

2 **The Potential and Challenges of Using ICT as a Vehicle for Rural Communication**
3 **as Characterised by Smallholder Farmers.**

4 ABSTRACT

5 Agricultural extension is a communication network linking different stakeholders in
6 agriculture to improve their productivity and Information Communication Technology (ICT) has
7 been utilised as an extension tool for enhancing information flow between agricultural extension
8 services and their clients. The application of ICT in agricultural extension and rural development
9 has significantly increased in several countries where it has provided **an adequate** access to
10 agricultural information. Efforts are, therefore, needed to scale up investments in physical ICT
11 infrastructure and services across **developing** country. This could be realised through the
12 implementation of interventions aimed at speeding up assimilation and adoption of improved
13 agricultural technology and management practices of the less productive smallholder farmers.
14 Drawing on relevant published works, this paper argues that agricultural knowledge and
15 information management within an extension system can improve **productivity** of smallholder
16 farmers. The role of ICTs in agricultural extension is discussed together with its challenges
17 towards the improvement of productivity among smallholder farmers. Smallholder farmers need
18 to develop and utilize ICT based knowledge management techniques to implement strategies and
19 interventions to transform the agricultural sector and improve their productivity.

20
21 **Key words:** Knowledge, ICT, Extension, Swaziland, productivity, sugarcane.

22 INTRODUCTION

23 One of the primary functions of **an agricultural** extension service is to disseminate knowledge and
24 information to farmers (Richardson, 2005). Knowledge and Information can be disseminated in many
25 forms such as printed materials, radios, television, cell phones, group discussions, individual visits and all
26 of these are routinely included in the communication strategies of extensions services however there are
27 some challenges that **hinders** the delivery of agricultural extension services. These challenges include;
28 the inability to relay knowledge and information on time; farmers having difficulty to access knowledge
29 and information directly; costs and logistics of knowledge and information dissemination; Inability to reach
30 masses as well as the commonly used **top down** approach system of knowledge and information
31 dissemination. The advent of ICTs presents a new opportunity for the extension service to overcome all
32 these challenges in their quest to effectively disseminate knowledge and information.

33 Information communication technology (ICT) is the assembling of different technologies aimed at
34 managing knowledge and information to enhance communication. ICT holds the potential to enhance
35 decision-making in agriculture thus influencing the effective management and success of agricultural
36 organizations – including farmers. It also connects the world, dramatically changing lifestyles. Technology
37 also provides an opportunity to **under developed** nations to establish strategies for competing with their
38 developed counterparts (Zahedi and Zahedi, 2012).

39 Recent studies have shown that agricultural extension should be looked at as a communication
40 network linking different social actors (Leeuwis and Van den Ban, 2004). ICT has been utilised as an
41 extension tool, which has enhanced the knowledge and information flow between agricultural extension
42 services and their clients. The application of ICT in agricultural extension and rural development has
43 significantly increased in several countries where it has provided a medium to adequate access to
44 agricultural knowledge and information (Richardson, 2005). Extension workers have a direct link with
45 farmers and other actors, and thus are well positioned to make use of ICTs to access modern knowledge
46 and information that could assist farmers to improve their productivity (Jones, 1997)

47 PURPOSE OF ARTICLE

48 ICT should serve as a repository of knowledge and information created by researchers and
49 farmers; and also a platform for experience sharing so that more smallholders can benefit from it. This
50 would undoubtedly strengthen the research-extension-farmer linkage and also enable the flow of up to
51 date knowledge and information among the stakeholders. The role of the extension worker would be
52 improved from transferring technology packages to that of transferring knowledge and information
53 packages. Extension activity of this kind will be more **knowledge intensive** and more effective as it meets
54 the timely knowledge and information needs of farmers. Furthermore, access to ICT service will enable

55 extension workers to engage in the full knowledge management activity and be in the position to gather,
56 store, and disseminate knowledge and information that are demanded by farmers. The purpose of the
57 article is to establish the value of ICT in extension and to explore the challenges in implementing an ICT
58 strategy. The article also discusses how knowledge and information is managed in agricultural extension
59 as well as the role of ICT in the dissemination of agricultural knowledge and information in extension.

60

61 EXPLORING ICT IN AGRICULTURAL EXTENSION

62 To make informed decisions in the agricultural industry, according to Zahedi and Zahedi (2012),
63 participants require bringing together, processing and manipulating data. Agricultural decisions such as
64 timely land preparation, planting, weeding, irrigating, harvesting, storage and marketing are central
65 concerns to agricultural stakeholders. The agricultural workforce requires greater **technological** skills than
66 before. ICT supports new methods such as precision agriculture which uses computerized farm
67 machinery to apply fertilizers and herbicides, and other computerized technologies to buy and sell online
68 and many electronic technologies for other pre- and post-harvest operations. However, despite the
69 growing popularity of such ICT-supported operations, the most important role of ICTs remains
70 communication (Zahedi and Zahedi, 2012).

71 Effective agricultural development requires access to information on all aspects of production,
72 processing **and** marketing. ICT shows potential to play that role in the [two-way] delivery of information in
73 both developed and developing countries (Zijp, 1994). In the context of agriculture, the potential of ICTs
74 can be assessed broadly under two categories: (a) as a tool for direct contribution to agricultural
75 productivity; and (b) as an indirect tool for empowering farmers to make informed and quality decisions,
76 which positively impact on the way they conduct agricultural activities. (FAO, 2006).

77 DIFFERENCES BETWEEN DATA, INFORMATION **AND** KNOWLEDGE

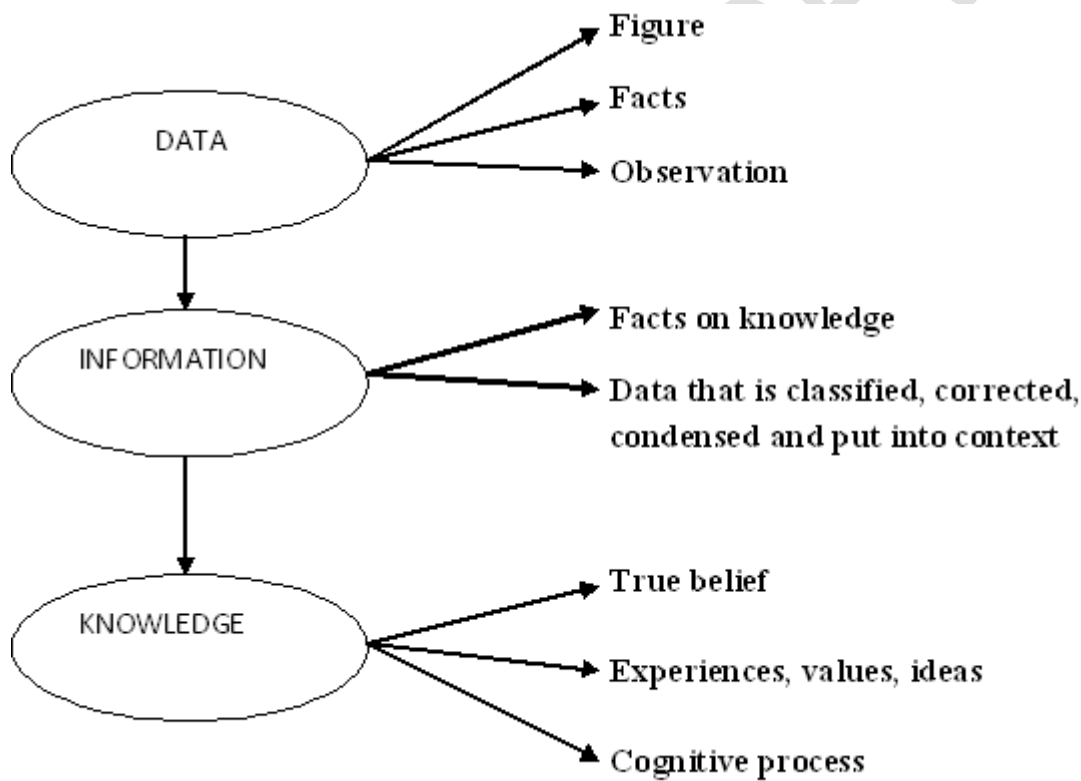
78 The term knowledge has often been used interchangeably with information and data, yet these
79 are different.

80 **Data** denotes a combination of records of figures, facts, words, numbers, images, and the like.
81 It refers to unprocessed facts and figures without any added interpretation or analysis. As symbols, 'Data'
82 is the storage of intrinsic meaning, a mere representation. The main purpose of data is to record activities
83 or situations, to attempt to capture the true picture or real event. Therefore, all data are historical, unless
84 used for illustration purposes, such as forecasting (Tuomi, 1999; Lang, 2001).

85 **Information** is data that has been collected, analysed and put into context. Information only
86 becomes knowledge when meaning is given to it via interpretation. Information refers to data that has
87 been interpreted so that it has relevant meaning, implication, or input for decision and/or action.
88 Information comes from both current and historical sources. In essence, the purpose of **information** is to
89 aid in making decisions and/or solving problems or realizing an opportunity (Tuomi, 1999).

90 **Knowledge** stems from information and data, as shown in the knowledge value chain (Figure
91 1). It is an individual's belief that is context-specific and it results from the individual's perspective and
92 experiences (Handzic, 2003). Knowledge is the combination of information, experience **and** insights that
93 may benefit an individual or an organization. The purpose of knowledge is to improve our lives and create
94 value for any enterprise and all its stakeholders. In short, the ultimate purpose of knowledge is for value
95 creation.

96



97

98 **Fig 1: The knowledge value chain (Source: Ndoro, 2011)**

99

100 Knowledge is subjective when it is based on an individual's perspective and experiences, but
101 becomes more objective when individuals share their knowledge and experiences with others. The
102 knowledge that has been shared will then influence the manner in which problems are tackled as well as
103 the decision-making process. Communication, knowledge and information management are critical
104 factors in any organization. They influence practical interactions affecting institutional goals and efficient
105 service delivery. (Turner, 2003; Hastings, 1993; Salomon and Engel, 1997; Powel, 2003). Kunnumkal
106 (2001) and Benyon (1997) concur that communication is **connectivity** of actions for the timely
107 implementation of decisions to improve productivity. According to Okyere and Mekonnen (2012), almost
108 every activity nowadays has become more ICT-reliant for one use or the other, and the benefits reach
109 even those without first-hand access to it. We need knowledge and information for the development of
110 agriculture so as to improve a lot of farmers, especially in the countryside of Africa (Salau, Saingbe, and
111 Garba, 2013). Without farmers' exposure to agricultural information, agricultural transformation cannot be
112 realized.

113 UNPACKING ICT IN AGRICULTURAL EXTENSION

114 Unpacking ICT in agricultural extension cuts across three factors: Information; information
115 communication; and communication technology. These are addressed briefly.

116

117 **Information:** This is data that has been processed in such a way as to be meaningful to the
118 person who receives it. For productivity to improve, new information must be generated that will bring
119 solutions to existing problems hindering maximum, profitable productivity. Research institutions, among
120 others, are responsible for the creation of new information through practically investigating farmer's
121 problems. The generated information must provide practical solutions to the existing farmer's productivity
122 challenges. Ideally, for this new information to be relevant and accepted by the farmers, the farmers must
123 be involved in the investigation process from its initial stages until the release of results. Smallholder
124 farmers are, in most cases, side-lined during the process of information creation thus making them merely
125 receivers of end results. This often results in the smallholder farmers not adopting such results because
126 the results do not address the farmer's existing problems or fit his particular circumstances. This
127 approach to creating information contributes to the low productivity of smallholder farmers. Approaches
128 such as Agriculture Innovations Systems suggest that farmers who are part of the innovation process will
129 end up with answers to their productivity challenges that are specifically suited to their farms, their
130 capacity and their particular circumstances (Klerkx, et al, 2012).

131 **Information Communication:** This is the process through which information is transferred
132 from a source to a receiver and back via a medium. "Effective knowledge and information management in
133 the agricultural sector will be achieved when the right knowledge and information is delivered to the

134 farmers and other stakeholders at the right time, in a **user friendly** and accessible manner” (UNDP
135 ETHIOPIA, 2012: 32). Because information communication systems are often weak, while many research
136 agencies, in the private and public **sector** continuously develop and release new technologies, not all
137 these findings reach the intended farmers. More attention should be paid to effective two-way
138 communication (Asopa and Beye, 1997).

139

140 Information communication has a direct bearing on farmers’ decision-making, particularly with
141 regards to agriculture. Information communication is a skill which is **learnt** and there are a number of
142 factors that influences effective communication. For communication to be effective there has to be
143 feedback that confirms understanding of what has been communicated (Dwumah et al, 2015). Most of the
144 information in agriculture is generated and presented in the English language yet most of the smallholder
145 farmers are illiterate. This makes it difficult for them to **utilise** such information for improved productivity.
146 Large-scale farmers, on the other hand, have employees who can understand and put into **practise** any
147 information presented in English [personal observation]. Failure to take account of the communication
148 needs of smallholder farmers puts them at a disadvantage.

149 **Communication Technology:** This involves facilitating communication between two people.
150 It involves the use of means of communication to transfer information such that the message reaches a
151 large number of people within a shortest time possible. Communication technology includes devices
152 (hardware) such as computers, radio, TV, telephone, cellular/mobile phones and faxes (Chhachhar, et al,
153 2014), as well as social media platforms such as specialised chat rooms, Facebook, Instagram and
154 WhatsApp (Suchiradipta and Saravanan, 2016). It also includes software programs that are used to store,
155 process and retrieve data.

156 KNOWLEDGE MANAGEMENT IN EXTENSION

157 Knowledge management can be defined as the condition of knowing a concept with a
158 considerable degree of familiarity acquired through experience, association or contact (Seidman and
159 McCauley, 2005). Knowledge management encompasses processes and practices concerned with the
160 creation, acquisition, sharing and use of knowledge, skills **and** expertise. This then follows a circular non-
161 stop process that continually updates itself (Bwalya, Okyere and Tefera, 2012).

162 For the circular flow of knowledge management to take place, knowledge that is sufficiently better
163 than the existing knowledge and means for transmitting it must be both available. The consumers of the
164 new knowledge must be willing and be able to use the better knowledge (Bwalya et al., 2012). The
165 attainment of effective knowledge management in the agricultural sector requires the systematic and
166 continuous interaction of stakeholders that include farmers, farmer organizations, research scientists,

167 policy makers, extension agents and the private sector among others (ASARECA, 2010). Therefore, to be
168 effective, knowledge management in agriculture must embrace the following four issues, according to
169 Bwalya et al. (2012), (i) comprehensive knowledge of what needs to be done to solve the sector's
170 problems or to exploit its potential, (ii) identify how the problem could be solved or opportunities that could
171 be exploited, (iii) the source of knowledge required for success, and (iv) determining who will be
172 responsible for taking the actions needed to solve the problem or exploit the identified opportunities.

173 In order to obtain satisfactory results out of knowledge and information management, farmers
174 need to be engaged in the whole knowledge management process. This is crucial as it will enable better
175 integration of tacit and explicit knowledge. The knowledge and information created out of this process is
176 also more likely to be accepted by the farmers as it would have incorporated knowledge and practices
177 developed and passed on to them through generations. Such knowledge and information **has** a high
178 potential of being implemented by these farmers in their daily farming activities hence improving their
179 productivity. Farmers can also improve their existing indigenous knowledge not only through the
180 interaction with modern knowledge but also by sharing **experience** with other farmers. However, in order
181 to scale up knowledge to other farmers, the knowledge and information needs to be codified, made
182 explicit, and upgraded or modernized with **research based** evidence (Bwalya et al., 2012).

183 Smallholder farmers in the developing world require up to date knowledge and information in order
184 to be able to efficiently and effectively perform their farming practices. Bwalya et al. (2012) noted that the
185 knowledge and information that farmers demand ranges from **accessibility** of new farming methods,
186 availability of weather forecast, and supply of inputs and output prices among others.

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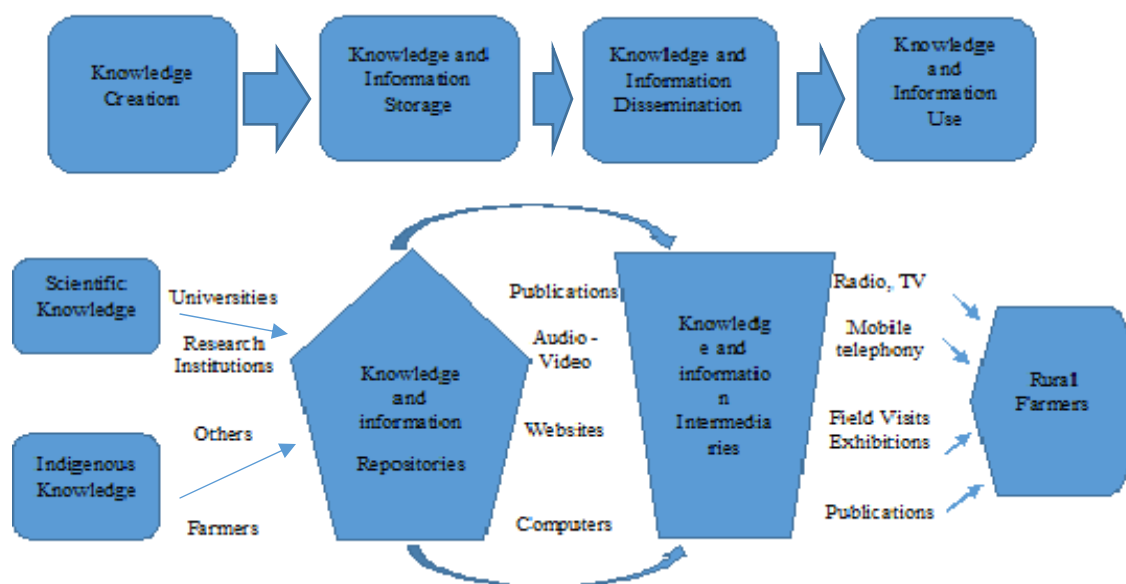
188 ICT FOR THE DISSEMINATION OF AGRICULTURAL KNOWLEDGE AND 189 INFORMATION

190

191 ICT can play a crucial role in benefiting the resource-strapped farmers with up to date knowledge
192 and information on agricultural technologies, best practices, markets, price trends, and weather
193 conditions. The experiences of most countries indicate that rapid development of ICT, which facilitates the
194 flow of data and information, has tremendously enhanced the knowledge management practice in
195 agriculture.

196 Knowledge is considered as the fourth factor of production after **labour, land and** capital (AFAAS,
197 2011) and is particularly critical in the agriculture sector. Making relevant knowledge accessible to the
198 farming community helps improve production and brings higher returns. If the practice of smallholders is
199 not supported by modern agricultural knowledge and information, agricultural households are likely to
200 remain trapped in low productivity, food insecurity **and** poverty. Generating new agricultural knowledge

201 and information and making it available for use by smallholder farmers through the extension service is
 202 important in promoting sustainable livelihoods and reducing rural poverty (Isaacs, 2007). ICT plays a very
 203 crucial role in enhancing information flow from its creation, storage, dissemination and usage by farmers.
 204 Figure 2 shows the flow of agricultural knowledge and information from creation to end use.



205
 206 **Fig 2: Tools of knowledge and information management in agriculture (Source: Bwalya et al.,**
 207 **2012)**

208
 209 **Knowledge and Information creation** - Various entities are engaged in the creation and
 210 development of knowledge and information. Likewise, several repositories and intermediaries play their
 211 role to bring the information and knowledge to the ultimate users. Agricultural knowledge and information
 212 is created from modern and indigenous sources. The modern knowledge and information is created
 213 through scientific research by universities and research institutions. Indigenous knowledge and
 214 information on the other hand refers to traditional knowledge, innovations and practices of local
 215 communities and is developed outside the formal education system (Bwalya et al., 2012).

216
 217 **Knowledge and information storage** - Once it is created from these sources it is then
 218 stored in various forms before it is disseminated for use. Knowledge and Information creation requires the
 219 use of various ICT gadgets to enhance the collection and interpretation of data and these include but not
 220 limited to cell phones, video recorders, and internet for data collection as shown in figure 2. The creation
 221 of knowledge and information management by these institutes begins with identification of knowledge and
 222 information gaps, and the capturing, storage and dissemination of the knowledge and information to the
 223 users. This is conducted through a participatory approach involving stakeholders such as farmers,
 224 researchers, extension experts among others. The major sources for capturing knowledge and

225 information are publications, conferences, events (field days, exhibitions, visits, etc.) and research
226 reports. Whatever is obtained in this way is stored in various forms including publications, **audio visuals**,
227 library services and websites among others.

228 **Knowledge and Information retrieval** - The stored knowledge and information is then
229 disseminated to users such as rural farmers, through intermediaries notably during **trainings**, field visits,
230 exhibitions, publications and using traditional forms of ICT (TV and radio), modern forms of ICT (Internet,
231 mobile phones, etc.) and others. Effective knowledge and information management **is** achieved when the
232 right knowledge and information is delivered to the right people at the right time in a **user friendly** and
233 accessible manner that helps the recipients to perform their jobs efficiently (Islam, 2010). The outcome of
234 effective knowledge and information management includes improved productivity and performance of the
235 agricultural sector.

236 **Knowledge and Information dissemination** - The knowledge and information **is** then
237 disseminated to researchers, extension experts, farmers and the public at large through publications,
238 mass media (radio and television), internet, field days, exhibitions and interviews. In practice, however,
239 field day's radio and TV programs were the major tools usually used to share knowledge and information
240 to the smallholder farmers while internet and other modern ICT tools were seldom found to be used
241 (Bwalya et al., 2012)

242 **Knowledge and Information use** – ICT can play a crucial role in benefitting the resource
243 trapped smallholder farmers with up to date knowledge and information on agricultural technologies, best
244 practices, markets, price trends **and** weather conditions. The experience of most countries indicates that
245 rapid development of ICTs which facilitates the flow of data and **information**, has tremendously enhanced
246 the knowledge and information management practice in agriculture. For information to be accepted and
247 used by farmers, it has to be timely, accurate, well understood and relevant to the farmer's problems.
248 Extension service providers use ICTs to ensure that accurate knowledge and information is delivered on
249 time and in a form that will be well understood by the farmers. The knowledge and information delivered
250 to the farmer must also be relevant to the farmer's problems.

251 ICT CHALLENGES IN AGRICULTURAL EXTENSION

252 In Africa, this process of ensuring the effectiveness of knowledge management is limited by a
253 range of constraints such as inadequate mechanism for capturing, systematizing and sharing available
254 knowledge; inadequate analysis of agricultural sector communication stakeholders, their knowledge
255 needs, attitudes and practices to knowledge management; use of less effective media and channels for
256 communicating with different stakeholders; and weak monitoring and evaluation of knowledge
257 management systems (ASARECA, 2010).

258 Various institutions and organizations in Swaziland are engaged in the creation, accumulation
259 **and** dissemination of agricultural knowledge. Nevertheless, the use of ICT in knowledge and information
260 management is so far not only low but also dominated by traditional ICT tools (radio and TV). The use of
261 modern ICT (internet, mobile phones, etc.) in storing and disseminating knowledge and information
262 remains very low, despite their huge potential. In this knowledge and information age, it is important to
263 address the challenges that limit the use of such tools and identify the opportunities that should be tapped
264 to assist smallholder farmers in their **endeavour** to improve production and match the standard of the
265 large-scale producers.

266 ICTs that will educate smallholder farmers are very crucial because some of these farmers do not
267 have control over the selling price of their produce. The only option they have is that of **maximising** their
268 productivity at the lowest cost possible. Therefore it is imperative to harness the use of ICTs for the
269 dissemination of all **production** knowledge and information **especially** to the smallholder farmers.
270 However, while the use of ICTs seems relatively easy once in place, there are challenges associated with
271 it.

272 **Availability and affordability** - Despite the fact that ICT has immense potential in
273 disseminating agricultural knowledge and information, the low level of ICT infrastructure in developing
274 countries is believed to have hindered the sector from realizing its potential. This has inhibited the
275 effectiveness of research institutions and extension agents from creating and delivering agricultural
276 knowledge for use by rural farmers to increase productivity. In most **cases** extension agents and farmers
277 are not connected to modern ICT infrastructure and services. As a result, research-extension-farmer
278 linkages are weak and costly. Such a linkage ends up having to be fostered through physical contact
279 such as training, field demonstrations, field day program visits.

280 In most cases, rural people live sparsely and this makes the provision of infrastructure and public
281 utilities such as electric power, water, health facilities and some devices of modern ICTs very difficult to
282 deploy in rural areas. The **low** level access to ICT **infrastructure** have slowed the sharing and exchange
283 of knowledge and information generated from research **centres** at national and regional levels. Electricity
284 infrastructure coverage in rural parts of developing countries remains low despite recent efforts to extend
285 the electricity grid to rural areas through the rural electrification program. The low level of electricity
286 coverage has **in turn** inhibited the expansion of ICT services to rural areas. (National Information and
287 Communication Infrastructure policy, 2005). The incomes of rural people are very low compared to urban
288 areas thus it becomes difficult for **the rural** people to afford modern ICTs. This then leads to a digital
289 divide between urban and rural areas which then lead to rural areas remaining **marginalised** forever. (ITU,
290 2010; Gillward and Stock, 2008).

291 ICT operators **on the other hand** are not willing to invest in the rural areas due to low returns
292 unless there are strong incentives to do so. This is mainly because of the high investment costs given the

293 capacity of the rural people to pay for the services offered. Actually, the high cost of services is the very
294 reason that continues to delay the uptake of many different forms of ICT in most of the African rural
295 areas. Gillward and Stock, (2008) confirmed that the low income of the people in the African rural areas is
296 the main adoption barrier of modern ICTs.

297 The other challenge is how to make ICT both affordable and available in venues that are
298 convenient to smallholder farmers. Availability of venues refers to the presence of various access points
299 particularly information kiosks, tele-centres, call centres, and so on in a manner that is accessible to the
300 majority of the farmers. These services are not adequately available and accessible to the small farmer in
301 developing countries.

302 Some of the African countries such as Ghana, Kenya, Nigeria and Senegal have a very dynamic
303 telecommunications sector however Africa as a whole continues to lag behind other regions of the world
304 in terms of its communication policies (Calandro et al., 2010). The national objective according to
305 Calandro et al. (2010) of achieving universal and affordable access to the full range of communication
306 services have been undermined either by poor policies constraining market entry and the competitive
307 allocation of available resources; weak institutional arrangements with low technical capacity and
308 competencies; and in some instances, regressive taxes on usage. Gilward et al. (2008) argues that in
309 addition to competition and open access regimes, effective regulation of other factors such as spectrum,
310 interconnection and tariffs are required to stimulate market growth, improve access, and lower prices.

311 **Accessibility and usability** - Gillward et al. (2008) discovered that diffusion of ICTs is highly
312 uneven, concentrated in urban areas, and leaving some rural areas almost untouched. Income is the
313 major barrier to the uptake of these technologies but as they become complex, they are increasingly
314 constrained by literacy and education. The study also revealed that women are not equally able to access
315 and use even the most prevalent forms of ICT. It was also reported that issues of income, education and
316 social position played a role in explaining ICT access and usage. Statistics have indicated that a woman
317 in a low income country is 21% less likely to own a mobile phone than a man. This scenario is disturbing
318 for agricultural development in Africa where more women are involved in agriculture than men especially
319 because they need technology and production information to improve their productivity.

320 The challenges of access to ICT can be divided into two: (i) access to ICT infrastructure and (ii)
321 access to ICT services. The access to ICT infrastructure in developing countries is still very low. In spite
322 of being a necessary condition, access to ICT infrastructure by itself is not sufficient for the dissemination
323 of knowledge and information to occur through it. Access to ICT infrastructure must be accompanied by
324 access to ICT services.

325 Awareness Culture and attitude - In addition to income, educational attainment, social and cultural
326 constraints are other factors that affect the likelihood of an individual having the necessary e-skills to use
327 different technologies optimally (Gillward et al., 2008). Munyua (2008) conducted a study on ICTs and
328 smallholder agriculture in Africa and found low usage patterns and adoptions. The main challenges that
329 influenced the use of ICT were summarised as: high costs of available technologies, inadequate
330 infrastructure and low ICT skills, poor and expensive connectivity, Inappropriate ICT policies, language
331 barrier, low bandwidth, inadequate credit facilities and systems. Moreover the author also identified
332 inappropriate local content, weak institutions, inadequate collaboration and awareness of existing ICT
333 facilities and resources, a poor sharing information culture as well as low awareness of the role of ICTs in
334 development at all levels.

335 CONCLUSION

336 Smallholder farmers in the developing world require up to date knowledge and information in
337 order to be able to perform their farming practices. The development of ICTs has facilitated the
338 dissemination of knowledge and information and has revolutionized the use of technology in agricultural
339 production for increased productivity. There is evidence that yield among rural smallholder farmers does
340 improve with the use of ICT to access knowledge and information. However there are challenges in
341 making ICT platforms available to a large number of the rural smallholder farmers and these include
342 availability and affordability of ICT infrastructure and its services. Accessibility and usability of such
343 services is also a challenge among the smallholder farmers. Awareness, culture and attitudes of
344 smallholder farmers towards the use of these ICT facilities are other factors hindering its adoption. For
345 knowledge and information management to be effective, it must be timely delivered to the farmer in a
346 user-friendly and accessible manner. Agricultural Extension is the ideal mechanism that can facilitate the
347 introduction and subsequent adoption of ICTs for effective knowledge and information management
348 especially among smallholder farmers.

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