

ICT in agricultural education, research, and outreach in Uganda

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Abstract

Past and ongoing efforts in the three functions of the agricultural sector, namely; research, education and outreach in SSA, have not had the desired impacts of transforming the agricultural systems and impacting livelihoods. This discrepancy is attributed to weak linkages in the agricultural research-extension-education nexus. ICT offers an excellent opportunity for improved coordination across the agricultural nexus, bridging the information gap, sharing information and creation of knowledge. This paper highlights efforts by partners from institutions, in the north and south, with mandates in agricultural research, extension and education networking towards building a common vision for designing and implementing an ICT-based system for effective coordination amongst NARS institutions initially in Uganda and Kenya then in eastern and southern Africa for sustainable agricultural development. The experiences have been generated in agricultural distance learning, information dissemination amongst stakeholders, and strengthening rural innovations. Piloting of e-distance learning-based strengthening of agricultural and environmental capacities by a consortium of north and south institutions has demonstrated that challenges notwithstanding, it offers a viable alternative for lowering education costs, increasing professional retention and keeping trainees within their professional and home environments. The linkages between NARS

partners can be done using a scalable and cost-effective web-based system designed by using simple open source software, Joomla, to cater for the diverse interests of the stakeholders that can be incrementally developed and extended to cover all aspects of agriculture and ensure lifelong learning. Understanding and addressing needs and priorities of societies in complex farming systems is being addressed by strengthening rural innovations capacities in five universities. Interactions so far reveal that the challenges are very similar across the institutions in the region. We propose a model for integrating ICT in agricultural education, research and outreach. There is need to upscale these experiences in order to realize improved and sustainable agriculture.

Keywords: ICT, rural innovation, e-learning platform, open source soft ware, distance learning, model

Rationale

Agricultural development programs in sub-Saharan Africa (SSA) have not had the desired impact on the livelihoods of the people (Eicher, 2004). Past and ongoing efforts in agricultural education, research and outreach are yet to translate into transformation of the traditional farming systems and improved livelihoods of the people. The levels of success in agricultural research, education and outreach during the last 100 years, as measured by the traditional indicators (improved per capita productivity and technology adoption), have rather been disappointing (Tenywa, 1999). Throughout this period, there has been a marked decline in per capita productivity and non-transformation of the farming systems. According to Opio-Odong (1992), the minimal impact of scientific research on sub-saharan Africa, Uganda in particular, has been attributed to three problems, namely; the tendency among agricultural researchers to ignore the management contexts (limitations and opportunities) of local agriculture/farmer innovations in the process of technology development; the failure to target real needs of the key actors, including smallholder farmers; and lack of economic appraisal of experimental results before extension recommendations are formulated. Universities have the trio functions (agricultural education, research and outreach) and have a share in these problems too.

Over the years, the inability of the agricultural system to generate relevant and appropriate knowledge to support the livelihood strategies of the communities has increasingly led to declining flow of resources into agricultural tertiary institutions, research and outreach systems (Court, 1999; Beintema and Pardey, 2003). The problem has been due to the three pillars of agricultural development (education, research and outreach) have largely been de-linked (Everson, 2001). When the agricultural research, education and outreach, as well as private sector (retailers, processors) are interlinked, they can better identify society needs and priorities thus likely to have greater positive social impacts as well as creating ownership (Zaake, 1999). In essence, once the stakeholders are convinced that the education, research and extension is meeting their needs they are more willing to provide direct or indirect support that may translate into more resources flowing into these functions (education, research, extension). For example, if the private sector recognizes that research can help tap into opportunities they may be able to allocate funds for research.

The existing models for integrating agricultural education, research and outreach for development are unsatisfactory. For example, the U.S. Land grant Universities system and the Indian State University have not improved farmers livelihoods in sub-Saharan Africa.

Information flow and knowledge creation between these stakeholders is minimal and in some cases non-existent. Farmers in Uganda are only able to market one third of their total food production. For example, Uganda ranks the second top most in producing bananas in the world but falls at the bottom of the list in terms of sales globally. This discrepancy is entirely attributed to the weak linkage between supply and demand sides of the agriculture sector.

Information and Communication Technologies (ICT) offers an excellent opportunity for improved coordination across the agricultural nexus, bridging the information gap, sharing information and creation of knowledge. In Uganda, the advent of National Agricultural Research Systems (NARS) Act of 2005, which provides for a system of non-traditional partners working together for improved agriculture, reinforces this opportunity. This can be in terms of communication and collaboration geared towards increased efficiency and effectiveness pertaining to the partners' mandates (e.g. curriculum review in agricultural education priorities and research and also extension dimensions). Efforts are underway to identify an appropriate home-grown model for improving efficiency and effectiveness of agricultural research education and outreach with ICT at its center.

Goal

To improve people's livelihoods through increased income, food security and sustainable resource management

Purpose

To increase the efficiency and effectiveness of the NARS through improved creation, sharing, access and application of relevant agricultural knowledge using ICT

Approach

The progress towards establishing an ICT-based system for effective coordination amongst NARS institutions in Eastern Africa has come through progressive spider-webbing of three networks (*ICT-mediated distance learning, Web-based agricultural information platform and strengthening agricultural rural innovations capacities*).

ICT-mediated distance learning

The "Strengthening Agricultural and Environmental Capacities through Distance Education (SAEC-DE), is a pilot distance education program being implemented by a consortium of partners; Makerere University - Uganda, University of Nairobi Kenya, University of Florida and International Center for Tropical Agriculture (CIAT) and funded by USAID. The program was developed after realizing that the face-to-face mode predominantly used in SSA for training has increasingly been found to be inept to meet the diverse needs of the prospective clients (e.g. working class and remotely living students). The objectives of the program are to: (i) develop long term collaboration among universities in the North and South and CGIAR for joint capacity strengthening and mentoring of students (ii) demonstrate an alternative and complementary model for ICT-based MSc. training, (iii) increase capacity of individuals and institutions in relevant program and distance education, and (iv) advance distance education in partner institutions.

The program was phased into three phases, namely; testing, piloting and full implementation. The testing was done in Fall (Sept-Dec) of 2005, using 12 guest students Colombia, Kenya, Tanzania and Uganda to generate experiences to inform the piloting process. The Pilot phase was started in the spring of 2006 with four candidates that were recruited from the Universities of Nairobi, Makerere and Columbia in Environmental Soil Science and Agricultural Entomology. The content delivery is largely electronic complemented by multi-media products (e.g. CDs, books, lab kits) delivered by courier. In terms of research work, the students are at various stages with some having started addressing locally relevant issues under joint supervision of the universities professors and Consultative Group on International Agricultural Research (CGIAR) researchers.

Based on the implementation so far, it can be deduced that distance education offers a viable alternative for lowering education costs, increasing professional retention and keeping trainees within their professional and home environments. This initiative pioneers Web-based ICT-based postgraduate training in agricultural and environmental education in the region that enhances exposures and motivates learners in intercultural platform. Partnerships are useful in developing programs and course content that are internationally appealing and conduct of locally relevant research. Joint supervision enhances quality and relevance of research. Beneficiaries would contribute to increased agricultural production and development in their countries, hence alleviate poverty and improve food security. The major challenge is how to overcome narrow bandwidth and internet connectivity.

Web-based agricultural information platform

A wide information gap and mixed perceptions and ranking of constraints to agricultural development exists amongst the stakeholders (Table 1). ICT presents a solution to bridge the information gap by exploiting advances in Information Technology (IT).

Table 1: Perceptions and ranking of constraints to agricultural production by some stakeholders in Uganda

Factor	Farmer	Biological scientist	Social scientist	Extension Agents	
Gender	17	16	9	14	Ascribed very low importance by almost all
Pests & diseases	15	n.a	7	n.a	
Marketing	16	1	1	10	Ranked 2 nd last by farmers and 1 st by Scientists
Soil fertility	14	6	5	2	
Climatic changes	6	1	12	1	
Population density	10	n.a	n.a	n.a	
Inputs / technology	12	5	n.a	13	
Technology transfer	n.a	1	2	n.a	Ranked 1 st by biological scientists
Extension	n.a	n.a	5	6	
Security	1	n.a	n.a	n.a	Ranked most important by farmers

Farming systems	8	n.a	n.a	n.a	
Training / research / extension	4	n.a	n.a	n.a	
Ignorance / illiteracy	6	n.a	n.a	7	
Environmental degradation	12	n.a	n.a	n.a	
Poverty	4	n.a	n.a	n.a	
Culture	10	18	10	n.a	
Health	8	n.a	n.a	n.a	
Policy	2	n.a	n.a	9	Ranked 2 nd most important by farmers
Infrastructure	3	n.a	10	8	
Prices of inputs	n.a	14	n.a	n.a	
Price of outputs	n.a	14	n.a	n.a	
Labour	n.a	11	4	5	
Postharvest technology	n.a	12	8	n.a	
Improved seed	n.a	4	n.a	n.a	
Diseases	n.a	9	n.a	n.a	
Pests	n.a	7	n.a	11	
Landuse planning	n.a	16	n.a	n.a	
Erosion	n.a	10	n.a	n.a	
Weeds	n.a	12	n.a	n.a	
Credit / capital	n.a	n.a	2	10	Ranked 2 nd most important by social scientists
Level of knowledge of farmer	n.a	n.a	n.a	3	
Land availability	n.a	n.a	n.a	4	
Land tenure	n.a	15	n.a	11	
Income	n.a	n.a	n.a	10	

n.a= not available as not ranked. Highest level of importance is ascribed lower magnitude of ranking.

Source: Tenywa M.M. et al. 1999. Proceedings of a Soil and Water Management workshop.

An Electronic Uganda National Agricultural Innovation System (EUNAIS) (Fig. 1) was built to strengthen the linkages between production and consumption through multi-media (Short Messages (SMS), discussion forum, News and Events, Search Mechanism (constraint diagnosis), sharing of information and knowledge creation. Thrust was to establish a system that exploits the advances in information technology to better help farmers to improve crop productivity and access to markets.

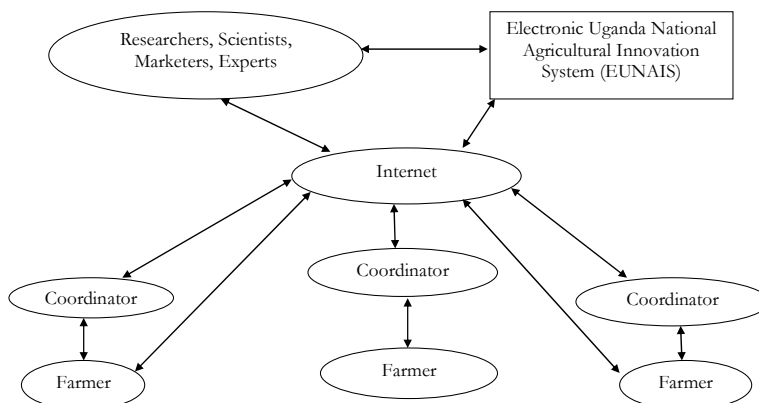


Fig. 1: EUNAIS high-level design. A double arrow indicates information flow

The system was designed by using simple open source, scalable and cost-effective software Joomla. PHP and java script was used as the main programming languages for web application development because it helps create dynamic and interactive web pages for database-driven websites. For the Database Management System, the open source MYSQL useful in building, debugging, and operating multi-user applications was used. Apparently, the website is operational (eunais.co.ug) but still requires further improvement. It also needs to be periodically updated to make the information relevant.

Partnership/learning network for strengthening agricultural rural innovations capacities

Initially, was the IAR4D learning initiative between Makerere University and NARO in Uganda which expanded to Kenya to form the Edulink ***Partnership/learning network for strengthening agricultural rural innovations capacities*** with support from EU. Strengthening of university capacity for promoting, facilitating and teaching rural innovation processes (SUCAPRI) consortium includes a network of teaching and research staff in Makerere University in Uganda and four universities (Nairobi, Egerton, Kenyatta, and Jomo Kenyatta University of Agriculture and Technology) in Kenya. The active interaction and sharing of knowledge between these universities and the International Centre for development oriented Research in Agriculture in the Netherlands is designed to improve teaching practice and research in rural innovation processes. Associate institutions include Uganda National Agricultural Research Organisation (NARO), Kenya Agricultural Research Institute (KARI) and other key stakeholders currently collaborating with the partners universities through the already existing Intergrated agricultural Research for Development (IAR4D) Steering Group (Uganda) and IAR4D national Task Force (Kenya). These stakeholders include the National Agricultural Advisory Service (NAADS, Uganda), the Ministries of Agriculture and Livestock (Kenya), The National Federation of Agricultural Producers (KENFAP, Kenya), and CIAT. Commonwealth of learning is supporting the ICT capacity development. It is now well established that scientific and technological knowledge yields its greatest benefits when used within a complex system of institutions and practices, known as a National Innovation System (NIS). The operationalization of the NIS is a paradigm shift from the linear training-research-extension-farmer model to systems approach to identification of society priorities and needs. The partnership will be set up to increase communication, interaction, and cooperation between agricultural higher education, research, extension and the non-traditional stakeholders to identify the critical needs to be addressed in the curricula. Critical aspects to be addressed include communication skills, personal and team skills and action research. Of relevancy is the Communication skills including changes in dissemination practices, increased writing for different categories of audiences – information storage and retrieval and increased use of ICT use in learning and communication. ICT will be used for good practices of curricula review, reform, content development, delivery, learning, quality control and course management.

Way forward

The pilot phases indicate that ICT can significantly contribute to strengthening linkages among stakeholders in the agricultural sector. Therefore, these cases have to be expanded to meet the diverse needs of production by overcoming the constraints apparent in different areas. The EUNAIS needs to be expanded to include not only information of agricultural markets, but also interlink with education and research institutions along the value chain to complete the loop. We propose a model for integrating ICT in agricultural education, research and

outreach (Fig.2). The model is based on the linkages that can be developed among the stakeholders. The advantage of the model is that every stakeholder is linked to every body else and so problem identification and direction for research follows the IAR4D model.

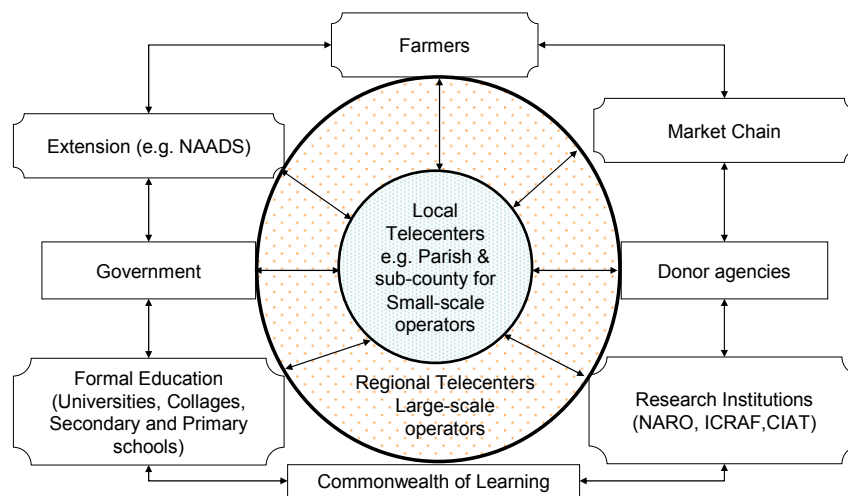


Fig. 2: Web-aided model for integrating agricultural education, research and outreach functions

So far, the links are more evident at higher levels but there is need to ramify similar linkages at the lower levels, for example, those between Agricultural Research and Development Centres (ARDS), and NAADS. This can be effected through web-aided interfaces to help farmers access recent information about technological innovations in different parts of the country to bypass the high costs involved in conventional extension methods.

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References

- Beintema N. M. and Pardey P. G., 2003. *Recent developments in African agricultural research and developments*. Paper presented at the second Forum for Agricultural Research in Africa (FARA) plenary, Dakar, 19-20 May.
- Court D., 1999. Financing higher education at Makerere University: the quiet revolution. *Human Development* 143-156
- Eicher C. K., 2004. Rebuilding Africa's scientific capacity in food and agriculture. Background paper No. 4 commissioned by the inter academy council (IAC) study panel on science and technology strategies for improving agricultural productivity and food security in Africa. At: www.interacademycouncil.net
- Everson R. E., 2001. Economic impacts of agricultural research and extension. In: Gardner, B. L., and G. C., Rauser (eds) *Handbook of agricultural economics*. Amsterdam North Holland/ Elsevier

- Opio-Odong J.M.A. 1992. Agricultural research in Uganda. In: Opio-Odong (ed.) Designs on the land; agricultural research in Uganda, 1890-1990. African Centre for Technology Studies Publishers. ISBN 9966-41-26-0. 40pp.
- Tenywa, M.M, Bekunda, A.M., Lufafa, A. and Taulya, G. (Eds.). 1999. Participatory soil fertility and Land management in Uganda; challenges and opportunities. Proceedings of the “Towards building a participatory soil fertility initiative for Uganda workshop” for the Soil and Water Conservation Society of Uganda (SWCSU) held 5-6th May, 1999 at Cardinal Nsubuga Leadership Training Centre, Kampala, Uganda.
- Zaake J. Y. K., 1999. Towards building a participatory soil fertility management initiative for Uganda. Key Note address (pg 1-12). Proceedings of a workshop on the theme “*Towards building a participatory soil fertility management initiative in Uganda*. 5th – 6th may 1999.
- Zaltman G. 1979. Knowledge utilization as planned social change. In Beverly Hills (Ed.) Knowledge, creation, diffusion, utilization. Sage Publications, pp. 82-105.