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Re-Conceptualisation of Agriculture Information System for Uganda

Benedict Oyo [1, ✉], Milton Kaye [2], and Lenard Nkalubo [3]

Abstract: **Researchers and practitioners have over and again advocated for more funding to stimulate growth in the agricultural sector, but none provide more than anecdotal coverage of how increased funding translates into better livelohoods for the smallholder farmers. Based on experience with the earlier version of agriculture information system for Uganda, this paper identifies two performance gaps, namely, productivity and profitability gaps, and knowledge and skills gaps, as key to individual and hollistic empowerment of smallholder farmers. Mitigation measures for these gaps are explored through iterative agriculture information system architecture. The paper concludes that the impact of agriculture information system rests on its technical efficiency as informed by the architecture and its operational effectiveness arising from situational adoption strategies.**

Keywords: Agricultural extension, cooperatives, smallholder farmers, grassroots, information technology.

1. INTRODUCTION

The initial working prototype of agriculture information system (AIS) for Uganda was developed in 2011 and is accessible at http://ais.eureka.ug. By that time, the focus was on empowering smallholder farmers with knowledge and skills to produce more, profit more and preserve adequate seeds for future seasons. Consequently the prototype was made up of three sub-systems, i.e.,

- Data management sub-system for storing the individual farmers recurrent performance data and producing performance gaps reports as well as success reports.
- Advisory sub-system for providing information to farmers on agricultural best practices using an up-to-date agricultural knowledgebase;
- Farmers cooperatives sub-system for production and marketing support.

This paper analyses the AIS prototype [14] and presents a roadmap for its evolution towards greater impact amongst smallholders in Uganda. The context of analysis is the three sub-systems above. For each sub-system, we evaluate the persistent challenges against existing interventions, and then provide the next course of action for faster adoption. This is matched with an overarching agricultural information systems architecture that succinctly minimizes productivity and profitability gaps on one hand, and knowledge and skills gaps, on the other hand, thereby strengthening subsistence farming. We hope that this paper will prove useful to farming systems and organizations supporting resource-poor farmers and also contribute to the small but growing literature that emphasize information technology adoption in agriculture.

2. AGRICULTURAL ADVISORY

A. *Background Issues*

The National Development Plan (NDP) of Uganda for the fiscal period 2011-2015, places top priority on agriculture, forestry, manufacturing, tourism, mining, information and communications technologies (ICTs) and construction as the primary growth sectors [7]. It calls on agriculture to be the engine for poverty eradication especially among the rural population through commercialisation, value addition (agro-processing), marketing and exportation.

This is reflected by the supportive polices such as Plan for Modernisation of Agriculture (PMA) through its seven pillars among which advisory services has been highly prioritised.

At implementation level, agricultural advisory/extension is the sole function of National Agricultural Advisory Services (NAADS). NAADS aims to increase farmers' access to information, knowledge and technology for profitable agricultural production. As a national programme, NAADS is funded by government and donors for which the first phase running 2001 to 2008 attracted USD ($) 108 million and the current phase attracting an additional USD ($) 665 million.

Despite the NAADS and other agricultural support initiatives, the growth rate of the agricultural sector has been volatile and below the National Development Plan's (NDP) annual growth target of 5.6 per cent. Indeed, over the last decade, growth in agricultural output declined from 7.9 per cent in 2000/01 to 0.1 per cent in 2006/07, then improved to 1.3 and 2.6 in 2007/08 and 2008/09 respectively [7].

[1, ✉] *Benedict Oyo is with Gulu University.* (Email: b.oyo@gu.ac.ug),
[2] *Milton Kaye is with EurekaLinks (U)Ltd.* (Email: kaye2milton@gmail.com),
[3] *Lenard Nkalubo is with Kyambogo University.* (Email: lnkalubo@kyu.ac.ug).

RECEIVED: 18, OCT., 2013; **REVISED:** 7, FEB., 2014; **ACCEPTED:** 11, MAR., 2014; **PUBLISHED:** 15, MAY, 2014.

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These figures have prompted critics to argue that previous extension services have not enabled better farming practices as poverty levels and food security at the grassroots continue to worsen [2,6,9].

At the same time, the complexities of the agricultural production function imply that for farmers to succeed, they need information on a variety of topics at every stage of the farming process. Due to weak extension services, smallholder farmers resort to other information sources, such as, their own trial and error, members of their social network, radios and newspapers. Either way, the costs involved in accessing useful agricultural information by farmers at the grassroots cannot be avoided and therefore must be met by organisations (government or non-government) working with farmers or the farmers themselves. Now is the time therefore, to explore new advisory/extension services that leaverage Internet technologies to provide timely information to farmers in order to improve their practices. This is the subject of the next sections B and C.

B. *Existing forms of Agricultural Extension*

Apart from the convetional extension services using extension workers, other forms of agricultural information dissemination mechanisms are now available through local radios, national televisions, newspapers and the Internet. Notable examples include the following:

- Weekly agricultural education programmes on most television (TV) stations, such as: "friends of botany" on UBC TV, "emere bugaga" (translated as 'food is wealth') on Bukedde TV, "on the farm"on NTV, etc. Archives of these programmes are also accessible on their respective *You Tube* channels.
- Special weekly newspaper coverage on modern farming such as: "harvest money" on New Vision newspaper, "seeds of gold" on the Daily Monitor newspaper, etc.
- Agricultural education radio programmes in many local languages at various geographic locations.
- Online advisory resources, e.g., advisory sub-system on AIS [14] and NAADS web resource [15].

While the alternative dissemination mechanisms presented here have potential to strengthen smallholders activities, they are largely constrained due to limited/no access in the rural areas arising from poverty [3]. However, ignoring these alternatives only escalates problems of the rural agricultural population. In the next section, we present a dissemination strategy that integrates these mechanisms and relays information to the farmers irrespective of the known information access barriers.

C. *Wayforward*

Following from the previous section, it is clear that relevant agricultural information is available but disintegrated. Integrating the different sources of agricultural information into a central knowledgebase and implementing channels of access through computers, mobile devices, TVs and radios, will give farmers more control over the information they want to access, how/when they want it. We conceptualise this integration in Fig. 1.

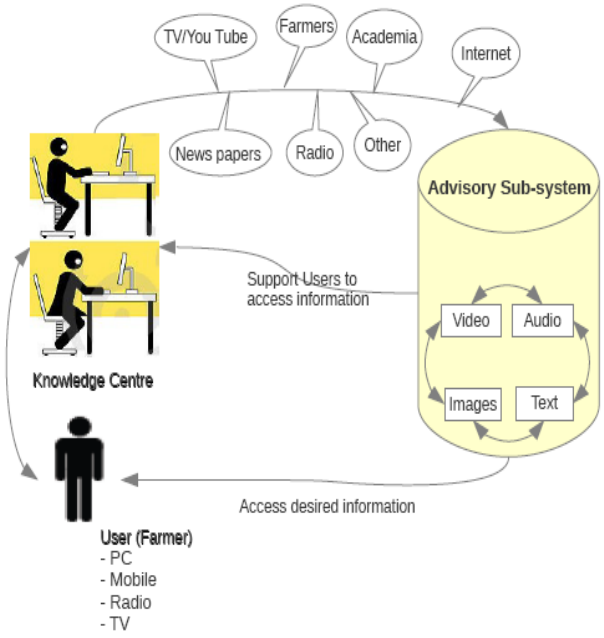

Fig. 1. Information flow for advisory sub-system

Once the advisory sub-system or knowledgebase is developed and populated with relevant information in video, audio, image and text formats, effort is then concentrated on enabling acces to this information. The two most suitable information access options as depicted in Fig. 1 are:

- Direct access by farmers using electronic devices such as computers, mobile devices, radio and television. Since 86 percent of land owned by the people of Uganda is cultivable [7], providing extensive, multi-format agricultural information opens the agricultural entry space to the educated people from any sector. This would culminate into the much needed modern agriculture as the middle class invest in agriculture for profit, while employing the smallholders. At the same time, smallholders would learn new methods leading to holistic transition towards modern agriculture. The second option seeks to provide access to agricultural information in rural areas through rural based information centres or knowledge centres.
- Access through knowledge centres. In the context of this paper, a knowledge centre is a free or subsidised Internet kiosk in a rural area. The kioks can be managed by government, non-government organisations or community based organisations. In addition, cooperatives at sub-counties, sub-country telecentres and schools can be empowered to support knowledge centre activities.

Because of the importance of agricultural information, building a central knowledgebase is not debatable even when access seems a far fetched reality. We contend that

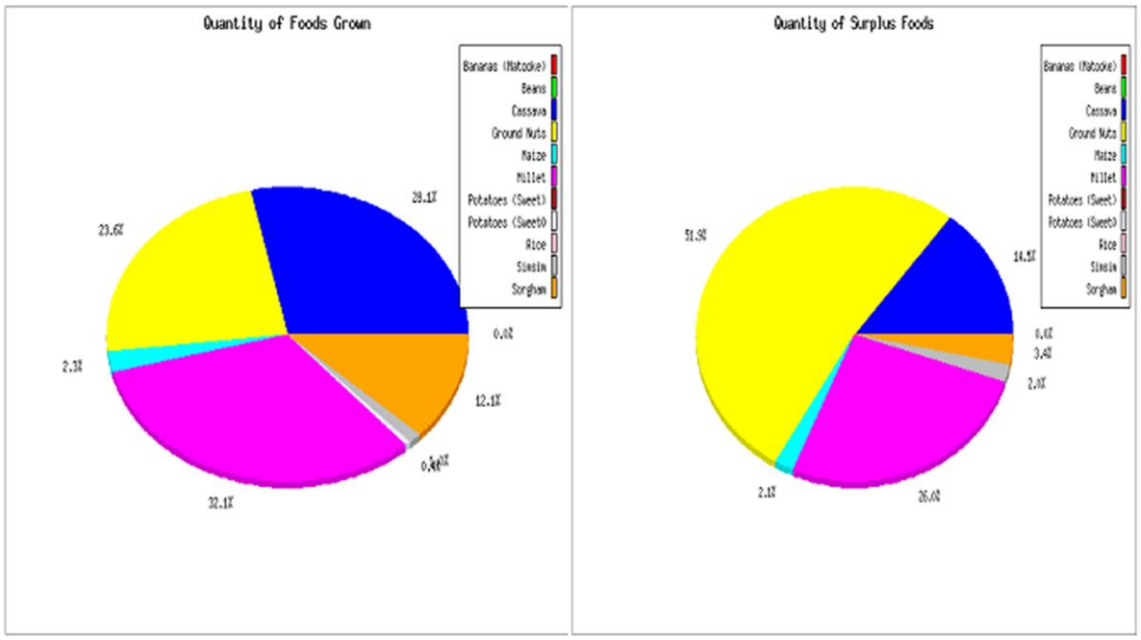

Fig. 2. Analysis of quantity of food grown and quantity of surplus food for sale.

once the knowledgebase is available, investing in its access either by individuals, groups, and farmer support organisations, or government becomes easier.

3. FARMERS DATA MANAGEMENT

All Farmers generate new data after every farming season. Collecting such data and analysing it reveals successes and performance gaps against which external support should be anchored. However, the current farmers support mechanisms especially at the grassroots are more generic and not linked to the actual challenges faced by specific farming community. Therefore, interventions should be informed by performance gaps emerging from farmers' data in the following areas:

- Sources of seeds for previous season, i.e., preserved, bought, donated or borrowed seeds.
- Quantities of each crop grown and their corresponding yeilds
- Family size and size of land owned
- Quantities of surpluses for sale per farmer
- Quantities of seeds preserved per farmer
- Crop prices immediately after harvest
- Farming methods/tools used
- Other farming activities, e.g., poultry, livestock, fishing, etc
- Types of external support received per farmer and farmer groups

A number of decision options can be tested from this data. The next section uses an example to amplify the importance of data-based decision making in agricultural practices.

A. Decision Making

Any form of decision has its associated risks. These risks escalate when dealing with unpredicatable behaviours of smallholders with minimal or no education. At the same time, the risks are minimized when decisions are data driven. For instance, an analysis of foods grown and corresponding purposes as shown in Fig. 2, suggests that groundnuts and maize are grown majorly for sale despite cassava and millet being the largest produced foods.

Since farmers are already engaged in growing groundnuts and maize for sale, marketing strategies such cooperatives can promote production of maize and groundnuts as well as the other crops for higher profits.

B. Next Steps

Ideally, interventions into smallholders situations should stem from data collection and problem formulation. This would minimise wrong assumptions of farmers' problems that are responsible low impact projects in the literature. It would also imply that every need of the farmer can be met because all the necessary information to meet those needs is available.

4. FARMER COOPERATIVES

A. Background

Cash crops based cooperatives in Uganda successfully empowered farmers until the mid 1980s and thereafter registered retarded growth until the early 1990s when they collapsed following liberalisation of agricultural markets. About a decade ago, the revival of cooperatives was initiated by Uganda Cooperative Alliance (UCA), as an independent umbrella organisation of cooperatives. Under the new UCA structure, the revived/reformed cooperatives are to offer complimentary services by combining access to

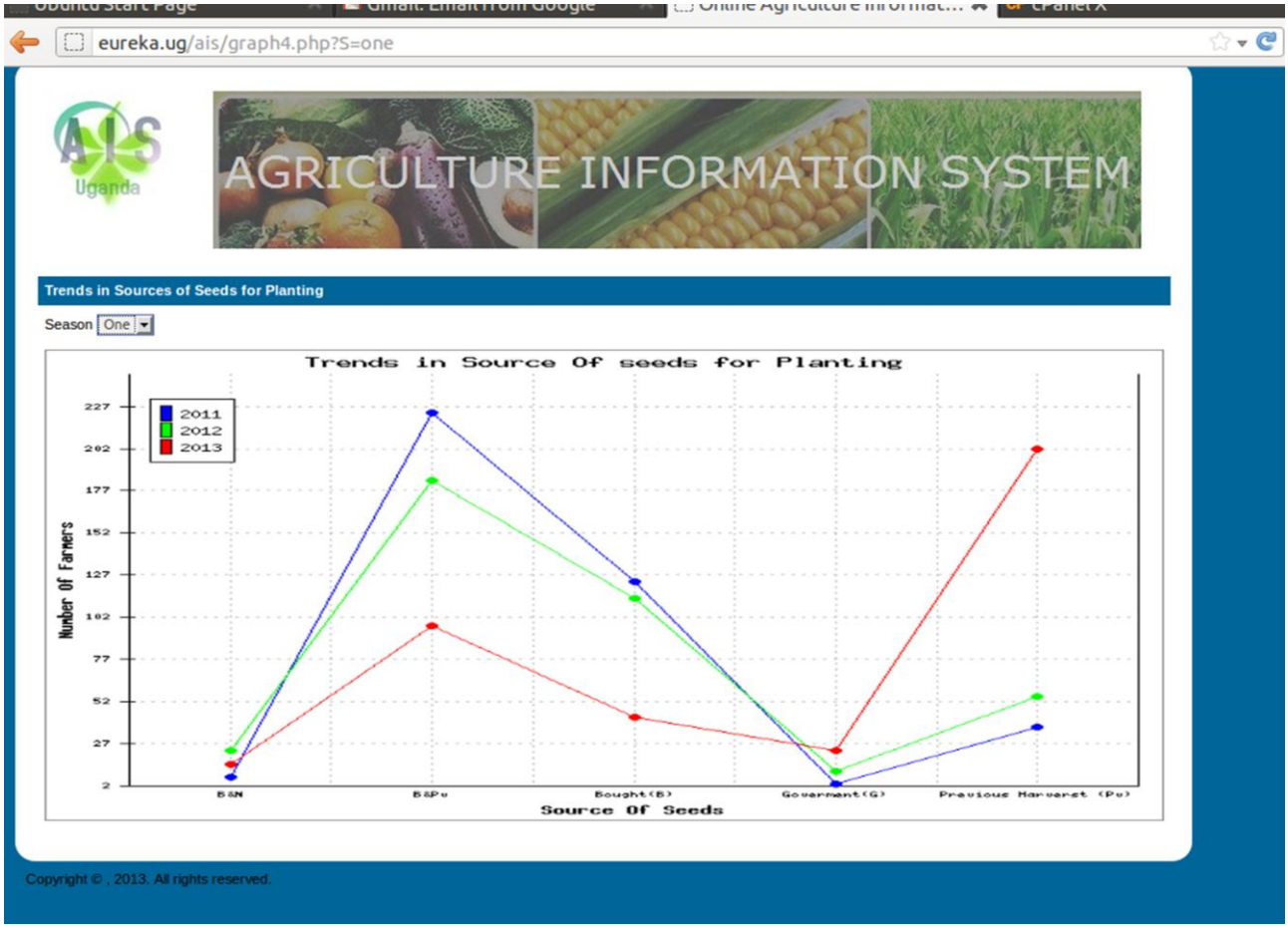

Fig. 3: Analysis of source of seeds for planting from 2011 to 2013

financial services through Savings and Credit Cooperative Organizations (SACCOs) with bulk-marketing services for farmer produce through: Area Cooperative Enterprises (ACEs) and Rural Producer Organizations (RPOs), all situated at sub-counties. The aim of this arrangement is to improve rural incomes while decreasing rural poverty [4].

In contrast, the cooperatives are still scarcely available and problems of access to seeds for planting and better markets for produce have persisted. For instance, analysis reports from *AIS* prototype [14] shows that during the pre-cooperatives revival period, farmers utilised less land than what is available for farming due to constraints of access to seeds for planting as depicted by '2011 graph' in Fig. 3 . Indeed the majority of the farmers bought seeds (B) compared to those who preserve seeds from previous harvest (Pv) in 2011. Aware of the fact that farmers are always without any savings, it is obvious that farmers will always have limited access to seeds for planting and hence low harvest in absence of support structures for seeds preservation. Other options, e.g., seed donations from government (G) and NGOs (N) were not reliable as depicted by their meager contributions in Fig. 3.

The graphs show progression towards a more desired trend compared from 2011 to 2013, arising from 'seed banking' interventions for seeds preservation. Details of seed banking as a special type of cooperatives is out of scope of this paper but can be found in [9,10].

B. Next Steps

While it has been persistently reported that the agricultural sector in Uganda is under funded by government [1,2,4,7,8], it is possible to realize growth if the current funding is carefully utilised. Establishing and promoting new forms of cooperatives the integrate activities of RPOs, ACEs and SACCOs would holistically empower farmers at the grassroots. Such a multi-functional cooperative, also refereed to as 'seed bank' has been piloted in Eastern Uganda and preliminary impact is very positive [9,10]. Therefore, adopting seed banking initiatives would strengthen the agricultural activities at the grassroots while improving rural livelihoods.

5. AIS ARCHITECTURE

Transforming the rural population using information technology has its inherent bipolar hurdles of limited/no access to computers/Internet and lack of quality/relevant content. While government is committed to extending computers and Internet to rural areas through telecenters and other computer centers in secondary schools and sub-counties, complementary electronic agricultural information is scarcely available. An effective agricultural information system (AIS) will require a team of experts to

build and enormous work in updating it with relevant information and promoting its use. We have developed an architecture as shown in Fig. 4, on which AIS should evolve. The prototype corresponding with the three sub-systems in this architecture is available at http://ais.eureka.ug.

At implementation level, each of the sub-systems in Fig. 4 can be separately developed and then integrated. The central focus is to support farmers mitigate their challenges and thus both advisory and farmer cooperatives sub-systems depend on issues emerging from farmers data. The *AIS prototype* [14] consists of a high level farmer cooperative called *seed banking* [9, 10] following critical diagnosis of farmers' underlying problems. Most cooperatives focus on marketing produce and providing basic inputs like seeds and therefore utilise only a section of seed banking capability. On the other hand, the effectiveness of the advisory sub-system depends on the volume of information available and the type of data formats supported, e.g., text, image, video and voice.

6. CONCLUSION

A lot of interventions for the smallholder farmers' problems have been attempted but with minimal success. As already discussed, researchers and practitioners have associated the persistence of these problems to: resource constraints in land, labour and capital, climatic changes, volatile food prices, pests and diseases, weak disaster response mechanisms, and weak extension services. This paper offers an information technology solution termed '*AIS prototype*' for most of these problems. The solution addresses knowledge and/or skills gaps amongst smallholders and provides a mechanism for managing all sorts of information that rural community actors or cooperatives generate as they interface with farmers. In effect, the *AIS prototype* guarantees availability of time-sensitive technical or non technical information, i.e., in the event that an agricultural problem manifests, knowledge on immediate mitigation measures is within a radius a mouse click or a phone call.

In advocating for the use of information systems to improve smallholders' activities, we are cautious of mythical claims by the targeted smallholders that may stifle adoption such as: farmers having more information than the computer/Internet, computers being difficult to use, computers not meant for farmers, etc. Since the *AIS prototype* have been developed and is managed by a private company (EurekaLinks Ltd), some sort of public-private partnership is definitely needed to ensure greater adoption in rural areas.

Whereas this paper has shown that an agricultural information system could fundamentally change productivity and profitability in agriculture while simultaneously improving the knowledge and skills of smallholders to confront and defeat current and/or future challenges, more research is needed to evaluate whether agricultural information systems are more effective and efficient in providing information to farmers than other traditional approaches.

ACKNOWLEDGEMENT

We would like to thank Stephen Magara and Geoffrey Andogah who participated in the 2011 study that has informed this study.

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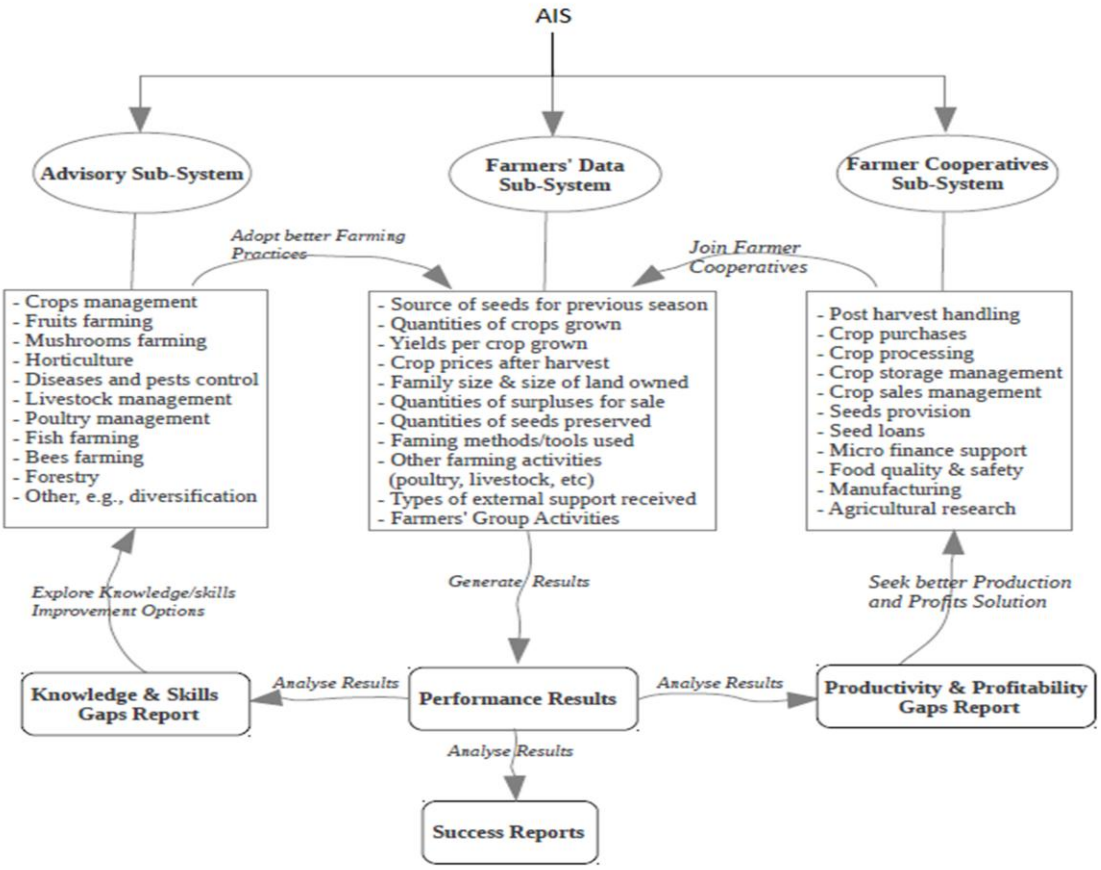

Fig. 4. The agricultural information system architecture

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Benedict Oyo, Milton Kaye, and Lenard Nkalubo, "Re-Conceptualisation of Agriculture Information System for Uganda," *TSEST Transaction on Electrical and Electronic Circuits and Systems*, Vol. 4(8), Pp. 39-44, May, 2014.