Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2016, 3(6):116-124**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Experimenting Open Agricultural Extension Service in Tanzania: A case of Kilosa Open Data Initiative (KODI)

Camilius A Sanga, Joseph PhillipoMasamaki, Kadeghe G Fue, Malongo R. Mlozi, Siza D Tumbo

Sokoine University of Agriculture, Tanzania

Abstract This paper presents results from the application of Open Data System to improve coverage of agricultural extension services using web-based and mobile-based farmers' advisory information Ushaurikilimo in Kilosa District. The research adopted a participatory action research method to develop the interventions. The findings from this study show that farmers and other actors get timely, relevant and personalized advisory services. The user interface of the Open System hosting Open Data is in Swahili language, a language widely spoken in the study area, which enhanced adoption of the system. The Open System did not require farmers and other actors to pay for the services, which motivated to attract farmers and actors to adopt the system. In order to lower the cost of implementing the project, agricultural extension officers in study villages were used to receive questions from farmers and provided answers, and sent difficulty questions to experts from Sokoine University of Agriculture to answer via their mobile phones.

Keywords open data, initiative, Kilosa, Ushaurikilimo, agricultural extension service

Introduction

The agricultural sector has been described as the engine for economic growth and the major source of livelihoods in Sub Sahara Africa for over 80% of the population [1-2]. However, about 30% of the population still experience problems of food insecurity and while about 51% of the population in Sub-Saharan Africa (338 Million people) live below the poverty line. One of the primary causes of food insecurity is lack of adequate and timely information to guide smallholder farmers and other stakeholders in ensuring sustainable agricultural production. As a consequence, most rural farmers in Tanzania make poor decisions regarding their agricultural activities. Thus, their decisions are either based on incomplete, inconsistent, inaccurate, outdated or no information at all.

This paper aims at improving decision making by farmers through developing of effective dissemination and communication of agricultural information through Open Data concepts. The agriculture sector is one of the sectors that are flooded with high volume (data size), velocity (speed of change), variety (different forms of data sources), veracity (uncertainty of data) and value (usefulness) of data about food market dynamics, weather patterns, and environment and soil conditions. With the emerging of Open Data concept, it is now possible to collect, fuse and analyze massive open data sets that incorporate the entire agricultural value chain and share with different actors. Our approach is to create a web and mobile based farmers' advisory information system where Open Data can be hosted and shared to different actors of agricultural value chains using Open access policy [18].

Open Data

Open Data can be defined as the data which can be freely accessible online for anyone to use and republish for any purpose.

Governments, businesses, foundations, NGOs, academic institutions and development stakeholders such as World Bank are developing programs to put Open Data into use. The World Bank in particular, has developed a methodology to help Governments around the world assess and build their own Open Data Programs (World Bank, 2015).

The World Bank (2015) report also gives advantages of Open Data. These include: fostering economic growth and job creation; improving efficiency, effectiveness and coverage of public services; increasing transparency, accountability and citizen participation; and facilitating better information-sharing within Government.

Schwegmann (2012) report shows that the number of open data initiatives in developing countries is still limited. Besides, the report was optimistic that this may not be the case in the coming years because civil society organizations and external partners of developing country governments are encouraging the use of Open Data to increase transparency, accountability and citizen participation [3].

Open Data for Government

Open Government Data (OGD) initiative which deals with the portal development principles, concepts and criteria for framing have started being operational in a number of countries [4]. The OGD gave details of issues challenging the implementation of Government portals for Open Data. Thus, Ubaldi (2013) suggested a methodology comprising of an Analytical Framework and a related set of data to be collected across OECD countries. The analytical framework enables the collected data to be measured using a common set of metrics. This will consistently assess impact and value creation of OGD initiatives within and across countries [4].

Jansen et al. (2012) explored the gap that exists between the promised benefits of Open Data and barriers to its adoption in the governments of different countries. They formulated five myths to promote the use of open data placing the expectation within the realistic perspectives. They found out that, despite the fact that Open Data has many benefits; there are a number of barriers in the field of task complexity, use, legislation, information quality and participation [5]. Thus, they recommended that in order to improve the quality of government information, creation and institutionalization of a culture of Open Data; government should provide tools and instruments with which to use the data.

Apart from the gap that exists between the benefits and barriers of Open Data, Anneke *et al*. (2012) conducted a comprehensive review of various types of social-technical impediment of open data. They concluded that realizing positive effects and creating public value from using Open Data on a large scale was too ambitious. This is due to the fact that the process in which data are either published or found or used or linked or reused or discussed encounters many obstructions which hinder or block the publication or use of Open Data. They categorized the impediments into the following: availability and access; finding ability; usability; understand ability; quality; linking and combining data; comparability and compatibility; metadata; interaction with the data provider; and opening and uploading. Furthermore they highlighted that the impediments are likely to change over time, suggesting that new policy and infrastructures are likely to solve many of these impediments. They also warned that due to higher expectations, new impediments may arise over time, but not likely to happen in a near future as most governments have established Open Data portal [6].

Robinson and You (2012) propose a more useful way for participants on all sides to frame the debate of Open Government. They suggested separation of the politics of open government from the underlying technologies insisting that technologies should make the information more adaptable and empowering third parties to contribute in the existing new ways of civic life. This has a potential to contribute to improve well being of poor communities [7].

In the perspective of possible impact on the poor and marginalized, Gurstein (2011) took a supportive yet critical look at Open Data. He provided a seven element model for how effective data use can be achieved. He further suggested that for Open Data to have a meaningful and supportive impact on the poor and marginalized, direct intervention is required to ensure that elements currently not in the local technology and social ecosystem are made available openly [8].

The Open Data in Science working group has put efforts in order to achieve a goal of making scientific data open [9]. The primary aim of this working group is to provide tools, apps and datasets for generating, discovering and reusing open data. The work noticed that, ideas are flowing continuously which requires the input of the wider scientific community to identify the problems they face in publishing, discovering and reusing data online and requesting assistance in order to solve them. Molloy (2011) argues that "Better science—in terms of transparency, reproducibility, increased efficiency, and ultimately a greater benefit to society—depends on open data".

In the same field of Open Data for Science, Reichman et al. (2011) did a study on challenges and opportunities of open data in ecology. They addressed the challenge of technology due to the dispersed and heterogeneous nature of the ecological data. Development of robust metadata and standardization of methods are said to increase data access, though they warned that, these are not sufficient. They finally recommended that sociological challenges that include inadequate rewards for sharing data should be addressed. Also they recommended establishment of well-curated, federated data repositories that can provide a means to preserve data while promoting attribution and acknowledgement of data use [10].

In Tanzania, there is a task force which has been formed to develop Open Data Policy. Initial assessment from the taskforce shows that Open Data movement in Tanzania faces the following challenges: absence of Open Data policy, absence of laws and regulations for Open Data, Low level of awareness on Open Data among public institutions and the public, Management Information Systems in the public institutions ar not interoperable, Limited coverage of Management Information Systems (regional or district centres), Unaffordable, limited and unreliable internet coverage, Inadequate sharing of ICT infrastructure among the public institutions and private sector, Variations in data management and data ownership among public institutions, Data are not published in machine readable format, Inadequate capacity of human resources implementing Open Data initiatives, lack of Open Data governing structure within the implementing agencies, absence and location of lead institution mandated with implementation of Open Data initiatives and inadequate financial resources for implementation of Open Data initiatives.

Open Data for Agriculture

The creation of data in agriculture is very immense than never before due to the advancement of ICT. The data explosion in agriculture needs to be harnessed so that it can benefit different actors in agriculture. Government with other actors plays a big role in this open data movement. Relevant data create daily for agriculture need to be available freely in usable and accessible format. Reliable, up-to-date, easily accessible data are important for improving agricultural productivity of smallholders' farmers. Even though open data has potential to benefit farmers in making informed decisions but there are challenges for implementing Open Data in developing countries like Tanzania (http://www.opengov.go.tz/). The challenges in implementing Open Data for agriculture are categorized into the following factors, namely: (i) lack of adequate resources to collect real time accurate and quality data (ii) low capacity to develop reliable ICT tools for Open data and (iii) lack of collaboration between different actors of Open Data (i.e. producers, consumers, policy makers). In most developing countries, surveys for collecting Open Data are expensive, capacity is limited, methods and tools are not fully developed, and key agricultural actors are not yet fully engaged. Thus, agriculture data available in developing countries is often inaccurate, out-dated, incomplete or inaccessible. Government should strive to provide enabling policy [11] for smallholder farmers' access to reliable data which will lead into higher agricultural productivity, greater access to markets and better food and nutrition. Among the ICTs which can be used to offer information system (i.e. open system) to provide Open Data Mobile phone based application promise to support large number of farming communities in rural areas [12]. Worldwide there are a number of mobile applications which offer different services to various actors in agriculture but few provide Open Data, Open Access, Open System and Open Services [12-13]. This is one of the major factors affecting adoption of those mobile applications to the farmers. This means there is mistrust between different actors of closed system offering dissemination and communication of agricultural Information. In this paper, the interest is to present one of the initiatives in Open Data for agriculture in Tanzania (http://ushaurikilimo.org/maswalimajibu.php). From the literature review, we

found that there are limited empirical studies in this field of Open Data [14] in developing countries. Thus, this is the gap in knowledge that this study tried to fill.

Case Study Description

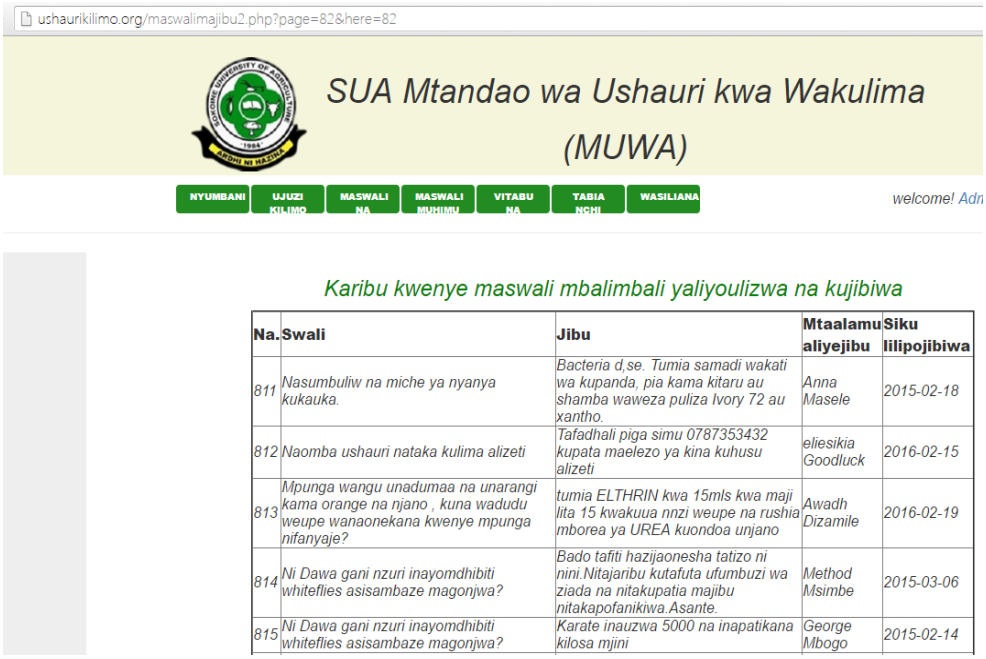
Participatory action research method was adopted as approach for this research. 40 farmers and other actors from Chanzuru, Ilonga Msalabani and Magomeni were involved during collecting user requirements. This was done during exploratory visit followed by, inception workshop and then baseline survey in 2011. The data collected helped to develop a prototype system for web – and mobile- based farmers' advisory system (M-FAIS & W-FAIS). Web – and mobile- based farmers' advisory information system (M-FAIS & W-FAIS) were developed using Participatory action research method. 40 farmers from Chanzuru, Ilonga Msalabani and Magomeni were involved also in testing the system. This was done during in 2012- 2013. The M-FAIS and W-FAIS are accessible on Web and mobile phone (Figure 1). The system is available at http://ushaurikilimo.org/index.php.'Ushaurikilimo' is a Swahili word that stands for 'Agro-Advisory'. 'Ushaurikilimo.org' is an Agro-Advisory Service that allows any agriculture actors (e.g. farmer, extension officer, policy maker, trader, etc.) to ask for advisory to agriculture extension officer using either web or mobile phone [18]. Furthermore, Ushaurikilimo is an open data initiative in Kilosa District (KODI). The development of 'Ushaurikilimo' has been done participatory with farmers and other actors for almost 3 years now. Any agricultural actors (e.g. farmers etc.) can send a question via mobile phone to a local mobile phone number 0688099408. Also, there is a backup international number in case there system is not accessible through local phone number. After the question has been posted in our system then extension officers in Kilosa can answer via their mobile phones. These systems are in use in 20 villages which has been selected randomly. Each village has one agricultural extension officer who has been trained in several training of trainer workshop conducted at Kilosa in 2014 – 2015. The task of agricultural officer was to train 20 farmers to use M-FAIS and W-FAIS. Also, farmers can send question using our system directly [15]. This is for those who have access of Internet. The questions which are answered are pushed back to farmer's mobile phone and a copy of the answer is posted on W-FAIS. Examples of answered questions are: http://ushaurikilimo.org/maswalimajibu.php. Furthermore, we have created a facebook page for agricultural actors who might be interested to follow what is happening in our project: https://www.facebook.com/Ict4AgriculturalExtensionServices [18].

Figure 1: Homepage of W-FAIS

Results

We have 19 extension officers answering questions from more than 380 farmers. Despite of the fact that the intended farmers were from Kilosa District but we are receiving questions from other Districts of Tanzania.

More than 1000 questions have been submitted to advisory system through SMS & Web (Figure 2). More than 800 answers have been given out by agricultural extension officers - http://ushaurikilimo.org/maswalimajibu2.php?page=1&here=1. Some 174 actors has subscribed to our facebook page (https://www.facebook.com/Ict4AgriculturalExtensionServices) [18].



Na.	Swali	Jibu	Mtaalamu aliyejibu	Siku lilipojibiwa
811	Nasumbuliw na miche ya nyanya kukauka.	Bacteria d,se. Tumia samadi wakati wa kupanda, pia kama kitaru au shamba waweza puliza Ivory 72 au xantho.	Anna Masele	2015-02-18
812	Naomba ushauri nataka kulima alizeti	Tafadhali piga simu 0787353432 kupata maelezo ya kina kuhusu alizeti	eliesikia Goodluck	2016-02-15
813	Mpunga wangu unadumaa na unarangi kama orange na njano , kuna wadudu weupe wanaonekana kwenye mpunga nifanyaje?	tumia ELTHRIN kwa 15mls kwa maji lita 15 kwakuua nnzi weupe na rushia mborea ya UREA kuondoa unjano	Awadh Dizamile	2016-02-19
814	Ni Dawa gani nzuri inayomdhibiti whiteflies asisambaze magonjwa?	Bado tafiti hazijaonesha tatizo ni nini.Nitajaribu kutafuta ufumbuzi wa ziada na nitakupatia majibu nitakapofanikiwa.Asante.	Method Msimbe	2015-03-06
815	Ni Dawa gani nzuri inayomdhibiti whiteflies asisambaze magonjwa?	Karate inauzwa 5000 na inapatikana kilosa mjini	George Mbogo	2015-02-14

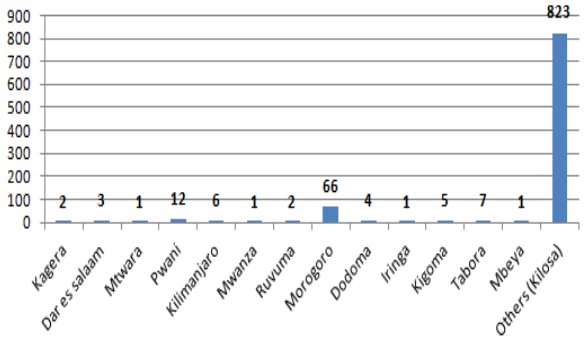
Figure 2: Questions and Answers from W-FAIS & M-FAIS

Analysis of questions answered shows that farmers submitted questions in the following categories:-

i. Crop husbandry (annual & food crops)
ii. Livestock
iii. Climate change issues
iv. Tree farming
v. Aquacultures
vi. Markets and market information

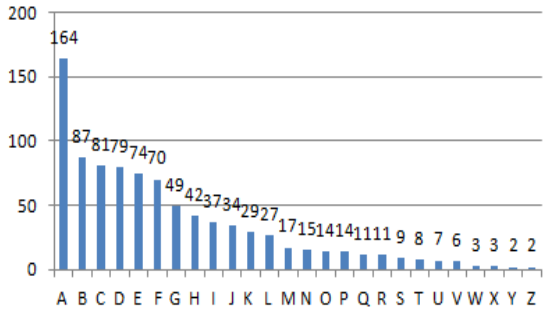
Furthermore, the pattern for those farmers who specified location in their SMS shows farmers seeking advisories are located in different parts of Tanzania (Table 2) [18]:

Table 1: Number of SMS sent to Ushaurikilimo Vs Region



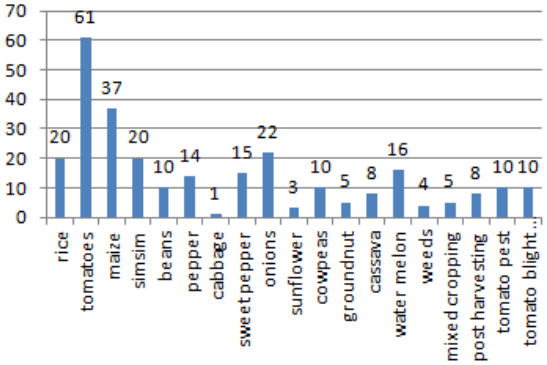
The average number of questions per farmer is 2.26 questions where 1289 questions were asked by 571 farmers. Out of these total questions only 895 have been answered by extension officers. The average number of questions answered by each extension officer is 33.15 (Table 3) [18].

Table 2: Number of questions answered Vs Extension officer



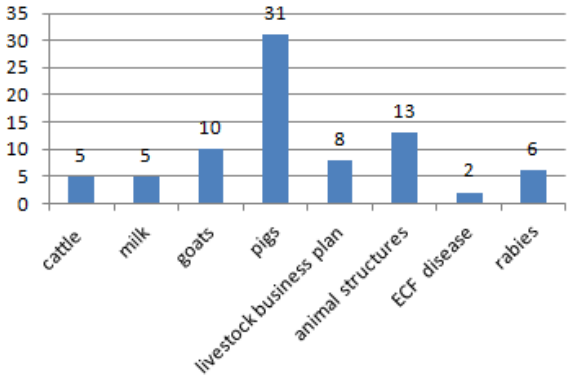
Analysis of questions answered shows that 279 questions asked were from crop husbandry (annual and food crops). The number of SMS sent to Ushaurikilimo for different types of crops is as shown in Table 4 below [18].

Table 3: Number of SMS vs Type of crop



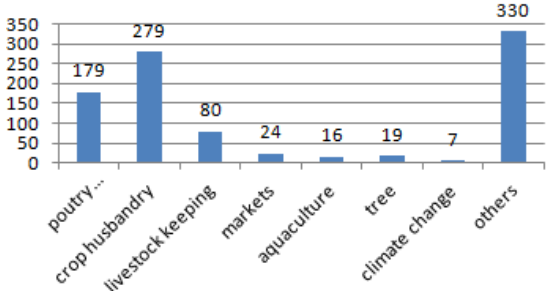
Also, there is 80 SMS which have been submitted by farmers asking advisories about livestock husbandry (Table 5) [18].

Table 4: Number of SMS vs Types of livestock



In summary, the types of questions asked out of 934 SMS were as depicted in Table 6. Most SMS contain multiple issues in a single SMS that is why it was difficult to categorize them [18].

Table 5: Number of SMS vs Issues in agriculture



Piloted W-FAIS and M-FAIS proved that mobile phones use has direct impact for enhancing rural livelihoods and the agricultural sector. Also, the project has improved work efficiency of the extension officers through provision of information to farming communities timely. The best extension officer has answered 87 questions apart from his/her daily face-to-face visit to farmers in the village. The average response time after the question has been assigned to expert for questions which have been answered last year is 32.49 hours. The system has been reengineered to improve the average response time and hence in previous month (April 2016) the average response time is 17.8 hours. Furthermore, W-FAIS and M-FAIS has linked major actors in the agricultural sector such as farmers, transporters, traders, input suppliers, extension officers, researchers and policy makers.

Discussion

From the above results one can deduce that FAIS, a prototype system is providing Open Data which has started being adopted by farmers and other agriculture actors in Tanzania. FAIS is useful in disseminating and communicating agricultural data and information between either farmers-to-farmers or farmers-to-extension officers and also, between farmers and other actors. This type of learning is termed as mutual learning. Jones (2006) stated there is a need of learning from what farmers pose as problem to researcher or extension agents which need some answers from any knowledgeable actors along the chain. After the problem has been answered it must be shared and benefit any actor along the chain [16]. By all the actors being in a constant environment of experimenting and learning from Open Data daily then the issue of lifelong learning is brought into context. Therefore Open data brings an enabling environment for lifelong learning to different people. For example, in our project we have seen a question asked about sacks for storing maize by certain farmers in a village creates an alert, which in turn gives an opportunity for traders to bring them into markets (Figure 3).

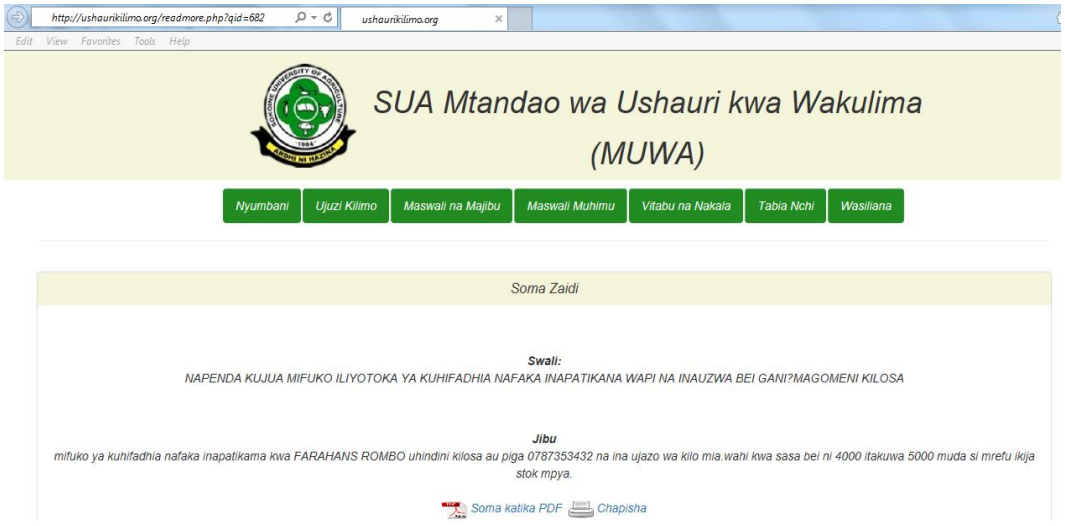


Figure 3: Example of question asked to 'Ushaurikilimo' [18]

The reason why there are more users motivated to use is that farmers can use the free SMS given by telecommunication companies after buying airtime voucher in prepaid bundle. Also, the use interface of the system is simple and easy to use. Furthermore, the system is reliable. Only 78 SMS were undelivered during last year 2015 (Figure 4) [18].

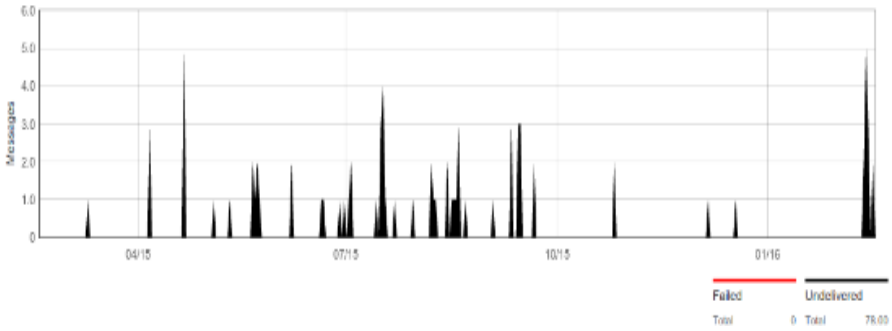


Figure 4: 78 Failed SMS during sending & receiving – Last year 2015

Beside the above mentioned benefits which FAIS offers to its users, farmers in the piloted villages described some challenges which they face in using the systems but the most important ones related to Open Data were: (i) Delay in answering their questions thus causing the Open Data, Open Information and Open Knowledge present online to be not updated frequently (ii) some of the answer (in form of Open Data) provided as advisory are not implementable by some illiterate farmers (iiii) prevalence of fake farm inputs inhibit the farmers truce the authenticity of answers. This is because sometimes farmers get poor results although answers (in form of advisories) provided by the system that were directed to farmers were correct (iv) lack of policy governing the Open data for research project (http://www.opengov.go.tz/index.php/togp/commitment_details/4). Thus, Intellectual Property Right of the Open Data was a problem till when we formulated copyright policy (http://ushaurikilimo.org/Copyright_Policy_2013_2016.pdf).

Furthermore, our open data project shows that the advisories available online from different Districts of Tanzania can be used by different actors depending on the value which is attached to it. This in turn brings a greater impact of the open data to many actors [17]. For example, questions related to certain problem submitted to FAIS from a certain village can be used by a trader who is selling pesticides to prepare the stock for it before farmers start coming to ask for it. On the other side, the same information can be used as early warning for researchers who are doing research in the same problem [18].

Finally, open data can be used by students while experimenting (i.e. modeling and simulation of data in virtual experiments) different ideas [19].

Conclusion

Disseminating and communicating agriculture data or information or knowledge openly has the potential to provide farmers and other actors in different agriculture value chains with better services, such as services to access quality and up-to-date agriculture information and knowledge. The key issue for farmers to be able to use Open Data for agriculture effectively and efficient is that it needs to be available and accessible in a timely. The Open Data for Agriculture must also be affordable, relevant, useful and trustworthy. This is possible if and only if different stakeholders in agriculture extension services are part and parcel of the development of Open System which hosts Open Data. Also, all actors must participatory be involved in all stages of the development of Open System and creation of Open Data.

References

[1]. World Bank. 2006. Africa development indicators: 2006. Washington: World Bank. http://devdata.worldbank.org/wdi2006/contents/cover.htm

[2]. Diao, X., Hazell, P. B., Resnick, D., & Thurlow, J. (2007).*The role of agriculture in development: Implications for Sub-Saharan Africa* (Vol. 153). Intl Food Policy Res Inst.

[3]. Schwegmann, C. (2013). Open data in developing countries. *European Public Sector Information Platform Topic Report*, (2013/02). URL:http://www.epsiplatform.eu/sites/default/files/127790068-Topic-Report-Open-Data-in-Developing-Countries.pdf

[4]. Ubaldi Barbara (2013), "Open Government Data: Towards Empirical Analysis of Open Government Data Initiatives", *OECD Working Papers on Public Governance*, No. 22, OECD Publishing. http://dx.doi.org/10.1787/5k46bj4f03s7-en

[5]. Janssen M., Charalabidis Y. and Zuiderwijk A. (2012). Benefits, Adoption Barriers and Myths of Open Data and Open Government. *Information Systems Management (ISM),* 29(4), pp. 258-268.
[6]. Anneke Z., Marjin J., Sunil C., Ronald M. A. and Roexsana Sheikh A. (2012). Socio-technical Impediments of Open Data. *Electronic Journal of e-Government, 10* (2), pp. 156 - 172.
[7]. Robinson David G and Yu Harlan (2012). The New Ambiguity of "Open Governmant". UCLA Law Review Disclosure. 59, pp. 178-208
[8]. Gurstein Michael (2011). Open data: Empowering the empowered or effective data use for everyone? First Monday. 16(2).http://firstmonday.org/ojs/index.php/fm/article/view/3316/2764
[9]. Molloy Jennifer C. (2011). The Open Knowledge Foundation: Open Data Means Better Science. PLoS Biol. 9(12): e1001195. doi:10.1371/journal.pbio.1001195
[10]. Reichman O. J., Jones M. B., and Schildhauer, M. P. (2011). Challenges and Opportunities of Open Data in Ecology. *Science, 331*, pp. 703-705.
[11]. OECD (2015), "Making Open Science a Reality", OECD Science, Technology and Industry Policy Papers, No. 25, OECD Publishing, Paris. http://dx.doi.org/10.1787/5jrs2f963zs1-en
[12]. Brugger, F. (2011).Mobile Applications in Agriculture. *Syngenta Foundation*. URL:http://www.syngentafoundation.org/__temp/Report_on_mAgriculture_abridged_web_version.pdf
[13]. Sanga, C. A., & Kibirige, G. (2016). Applying Kolb Learning Experiential Theory with Cloud Computing in Higher Education Institutions: Tanzania. In *Web-Based Services: Concepts, Methodologies, Tools, and Applications* (pp. 1968-2000). Hershey, PA: Information Science Reference. doi:10.4018/978-1-4666-9466-8.ch087
[14]. Reilly, K. and Alperin, J. (2016) Public engagement in open development: a knowledge stewardship approach. [pdf] Singapore: Singapore Internet Research Centre (SIRCA White Paper 6). Available at: http://www.sirca.org.sg/wp-content/uploads/2015/08/Reilly_WhitePaper.pdf
[15]. Ushaurikilimo. (2016). Crowd sourcing platform. URL: http://ushaurikilimo.org/farmerloginok.php?fname=1
[16]. Jones, M. (2006). Collaboration in learning at the farm level to achieve development goals. URL:http://pcf4.dec.uwi.edu/viewpaper.php?id=141
[17]. Addison, C., Jellema, A., & Meijninger, W. (2015). *Open data and smallholder food and nutritional security*. CTA. URL: http://www.cta.int/images/Opendataforsmallholders-report_.pdf
[18]. Sanga, C. A., Phillipo, J., Mlozi, M. R. S., Haug, R., & Tumbo, S. D. (2016). Crowd sourcing platform "Ushaurikilimo" enabling questions answering between farmers, extension agents and researchers. International Journal of Instructional Technology and Distance Learning, 13(10), 19–28.
[19]. Barakabitze, A. A., Fue, K. G., Kitindi, E. J., & Sanga, C. A. (2016). Developing a Framework for Next Generation Integrated Agro Food-Advisory Systems in Developing Countries. International Journal of Information Communication Technologies and Human Development (IJICTHD), 8(4), 13-31.