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Online Agricultural Extension Based on Internet Communication Principles

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ABSTRACT

The important role agricultural growth plays in mitigating poverty, economic growth stimulation as well as development in emerging economies like Kenya cannot be over stated. Available literature shows that agriculture is a key driver of economic growth and development strategies in attaining sustainable poverty reduction. ICT acts as an enabler when addressing food security with such factors as legal framework, policy, knowledge, markets, technology, and research among others. Information and skills gaps have kept most subsistence farming systems to much less productive and lucrative than they could be. Further, extension services are always often faced with the problem of underfunding, weak link between farmers and agricultural research agencies as well as lack acceptable contact to farmers. The problem is exacerbated by lack of coordination along the agricultural value chain from farm inputs to food processing, which increases the cost of production and lowers farmers' revenue. The aim of this paper is to investigate the perception stakeholders in agricultural value chain have on online agricultural extension services as well as the challenges associated with the same.

Keywords : eAgriculture, Semantic Web, Agricultural Extension, Smart Farm

I. INTRODUCTION

Information and communication technology (ICT) applications promises major contribution to meet the future food needs globally. An increasing body of evidence shows that ICTs, in particular web based applications can significantly assist in addressing challenges faced by smallholder farmers mainly by improving access to both information and capacity-building opportunities for smallholder farmers in developing countries (Nakasonea & Torerob, 2016). This can be achieved through the use of ICT to gather and distribute appropriate and precise information on weather, inputs, pest, and markets; by serving information into research initiatives as well as by circulating knowledge to farmers (FAO, 2011).

Kenya, like many developing economies of the world depends on agriculture as the backbone of its economy (KNBS, 2019). Indeed, according to the economic survey 2019, 17.8 million persons are engaged in agricultural related activities as at 2018 (KNBS, 2019). The report further singles out agriculture as the dominant sector of the economy accounting for about a third of the total value of the economy (KNBS, 2019). Like in any other field, agriculture is faced with a myriad of uptake challenges when it comes to adoption of new technologies (Sousa, Nicolay, & Home, 2016). ICT has been known as a major technique of enhancing efficiency as well as adding value to many areas of the economy and at the same time, holds the promise of making substantial input to transformation of public administration at all levels (Hendrick, 1994; Heeks, 1999).

ICT supports smart farming which involves the use of sensors to measure and control farming activities (Berners-Lee, Hendler, & Lassila., 2001). For better decisions making, sematic web comes in handy as an integration mechanism of data that is always distributed across many organizations (Bizer, Heath, & Berners-Lee, 2009). Data management provided for by an open source middleware called Global Senor Network (GSN) is a key issue as sensors continuously produce data streams which grows to large volumes over time (Berners-Lee, Hendler, & Lassila., 2001). This is conceptualized in figure 1 below.

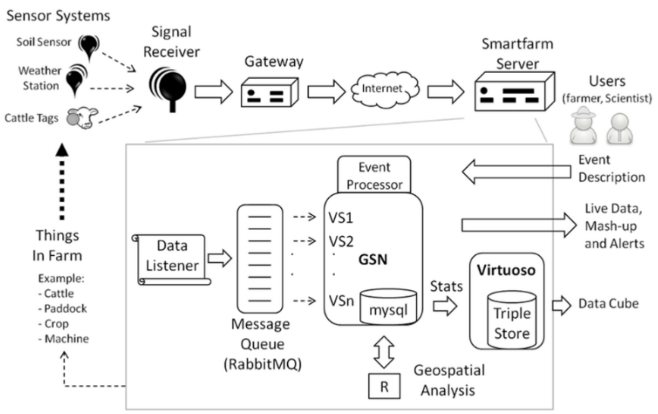

Figure 1 : ICT Smart Farm Architecture

Statement of the Problem

The widespread penetration of information communication technologies in rural areas in developing countries presents new opportunities in every aspect of human life, including agricultural extension services. Information and skills gaps have confined a majority of subsistence farmers to reduced production and less lucrative than it could be in the ideal situation. Further, public extension services are often confronted with the problem of underfunding, suffer from frail agricultural research and lack of acceptable contact to farmers especially with pandemics of such magnitude as COVID-19 that requires social distancing. The problem is exacerbated by lack of a synchronized approach throughout the agricultural value chain which leads to increased production cost and decreased income for farmers. While extension services automation is meant to afford timely, accurate and efficient access to information to farmers and agricultural research agencies, such access has largely remained a mirage. This is mainly attributed to the use of outdated platforms and technology. The challenge is worsened by the ever-changing technology that further widens disconnect between agricultural research agencies and smallholder farmers who are in dire need of not just access to information on current farming techniques, but also real time feedback.

Semantic Web and Agricultural Extension

Tim Berners-Lee and others coined the term semantic web with the intention of bringing structure and meaning of information as described on web pages (Berners-Lee, Hendler, & Lassila., 2001). The same reasons are espoused by World Wide Web Consortium (W3C) as it is encoded into its standards.

Semantic web technologies continue to gain prominence in the application of meaning to unstructured data (Berners-Lee, et al., 2001). However, their application in agriculture to agricultural related problems remains low compared to complementary problems (Drury, Fernandes, Moura, & Lopes, 2019). According to FAO (2019), agriculture has vast semantic resources despites developed by agricultural NGOs including FAO. Agriculture, particularly precision agriculture produces large volumes of raw data from drones, sensors as well as weather station which offer very little value to the farmers in its raw form (Drury et al., 2019). Data usefulness is derived from its context, meaning (semantics) as well as its combination with additional data sources. The context, meaning as well as aggregation can be provided by semantic web technologies through provision of common data interchange formats and data description languages.

Information gathered from sensors both real time and non-real time provides semantic web technologies with common structured representation of information. Precision agriculture is faced with a major issue of data integration (Zhang, Wang, & Wang, 2002). To allow data integration across the web, Lefort, et al., (2011) argues that ontologies such as semantic sensor network (SSN) is necessary while Bizer, Heath, & Berners-Lee, (2009) suggests the need to employ Linked data Techniques which are largely accepted in semantic web circles. The disparity between existing tools like GSN and the need for providing open access for an effective integration of sensor network data exists as a barrier. Accordingly, semantic web technologies are beginning to play a pivotal role.

The fact that agriculture is becoming heavily dependent upon data, it can be asserted that the role played by semantic web technologies in e-agriculture as well as precision agriculture is gaining prominence as a result of its ability to represent and integrate data and infer knowledge through reasoning (Omran & Khorshid, 2014; Tomic, Drenjanac, Hoermann, & Auer, 2015).

II. Methodology

This paper sought to investigate and analyze the issues within the agricultural extension domain and technical facets that challenges the use of electronic agricultural extension services in Kenya. This study's data was essentially drawn from interviews extension officers, information technology practitioners and farmers. Snowballing strategy was employed in sampling the respondents. Qualitative data analysis method was employed. The design was considered appropriate guide in gathering of reliable data for this study.

Findings of the Study

The study sought to know the perception of the respondents towards online extension services in relation to agricultural production. While 80% of the respondents felt that online agricultural extension services have huge potential of boasting agricultural production, 15% were not sure whether this will have any impact and the remaining five percent felt that online agriculture extension services had no potential to improve agricultural production. Those who felt that online agricultural extension services would improve agricultural production backed their argument by claiming that access to information contributes significantly to improved agricultural production and the fact that online extension services offered instantaneous access while giving farmers a chance to take charge of the services they were interested in. 15% were not sure whether online agricultural extension services could increase production while the remaining five percent felt that online extension services could not improve agricultural production as they cited low digital literacy among most farmers and poor network coverage as the major hindrances. This is summarized in figure 2 below.

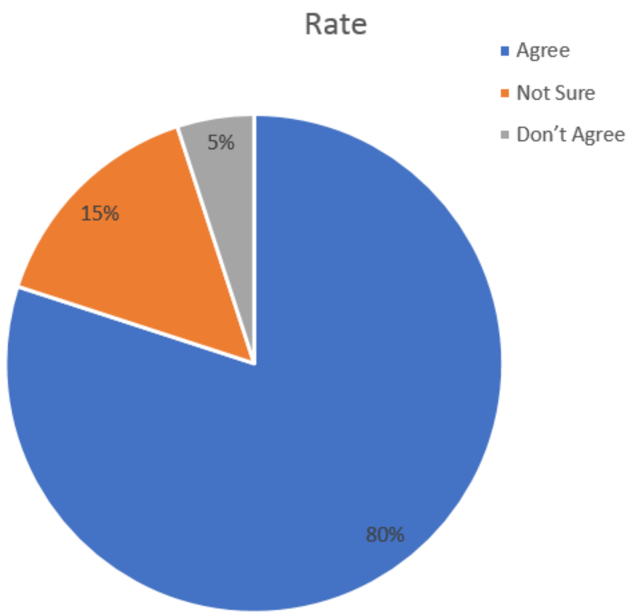

Figure 2 : Perception of the Impact of Online Agricultural Extension Services on Production

The study also sought to establish the challenges likely to adversely affect the success of online extension services. While it is evident that online extension services have the potential to improve agricultural production, several challenges were fronted as shown in the table 1 below.

Table 1 : *Responses on Challenges on e-agriculture*

Challenges	Level of Challenge				
	Not at All [1]	Low [2]	Medium [3]	High [4]	Very High [5]
Inadequate digital service centers & facilities [Q1]	0	13	19	14	54
Low knowledge on online extension [Q2]	0	11	12	36	41
Low Quality of Information [Q3]	0	10	14	39	37
Expensive to use [Q4]	10	25	22	23	20
Lethargy towards new technology [Q5]	8	29	20	26	17
Inadequate of Training [Q6]	13	36	24	13	14
Inadequate relevant customized content [Q7]	14	35	26	17	8
Lack of Feedback [Q8]	11	32	33	10	14

90% of the respondents perceived low quality of information to be problematic implying that the quality of information is very significant as far as the success of online agricultural extension services. This was followed by low knowledge on online extension where 89% of the respondents indicated this as a challenge, implying that training on online agricultural extension is key to the success of the same. 87% felt that inadequate digital service centers and facilities was a challenge. This implies that investment in digital services centers and facilities impacts positively to the success of online agricultural extension services. 65% of the respondents felt that costs associated with the use of online agricultural services was a challenge that is likely to adversely affect the uptake of the same. 63% felt that apathy towards new technology is likely to be a challenge as far as the implementation of online agricultural extension is concerned. 57% of the respondents felt that inadequate training on online could adversely affect online extension services implying that training is an important aspect as far as the success of the same is concerned. 51% of the respondents felt that both low relevant customized content and lack of feedback was likely to be a challenge as far as online extension services are concerned. This implies that users of the online extension services valued taking charge of the information as well as dialogic principles incorporated in the online extension services. This if summarized in the figure 3 below.

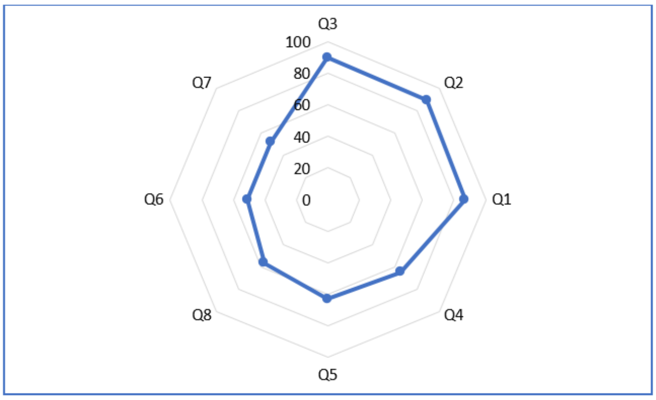

Figure 3: *Level of challenge in relation to online agricultural extension services*

III. CONCLUSION

While online agricultural extension presents huge potential in improving agricultural production especially these time when the chances of conventional extension services continue to shrink, addressing the challenges that adversely affect the use and adoption of the same by target groups remains top of the must do list. Equally, any implementation of online extension services devoid of stakeholders' involvement will most likely be counterproductive as it will be very difficult to cater for needs of the concerned players. Future research should assess the impact of unstructured data on online extension services and ways in which the problem of unstructured data can be addressed.

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