.0% | 1.3% | 0.5% |
| No formal education | 10.6% | 9.1% | 10.0% |
| **Total** | 100.0% | 100.0% | 100.0% |

During interviews, respondents were asked to state why informal sources of information were their prefered choice. All respondents are cited here verbatim. One respondent said:

> Information from family and friends is easy to understand, compared to information from other sources. When I am faced with a difficult problem, I reachout to a friend in my village and they breaks down the solution for me in simple relatable terms.

Findings show that most respondents interviewed had limited skills and training needed to seek and utilise information from exogenous information sources. For example, some respondents said they were not well-versed in using mobile phones and internet to obtain agricultural information. They acknowledged that they had seen some highly educated smallholder farmers use the internet to seek agricultural information, but believed that such technologies were only helping the educated. They also expressed their lack of awareness of existing exogenous information sources that could provide them with improved agricultural information. Relatedly, during the focus group discussions, several respondents reported that they owned mobile mobile phones and some of them owned smartphones but did not know how to use them to seek new information and who to call to get new information.

In the focus group discusssions, most smallholder farmers stated that they were dissatisfied with the technical terms normally used in the materials (booklets, news letters, extracts) often distributed to them by various information providers like agricultural NGOs, research institutions, and print media.

One smallholder farmer noted:

> People from NGOs sometimes come to visit us and they leave us with booklets containing agricultural information but the problem is, the booklets contain complicated english terms and when they go away, there is no one to interpret for us what the terms mean.

### *Poor Quality Information*

Smallholder farmers' perceptions of information quality were assessed using a four-point Likert scale (Very Satisfied, Satisfied , Dissatisfied, Very dissatisfied) as well as computed medians and means. This study adopted a Batini et al. (2009) categorization of information quality dimensions of timeliness, accuracy, reliability, relevance, completeness, and consistency since they constitute the focus of most authors (Batini et al., 2009; Wand & Wang, 1996). The findings are presented in Table 4. Columns A,B,C,D,E,F,G,H represent various sources of information whose information quality was assessed. These are: family/friends (A), extension agents (B), middlemen (C), farmers froup (D), NGOs (E), research institutes (F), print media (G), ICTs (H).

**Table 4**

*Respondents Perception of Information Quality*

| Information quality dimensions | Median | | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | |
| Timeliness | 1 | 3 | 3 | 2 | 4 | 4 | 3 | 2 | 2.75 |
| Accuracy | 3 | 1 | 4 | 1 | 2 | 3 | 3 | 3 | 2.5 |
| Reliability | 2 | 3 | 4 | 2 | 3 | 4 | 4 | 3 | 3.13 |
| Relevance | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 3 | 2.38 |
| Completeness | 2 | 1 | 3 | 2 | 2 | 2 | 3 | 3 | 2.25 |
| Consistency | 1 | 3 | 2 | 2 | 4 | 4 | 4 | 3 | 2.90 |
| Mean | 1.83 | 2.0 | 3.2 | 1.83 | 2.83 | 3.33 | 3.33 | 2.83 | 2.70 |

Findings in Table 4 show that the quality of information varies according to the source of information. However, means of 1.83 and 1.83 indicate that there was a positive perception of quality of information received from family and friends, and farmer groups, respectively. In the interviews, respondents stated that information from family and friends was timely and consistent, however they were dissatisfied with the accuracy of this information. Similar findings were stated by respondents in focus groups. One smallholder farmer said:

> A friend who has grown tomatoes for more than five years can give you all the information about tomatoes anytime you want it. You just have to walk to her home and ask. But sometimes they give you information that they heard from other farmers, which may not be accurate to the problem at hand.

Respondents also expressed their disatisfaction with timeliness of delivery of information from extension officers, yet they considered time a very important factor in agricultural production.

To quote one smallholder farmer, among many similar statements provided in the focus group discussions: “Sometimes I spend weeks trying to get in touch with government extension officers from the sub-county, and completely fail to see them. Extension officers are not reliable.”

Respondents in focus groups discussions and interviews also expressed dissatisfaction with information from research institutions and NGOs. They reported that information from these sources was always unreliable, untimely, irrelevant, and incomplete. A big number of smallholder farmers stated that:

> They come and teach us new techniques of farming and they promise to come back to see how the farm is performing so that they can give us more tips but they do not always come back. More so, they only come when introducing new varieties of crops and do not want to listen to existing problems we have.

A number of respondents also reported that information from middlemen, mostly price and input information, was very misleading. They stated that it was usually profit-oriented, and only benefitted the middlemen.

### *Poor Design of Information Channels*

Smallholder farmers’ perceptions of the user experience of various information sources were assessed. This was essential in determining the user exprience or subjective value of various sources of

information. The design features assessed include accessibility, ability to update information, ability to receive feedback, ease of use, as well as the ability to store and reuse information. These design features were adopted from Mahindarathne and Min (2018) study on farmers' information needs and seeking patterns that are essential for designing agricultural information systems. The findings are presented in Table 5. Columns A,B,C,D,E,F,G,H represent various sources of information whose perception of design of channels was accessed. These are: family/friends (A), extension agents (B), middlemen (C), farmers group (D), NGOs (E), research institutes (F), print media (G) and ICTs (H).

**Table 5**

*Respondents' Perception of Design of Information Channels*

| **Design Features** | **Median** | | | | | | | | **Mean** |
|---|---|---|---|---|---|---|---|---|---|
| | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | |
| Accessibility | 1 | 3 | 3 | 2 | 4 | 4 | 4 | 2 | 2.87 |
| Ability to update information | 2 | 1 | 3 | 1 | 4 | 4 | 3 | 2 | 2.50 |
| Ability to receive feedback | 1 | 2 | 3 | 2 | 4 | 3 | 4 | 3 | 2.75 |
| Ability to store and reuse information | 4 | 4 | 4 | 4 | 3 | 3 | 2 | 2 | 3.25 |
| Ease of use | 1 | 2 | 3 | 2 | 3 | 4 | 3 | 3 | 2.63 |
| **Mean** | 1.80 | 2.40 | 3.20 | 2.20 | 3.60 | 3.60 | 3.20 | 2.40 | 2.80 |

The findings in Table 5 above show that the general perception of the design of information channels was low. This is indicated by the mean of 2.80 of the responses. From the interviews, 31.5% (63) of respondents stated that they had means to explicitly store agricultural information and 68.5% (137) reportedly lacked the means to explicitly store agricultural information. Of those that stored information, 70% stored it on paper, and 30% stored it electronically on their mobile phones (SMS). In focus group discussions, respondents stated that they wished they had stored important information obtained from various sources.

This is because they always cultivated similar crops season after season, and could learn from some of the information in such case that they had stored it.

In the interviews, respondents also reported that most ICTs like radio, mobile phones, and television are difficult to use, and do not give them the opportunity to ask questions or interact with the information providers easily. One smallholder farmers noted that: "Mobile phones have very small screens, typing is difficult and the messages are very brief. You cannot easily use them to convey long explanations. They are only good for financial transactions."

Similar findings were stated by smallholder farmers in focus group discussions. Some smallholder farmers who used internet to search for information stated that most websites visited have static and outdated information, and are not interactive. To quote one smallholder farmer, among many similar statements in the focus groups:

> Information posted on a website is normally long, complicated texts, which is rarely updated. Asking question is difficult. It requires one to look for contact information, which is always hard to find. One is normally presented with a form to fill in what they want to ask and then wait for feedback in form of an email, which rarely comes.

The findings show that poorly designed information channels affects smallholder farmers' subjective value perceptions, which consquently undermines their ability to extract value from agricultural information.

### *High Cost of Information*

High cost of agricultural information was reported to be one of the challenges smallholder farmers faces in extracting value from information. Most of the costs were related to information search and retrieval. In the interviews, respondents attributed the costs to acquiring and maintaining ICTs used to search for agricultural information. These costs included airtime, internet, and dry cells for the radios.

Other costs were related to transport facilitation required by extension personnel from the sub-county headquarters to the farm, and costs related to transportation of the farmer from the farm to sub-country or district headquarters, where agriculture offices are located. In support of this, during the focus groups, one smallholder farmer narrated the following:

> Information from extension workers is very helpful, but each time you call them to your farm, they require that you give them transport facilitation. Imagine the amount of money you spend on airtime and transport, which you could have spent on buying inputs.

## Strategies to Enable Smallholder Farmers Extract more Value from Agricultural Information

Smallholder farmers were requested to provide strategies that can be deployed to overcome challenges faced in extracting value from agricultural information.

Below are their suggestions:

Short training programes: Smallholder farmers stated that they could expand the sources from which they seek information if they received relevant training, particularly in the use of ICTs. Over 90% of respondents had mobile phones and of those, 38.2% were smart phones.

Those who owned smart phones mostly used them for normal communication. They agreed that use of ICTs would save them time and costs needed to access information especially where they had to travel long distances to get information. They also stated that they had heard that internet could be used to find solutions to the problems they were facing. To quote one smallholder farmer, among many similar statements provided in the focus group discussions: "I heard that I can 'google' and find all the answers to the problems I have in the garden, but I don't know how to 'google'."

Simple information formats: Most respondents agreed that the use of audio, video and picture formats is helpful in making information easy to understand. They had seen some of their fellow farmers watching agricultural related video content with smartphones, and therefore suggested they would consider using the same means to access agricultural information in future.

Most respondents agreed that constant and interactive communication with external sources is important in helping them breakdown new agricultural information and apply it correctly. In the focus group discussions, most respondents opted for information conveyed by word of mouth, because it is possible to seek clarification when obtaining the information. Smallholder farmers have suggested that other

information sources, such as ICTs, should design mechanisms that allow for human interaction and collaboration that mimic the existing mechanisms they use to communicate with other farmers. They also proposed that information sources ought to translate information into local languages. In the focus group discussions, one smallholder narrated:

> Everything is in English. When I buy chemicals for my garden, all the instructions are in English. I use my local language all the time, even while in the market. Information providers should translated materials into our local language, because we understand things better when they are in our local language.

They also suggested that government ought to make some of the information sources freely accessible and subsidize internet bundles, voice bundles, television sets, and smartphones, so that they might be able to take advantages of the new sources of information to improve production.

## DISCUSSION OF FINDINGS

Smallholder farmers are faced with various challenges that inhibit them from extracting value from agricultural information. The results are consistent with previous findings, which show the prevalence of low access and low utilization of information, despite wide availability of improved agricultural information.

### Education and Training

A majority of smallholder farmers are poorly educated, and this challenge limits their ability to seek and use information from exogenous sources. These findings are consistent with the views of Jenkins et al. (2011), Just et al. (2002) and Opolot (2016), who reported that actors with low levels of education are likely to seek information from informal sources including family, friends, neighbors, and farmer groups. Mahindarathne and Min (2019) also stated that farmers with high levels of education and training tend to seek out information more actively than do those farmers with relatively low levels of education and training. The findings are also consistent with the study by Just et al. (2006), which found that actors with low levels of education are likely to consume highly refined information packaged in simple formats. Yap et al. (2020) also states that low levels of education and training are also associated with low awareness of information sources and lack of information search skills. In a study by Yongling (2004) conducted in China, it was found that low levels of education affects farmers' ability to distinguish between 'good' and 'bad' information. This implies that low level of education and training undermines pre-use value perceptions as well as experience value perceptions, which encumbers proliferation and consumption of new knowledge and information from exogenous sources like research institutions, print media, and non-governmental organizations, which may affect outcomes of agricultural activities.

### Information Quality, Cost of Information and Design of Information Channels

From the findings, it is apparent that the general perception of information quality is poor. These findings are consistent with the study by Dutta (2009) and Akpabio et al. (2007), which showed that smallholder farmers often get information that is outdated, unreliable, and inaccurate. As a result, Llewellyn (2007) also stated that farmers perceive information from farmers groups to be of high quality, and information from exogenous sources to be of low quality. Findings from the focus groups and interviews attribute this shortfall to the timelines, consistency, reliability, and aspects of the information received from these exogenous agricultural information sources. Majid et al. (2001) maintained that lack of current, accurate, sufficient, relevant, and timeliness of information may hinder proliferation of new knowledge and information to farmers. In a related study by Yongling (2004)

conducted in China, it was found that there was a problem of low-quality, outdated, inaccurate, or incomplete agricultural information. These findings confirm that information quality shapes smallholder farmers' value perception of information. Poor quality of information cuts across all the value aspects. It affects pre-use value perception – that is, prior to information use; use value (while using the information); and post-use value outcomes which consequently leads to low agricultural productivity.

Insofar as cost of information is concerned, the findings show that the cost of information search and retrieval is high, especially information costs involved in use of ICTs to obtain information compared to other sources like fellow farmers. The cost of computers and mobile phones is too high for many to afford in most countries in SSA, monthly internet access rates are very high, and related charges are unaffordable for most people (Hosseini et al., 2009). These findings are also consistent with those of Hosseini et al. (2009) and Khan (2001), which show that the cost of buying and maintaining mobile phones affects the use and adoption of ICTs in agricultural activities. A study conducted by Wyche and Steinfield (2015) found that farmers sometimes switch off mobile phones to "preserve the charge", or only maintain small airtime balances on their phones, which constrains their ability to seek out agricultural information. Prior empirical studies by Yap et al. (2020) and Zimmer et al. (2007) argued that information seekers tend to minimize the access cost and use the most convenient and cheapest sources.

These findings are consistent with the views expressed in the study by Islam and Gronlund (2011), and Martin and Abbott (2011). They stated that information search costs are one of the most significant impediments farmers face while extracting value from agricultural information from formal sources.

On the design of information channels, findings show that most information channels used by smallholders are poorly designed in terms of ability to provide feedback, ease of use, storage, and reuse of information. This is consistent with the findings in the study by Lwoga et al. (2010), who reported that smallholder farmers lack mechanisms to explicitly store agricultural information. Baumüller (2018) and Salemink et al. (2017) also stated that poor usability of ICT applications is one of the impediments that slows implementation of ICTs for agriculture especially in rural areas. Harris and Achora (2018) state that poor design of ICT based information channels makes it challenging for inexperienced users to obtain agricultural information, and that this is exacerbated by very small screen real estate that makes navigation on feature phones difficult.

## Suggested Strategies to Enhance Extraction of Value from Agricultural Information

Strategies that could help smallholder farmers extract more value from information include short training programmes directed at improving skills of smallholder farmers especially in the use of ICTs, simple information formats which are easy to understand, subsidization of agricultural information services. These strategies are consistent with the studies conducted by Lwoga et al. (2010), Oladele (2008), Opolot (2016) and Zhang et al. (2016). Lwoga et al. (2010) expressed the need for capacity building in the use of ICTs to enhance information flow between farmers and information providers. Smallholder farmers also stated that such programmes would increase their awareness of existing information sources. Oladele (2008) and Zhang et al. (2016) proposed use of audio-visual guides as means to enhance utilization of information especially among the illiterate. Opolot (2016) proposed regular and interactive communication with external information sources for proper application of agricultural information.

## Implications and Recommendations

### *Practical Implications*

Regarding low levels of education and training, information service providers and policy makers should integrate capacity building programs when rolling out new information services. Information service providers should also be aware of the existing illiteracy handicaps and craft solutions that are easier to adopt for the less educated. Furthermore, information service providers should improve information quality across all dimensions of information quality, particularly the time taken to access the information services, since time is a key factor in agricultural activities. In relation to the high cost of information and information access, the government should lower costs of access to information and gadgets through provision of government subsidies for devices, as well as internet or airtime packages, in order to help smallholders. Information service providers should approach the design of information services from a human-centered design perspective, considering that smallholders are illiterate, use feature phones that have small screens, and operate in environments that have poor telecommunication infrastructure. Governments and other organizations involved in provision of agricultural information can use this study's findings to guide formulating agricultural information dissemination policies aimed at improving utilization of modern information.

### *Theoretical Implications*

This study demonstrates the relationship between value of information theory and information-seeking behavior theory and uses these theories to shed light on challenges hindering smallholder farmers from extracting value from agricultural information. This is significant because it highlights the processes smallholder farmers undertake to extract value from agricultural information, which will inform future studies about aspects in agricultural information value extraction that should be understood to improve utilisation of agricultural information, and consequently increase productivity and profitability of the agricultural sector in the developing world. The study also contributes to the body of knowledge by elaborating that agricultural information is valued through use and thus providing an essential ingredient in focusing efforts that will reduce existing bottlenecks related to consumption of agricultural information.

## CONCLUSION AND FUTURE WORK

The study set out to investigate challenges smallholder farmers face in extracting value from agricultural information and what strategies can be implemented to enable them overcome those challenges.

The findings indicated that most respondents had low level of education with the majority below an ordinary level certificate of education. The primary source of agricultural information utilised by most respondents was other farmers including family, neighbours, friends, and farmer groups, due to the ability to interact and seek clarification when needed, proximity in terms of timeliness, as well as ease of access. The sources that were utilised the least are research institutions, print media, non-governmental organisations, and the internet. This was due to hight level of difficulty in accessing these sources, high cost involved in utilising these sources, poor information quality, and lack of training regarding how to use some of these sources. Respondents also lacked means to efficiently collect and store agricultural information, which hindered them to learn from past experiences and make accurate references from information received. Furthermore, respondents stated that they lacked the means to interactively engage with other sources to seek clarifications, to easily share experiences, and to collectively solve common agricultural problems. Several strategies were proposed to solve these challenges. They include training, improving design of information channels, close collaboration with other stakeholders, translating agricultural information into local languages, and government intervention in accelerating use of ICTs.

## Limitations

The study solely collected information from smallholder farmers, but other stakeholders such as information service providers could have been useful as well, since they are involved in the dissemination of agricultural information. This study was limited to only three districts in Uganda, with only 200 respondents, which might not be fully representative of all the smallholder farmers in Uganda.

## Future Research

In light of the findings, the study recommends an investigation be carried out to determine whether the suggested strategies can aid smallholder farmers to extract more value from agricultural information. More studies should also be conducted in other countries in Africa and the rest of the developing world to generalize and validate the findings of this study. Some challenges like poor information quality and high cost of information are broad in terms of depth of research and therefore can be independently investigated. Furthermore, an information system based on the suggested strategies can be implemented to put these strategies into practice.

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